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National Level

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PREFACE

Green Technology and Engineering 2020 (Greentech2020) Virtual Conference was auspiciously convened on October 15-16, 2020 anchored on the theme 'Energizing Sustainability through Smart Society'. This virtual conference is a joined collaboration between Politeknik Sultan Azlan Shah (PSAS), and the Research and Innovation Center, Department of Polytechnics and Community Colleges Education (DPCCE), which was conducted via Microsoft Teams platform.

The commencement of the Greentech 2020 Virtual Conference and the publication of these e-proceedings marked another milestone for PSAS, as it is the first conference conducted virtually at the national level. Thus, it sets another standard for the Commercialization, Research, and Innovation Unit, in conducting such an event in the future.

From this event, Greentech2020 had successfully yielded 92 research articles from diverse disciplines including green technology, engineering, and social sciences, which are compiled in this e-proceedings. These research papers are contributed by researchers who are mostly lecturers, students, and academicians from polytechnics, community colleges, other institutions, and organizations nationwide.

As the conference aspires to be a platform that produces reliable and quality research papers, each submitted manuscript went through a Turnitin test and a rigorous peer-reviewed process. We hope that this e-proceeding could be a credible and relevant source of reference for lecturers, students, and the industry. Thus, the e-proceeding anticipates more quality research papers in the future covering a wide range of disciplines both applied and fundamental research.

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Abstrak. Kualiti Persekitaran Dalaman atau *Indoor Environmental Quality* (IEQ) merupakan komponen penting kearah bangunan mesra alam yang akan menentukan tahap kualiti penghuni di dalam sesebuah bangunan. Selain itu ia juga menjadi salah satu kriteria membuktikan sama ada bangunan terbabit mengaplikasikan konsep Indeks Bangunan Hijau atau *Green Building Index* (GBI). Ini kerana ketidakseimbangan IEQ menyumbang kepada Sindrom Bangunan Sakit (*Sick Building Syndrome*) sekali gus memberi kesan yang negatif kepada produktiviti di tempat kerja. Secara purata penghuni bangunan menghabiskan masa hampir 12 jam sehari di dalam bangunan. Sehubungan itu, kajian ini bertujuan untuk melihat bagaimana kualititi pesekitaran dalaman bangunan mempengaruhi produktiviti di tempat kerja. Metodologi kajian ini menggunakan pemerhatian daripada data-data kajian yang lepas. Hasil kajian menunjukkan kualiti persekitaran dalaman yang rendah akan mengurangkan produktiviti kerja dan pada masa yang sama menjejaskan kesihatan fizikal penghuni di dalam bangunan tersebut. Kajian ini turut membantu dalam mengenal pasti aspek persekitaran tertentu yang memerlukan penyesuaian dan penambahbaikan dalam menyediakan persekitaran dalaman yang lebih baik untuk penghuni.

Kata Kunci - Kepentingan, *Indoor Environmental Quality* (IEQ), Penghuni, Produktiviti

1. PENGENALAN

Kualiti Persekitaran Dalaman (IEQ) merupakan keadaan persekitaran dalam bangunan yang boleh mempengaruhi penghuni dari segi kesihatan dan keselesaan ketika berada di dalam bangunan. Selain itu juga ia turut mempengaruhi produktiviti kerja penghuni tersebut. IEQ adalah salah satu daripada enam kriteria untuk sesebuah bangunan mendapat pengiktirafan *Green Building Index* (GBI) sebagai bangunan 'hijau' di Malaysia. Dalam komponen GBI, elemen kualiti persekitaran dalaman atau *Indoor Environmental Quality* (IEQ) mewakili 21% kriteria penilaian bangunan bukan kediaman seperti bangunan pejabat (GBI Organisation, 2010). Ini bermakna, bangunan pejabat perlu diambil kira dalam penilaian IEQ. Inisiatif ini dilaksanakan untuk menggalakkan pemaju-pemaju memelihara alam sekitar semasa mereka bentuk dan membina sesebuah bangunan. Di Malaysia, GBI telah diwujudkan seiring dengan kebimbangan yang semakin meningkat terhadap perubahan iklim dan keperluan dalam mempunyai reka bentuk bangunan yang mampan. Antara elemen-elemen IEQ ialah keselesaan termal, akustik, pencahayaan, kualiti udara dalaman, ruang, ergonomik perabot, dan estetika. IEQ adalah komponen penting dalam konteks bangunan mesra alam untuk menentukan tahap produktiviti penghuni di dalam sebuah bangunan. Pembinaan bangunan mesra alam amat digalakkan kerana penghuni menghabiskan masa separuh hari di tempat kerja. Menurut Zhang (2005) rata-rata manusia yang bekerja adalah 23 jam 15 minit sehari atau 97.7% sepanjang hayat mereka. Produktiviti adalah salah satu aspek penting dalam pembangunan sesebuah negara kerana ia

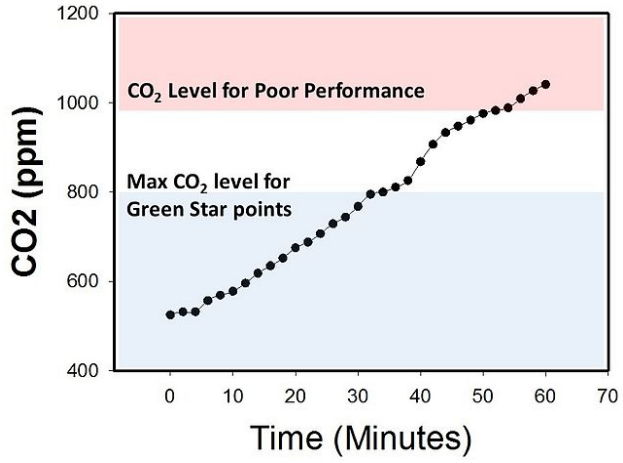
mempengaruhi pembangunan ekonomi negara. Menurut Atasya Osmadi (2013) persekitaran fizikal tempat kerja yang terurus dapat menghasilkan pekerja yang produktif dan berkualiti seiring dengan kemajuan negara, tetapi sayangnya berbeza jika bangunan tempat kerja yang tidak dikendalikan dengan baik akan memberi impak negatif jangka panjang terhadap kesihatan, keselamatan, tekanan emosi dan kursusnya produktiviti pekerja.

Isu produktiviti kerja di Malaysia amat membimbangkan walaupun mereka bekerja lebih masa jika dibandingkan dengan pekerja daripada negara Asia yang lain. Ini diperkuat oleh fakta oleh Mohd Nazirol Syafiq (2013) bahawa pekerja pejabat menghabiskan sebahagian besar waktunya di bangunan tempat mereka bekerja. Oleh itu, persekitaran fizikal pejabat atau tempat kerja sangat penting untuk membangunkan persekitaran kerja yang baik dan sihat (Kamarulzaman & Sabrani, 2011). Pekerja memerlukan persekitaran fizikal dalaman yang kondusif untuk mereka bekerja secara produktif. Walau bagaimanapun, kebanyakan organisasi lebih menumpukan pada pencapaian syarikat dan keuntungan jika dibandinganken dengan keselesaan ditempat kerja. Kekurangan pengudaraan yang cukup akan meningkatkan penyebaran penyakit pernafasan berjangkit atau jangkitan sinus Mendell (2004). Malah menurut ASHRAE (2009), kualiti udara dalaman yang lemah membawa kepada beberapa gejala penyakit seperti sakit kepala, sesak nafas, keletihan serta kerengsaan mata, hidung, tekak dan paru-paru. Namun demikian, faktor-faktor yang mendorong penyakit ini lebih cepat merebak ialah disebabkan kemerosotan kualiti udara dalam bangunan, tahap keselesaan termal tidak baik, faktor pencahayaan, kesan hingar dan banyak lagi (EPA, 2010). Faktor-faktor yang berpotensi berkaitan dengan persekitaran fizikal dalaman pejabat harus diambil kira kepada pekerja adalah aset penting organisasi. Ketidakseimbangan IEQ menyumbang kepada *Sick Building Syndrome* yang seterusnya mempengaruhi produktiviti penghuni dan juga struktur bangunan. Kepentingan persekitaran dalaman di tempat kerja perlu dititikberatkan oleh sesebuah organisasi. Clement (2006), turut berpendapat IEQ yang tidak konsisten dalam bangunan boleh menjejaskan kesihatan, keselesaan, kepuasan, dan produktiviti para penghuni yang menghabiskan sebahagian kehidupan seharian dalam bangunan.

Pelbagai bentuk dasar dan sistem perundangan telah dirancang dalam memastikan persekitaran dalaman diaplikasi dengan jayanya. Pada tahun 1994, kerajaan telah membuat undang-undang yang iaitu Keselamatan dan Kesihatan Pekerjaan daalm usaha memantau persekitaran kerja agar memenuhi keperluan psikologi dan fizikal penghuni bangunan tersebut. Selain daripada itu kerajaan turut menetapkan garis panduan seperti kod amalan Malaysia Standard MS 1525, dalam usaha untuk mewujudkan persekitaran.

Menurut wakil, Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP), *"Persekitaran pejabat kerajaan dapat mendedahkan penjawat awam kepada bahaya seperti penggunaan kimia dan biologi dan fizikal", dan "Sepanjang tahun 2008, 33 kes dilaporkan kepada JKKP melibatkan penyakit paru-paru, jangkitan kuman, alahan kulit dan pendengaran dan kami percaya masih banyak kemalangan dan masalah kesihatan di tempat kerja yang tidak dilaporkan dan ini memerlukan kesedaran penjawat awam."Selain itu, dia menambahkan," Masalah lain yang terjadi di kebanyakan pejabat adalah dari segi sistem pencahayaan dan kebisingan yang buruk yang mengganggu fokus dan kesihatan pekerja* "(Bernama, 2009). Oleh yang demikian kajian ini dilakukan untuk melihat keberkesan IEQ dalam meningkatkan produktiviti pekerja ditempat kerja serta melihat kepentingan IEQ kearah meningkatkan produktiviti pekerja.

Rajah 1 menunjukkan kepekatan CO_2 di ruang pejabat tertutup bersaiz 3.5m x 4m. Dalam 45 minit penghentian pengudaraan dan penutupan pintu / tingkap, tahap CO_2 mencapai 1.000 ppm.



Rajah 1: Kepekatan CO_2 di ruang pejabat tertutup

Sumber : www.edaphic.com.au(2019)

2. SOROTAN KAJIAN

2.1 Kualiti Persekitaran Dalaman (IEQ)

Kualiti persekitran dalaman (IEQ) adalah antara enam kriteria *Green Building Index* (GBI) yang perlu dicapai oleh pemilik bangunan agar dapat mengiktiraf sesebuah bangunan 'hijau' di Malaysia. IEQ adalah elemen penting yang perlu dititikberatkan sebelum reka bentuk bangunan dalam menjamin kesihatan dan kesejahteraan penghuni khususnya di tempat kerja. IEQ juga sangat penting dalam melahirkan persekitaran kerja yang sihat dan merupakan komponen utama dalam konteks bangunan hijau yang akan menentukan tahap kualiti penghuni di sebuah bangunan (Naziatul S.M et. al, 2011). Kualiti persekitaran dalaman merujuk kepada kualiti alam sekitar bangunan berhubung dengan kesihatan dan kesejahteraan penghuni yang menduduki ruang di dalamnya. Kenyataan ini disokong oleh Zainal (2011) yang menyatakan dalam memastikan persekitaran dalam bangunan berada dalam keadaan baik adalah penting penghuninya akan merasa lebih selesa dan selamat. Terdapat empat elemen utama dalam IEQ iaitu keselesaan termal, kualiti pencahayaan, kualiti akustik dan kualiti udara dalaman adalah faktor penting IEQ (Bluyssen P. (2009).

Jadual 2: Had yang dibenarkan mengikut parameter

Parameter	Item	Unit item	Had limit dibenarkan
Kualiti udara dalaman	• Pergerakan udara • Karbon Dioksida • Karbon Monoksida • Formaldehid • Zarah Ternafaskan • Jumlah Sebatian Organik Meruap (TVOC)	m/s ppm ppm ppm mg/s^3 ppm	0.15-0.5 1000 10 0.1 0.15 3
Keselesaan termal	• Suhu • Jumlah Sebatian Organik Meruap	°C %	23-26 40-70
Pencahayaan	• Cahaya	Lux	300-400
Kualiti akustik	• Bunyi	dB(A)	40-50

Sumber: Ismail, 2013

2.1.1 Kualiti Udara Dalaman (IAQ)

Kualiti udara dalaman adalah kualiti udara di dalam kawasan tertutup yang akan memberi kesan kepada kesihatan dan keselesaan penghuni (Yau et al., (2012)). Kualiti udara dalaman (IAQ) merangkumi suhu udara, kelembapan relatif, dan kepekatan pencemar udara. IAQ penting kerana kebanyakan penghuni menghabiskan sebahagian masa mereka di dalam bangunan. Menurut Zhang (2005), kajian berkaitan IAQ telah dikaji sejak tahun 1970-an dan hingga sekarang. Ini menunjukkan bahawa IAQ adalah penentu asas kepada kehidupan sihat, kesejahteraan, dan produktiviti penghuni di bangunan terutama bangunan pejabat. IAQ yang kurang baik akan mempengaruhi kesihatan dan produktiviti pekerja di tempat kerja dan pada masa yang sama "*Sindrom Building Sickness*" akan wujud (Al horr Y dan Arif M, (2016). Menurut Hess-Kosa dan Kathleen (2002), kesan IAQ yang lemah boleh menyebabkan pemilik bangunan terutama pekerja yang menghadapi masalah kesihatan seperti selesema, dermatitis, kerengsaan, keracunan sistemik, sakit kepala, keletihan dan sesak nafas dan ini secara tidak langsung melambatkan kecekapan dan produktiviti pekerja. Gas karbon dioksida (CO_2) adalah parameter utama dalam menentukan kualiti udara dalaman dan juga keberkesanan pengudaraan (Syazwan et al., 2009). Ciri-ciri kandungan gas tersebut adalah sejenis gas yang tidak berwarna, tidak berbau, hampir tidak berasid, merupakan gas yang tidak mudah terbakar apabila berada di dalam suhu bilik dan gas ini merupakan gas keempat terbanyak dalam atmosfera bumi (Sakinah, 2014). Kandungan CO_2 yang lebih tinggi boleh menjejaskan kesihatan, prestasi dan produktiviti. Kualiti udara dalaman akan memberi kesan kepada kesejahteraan dan produktiviti manusia ini kerana manusia menghabiskan 90% masa seharian mereka di dalam kawasan tertutup (Baba et al., 2012). Dalam memastikan kualiti udara dalaman yang baik di dalam bangunan, sistem pemanasan, pengudaraan dan penghawa dingin (HVAC) perlu diberi perhatian yang serius. Melalui sistem ini udara dapat dipanaskan atau disejukkan bergantung pada keadaan cuaca sekeliling. Sistem HVAC ini dapat menunjukkan bagaimana bahan pencemar dibebaskan. Sebahagian besar bangunan pejabat di Malaysia menggunakan sistem pengudaraan mekanikal seperti pemasangan penyaman udara. Ia berfungsi untuk menjaga persekitaran udara dalam bangunan kerana Malaysia beriklim tropika panas dan lembap. Sekiranya sistem mekanikal tidak berkesan dengan baik, ia akan menghasilkan udara yang tidak bersih ke atas persekitaran dalaman dan seterusnya menjejaskan kesihatan penghuni bangunan (Kamaruzzaman & Sabrani, 2011). Kenyataan ini disokong oleh Teresa Nunes et. al, (2012) yang menyatakan bahawa bahan cemar di dalam bangunan institusi pendidikan mungkin menjejaskan kesihatan pelajar dan pada masa yang sama prestasi pembelajaran mereka serta kehadiran akan turut terjejas.

2.1.2 Keselesaan terma

Masalah-masalah yang sering timbul disebabkan persekitaran kerja yang tidak selesa dari aspek keselesaan termal ialah masalah kesihatan. Antaranya ialah penghuni mudah kelesuan, cepat berpeluh, cepat letih, demam, batuk, selesema, pening dan sebagainya. Hal ini dapat dijelaskan dengan sejenis sindrom yang dikenali sebagai Sindrom Bangunan Sakit (SBS) (Afzainizam,2014). Keselesaan terma adalah salah satu daripada elemen IEQ yang boleh menjejaskan kepuasan penghuni bangunan sekiranya tidak mengambil penting. Menurut American Society Of Heating, Refrigerating And Air Conditioning Engineer (ASHRAE), (2004) menjelaskan bahawa terdapat beberapa faktor mempengaruhi keselesaan terma iaitu suhu udara, kelajuan udara, min suhu dan kelembapan suhu. Menurut Afzainizam & Haryati (2013) suhu adalah satu ukuran tenaga kinetik translasi purata yang dikaitkan dengan gerakan mikroskopik yang bercelaru daripada atom dan molekul. Pemilik bangunan yang mengabaikan aspek keselesaan terma boleh mempengaruhi kualiti hidup penghuni dari segi produktiviti kerja. Menurut ASHRAE, 2004) syarat keselesaan terma terbahagi kepada tiga faktor utama: -

i. Manusia (metabolisme, pakaian, ukuran badan, faktor lemak, aktiviti dilakukan)
ii. Bahagian Dalaman Bangunan (bahan binaan, suhu lantai, susun atur perabot, kedudukan bukaan tingkap)
iii. Bangunan Luaran (sinaran matahari, faktor penyumbatan, topografi, angin dan lain-lain)

Bahan binaan memainkan peranan penting dalam keselesaan termal. Bahan yang digunakan untuk pembinaan sesebuah bangunan seperti simen konkrit dan batu bata mestilah bersesuaian dengan iklim tropika seperti Malaysia. Pemilihan jenis batu bata turut berperanan dalam meningkatkan produktiviti penghuni di dalam bangunan. Batu bata daripada tanah liat mempunyai kandungan karbon yang lebih rendah berbanding dengan konkrit. Kesan kandungan karbon yang tinggi boleh memberi kesan negetif kepada kesihatan penghuni di dalam bangunan (Farid Wajdi Akashah et. al, 2015). Menurut Haryati (2007), menyatakan lebih 80% masa harian manusia dihabiskan di dalam bangunan berbanding luar bangunan. Oleh hal yang demikian, kualiti hidup yang baik akan terhasil apabila tiadanya gangguan masalah kesihatan ketika menjalankan aktiviti harian. Dinding berperanan untuk mencegah suhu panas daripada luar masuk ke dalam bangunan, justeru itu bahan dalam menghasilkan dinding harus dititikberatkan agar dapat memberikan keselesaan kepada penghuni seterusnya meningkatkan produktiviti penghuni untuk bekerja (Farid Wajdi Akashah et. al, 2015). Batu tanah liat mempunyai keupayaan untuk menyerap haba apabila berada pada suhu yang berbeza, ini kerana ia boleh memperlahankan keupayaan untuk mengalirkan haba ke dalam bangunan. Bahan binaan yang mempunyai terma haba turut membantu untuk menstabilkan variasi suhu dalam suatu bangunan. Kenyataan ini disokong oleh Zalena (2017) yang menyatakan bahawa apabila suhu luar menurun, pengaliran udara kedalam bangunan melalui dinding akan bertukar arah, haba panas akan menuju ke suhu yang lebih sejuk iaitu suhu di luar. Semakin tinggi terma haba, semakin banyak haba yang disimpan di dalam bahan binaan yang mempunyai terma haba yang tinggi dapat dan pada masa yang sama menyebabkan suhu dalaman sesuatu ruang tersebut tinggi. Ini akan mengurangkan keselesaan terma penghuni dalam bangunan terebut.

2.1.3 Pencahayaan

Malaysia merupakan sebuah negara yang beriklim panas yang menerima cahaya matahari sebagai sumber cahaya semulajadi hampir sepanjang tahun. Cahaya yang mencukupi perlu ada di tempat kerja untuk memastikan keselamatan dan kesihatan setiap pekerja. Pencahayaan di tempat kerja hendaklah membantu penghuninya melihat dengan selesa dalam melaksanakan tanggungjawab seorang pekerja. Menurut Garis Panduan Keselamatan dan Kesihatan Pekerjaan untuk Pencahayaan di Tempat Kerja (2018), pencahayaan yang baik juga mewujudkan suasana yang menyenangkan dan memberikan rasa kesejahteraan kepada pekerja. Ini dapat meningkatkan produktiviti dan kecekapan mereka. Pencahayaan adalah salah satu aspek fizikal penting mempengaruhi keselesaan semasa bekerja (Palmer & Rawlings (2002). Pencahayaan yang terhad menganggu tumpuan mereka untuk bekerja oleh itu penggunaan lampu yang mesra alam sekitar amatlah digalakkan dalam menjamin kelestarian alam sekitar di tempat kerja. Menurut M. Ali & P. J. Armstrong (2008), sesuatu bangunan terutama bangunan pencakar langit bukan sahaja memberikan kualiti estetik dan untuk meninggalkan expresi rekabentuk sesuatu binaan, namun juga berperanan untuk mengawal keadaan dan keselesaan ruang dalam bangunan itu sendiri. Ia bertujuan untuk memaksimumkan penggunaan cahaya semula jadi dan meminimumkan penggunaan cahaya elektrik. Kemasukan terus cahaya matahari di dalam bangunan perlu dielakkan untuk mengelakkan masalah kesihatan kepada penghuninya. Kesan-kesan dan impak kesihatan seperti ini akan menyumbang kepada perbelanjaan rawatan perubatan, cuti sakit dan seterusnya kurangnya produktiviti kepada penghuni-penghuni bangunan berkenaan (Naziatul S.M et. al, 2011). Aspek utama keselesaan pencahayaan adalah tahap cahaya (intensiti atau kecerahan), kontras, dan silau. Keperluan intensiti cahaya bergantung pada jenis aktiviti di bangunan; sebagai contoh, bilik operasi memerlukan tahap yang lebih terang daripada ruang tamu Pencahayaan yang kurang baik akan mempengaruhi penghuni seperti mata merah, ketidakselesaan dan kegelisahan semasa membaca dan melaksanakan tugas (Johnson, 2011). Oleh yang demikian kawalan lampu yang harus dijaga dapat mengelakkan ketidakselesaan dan silau semasa waktu bekerja. Menurut Erwine & Heschong (2002), kualiti pencahayaan terbaik adalah hasil gabungan cahaya siang atau cahaya semula jadi dan cahaya buatan.

2.1.4 Bunyi dalaman

Bunyi dalaman dipengaruhi oleh tahap dan sifat suara penghuni di dalam bangunan. Terdapat beberapa kesan negatif ekoran daripada penghuni yang terdedah kepada kebisingan yang melampau seperti penyakit kardiovaskular, tekanan darah tinggi, sakit kepala, perubahan hormon, penyakit psikosomatik, gangguan tidur, penurunan prestasi fizikal dan mental (Naziatul S.M et. al, 2011). Perkara-perkara ini akan menyebabkan produktiviti berkurang, tekanan emosi dan gangguan psikologi kepada seseorang yang mengalami gangguan pencemaran bunyi. Kebisingan yang terlalu kuat boleh menyebabkan seseorang itu hilang kawalan serta gagal berfikir dengan baik. Ini akan membawa kemerosotan prestasi kepada seseorang. Pencemaran bunyi boleh menyebabkan tekanan kerja dan kesan kesihatan seperti pening (Naziatul S.M et. al, 2011). Oleh itu rekabentuk sesuatu bangunan perlu menitikberatkan kesan bunyi untuk memberi keselesaan penghuni pekerja seterusnya dapat meningkatkan produktiviti kerja. Bahan yang dihasikan untuk pembinaan siling dan sistem lantai perlu diambil perhatian dalam memastikan bunyi dalaman tidak menjejaskan produktiviti kerja. Bahan yang digunakan untuk pembinaan siling adalah asbestos. Asbestos merupakan mineral semula jadi yang ditemui di dalam tanah dan batu yang terhasil dari serat yang berbeza-beza saiz dan bentuk, mempunyai daya ketahanan yang tinggi terhadap panas dan kebanyakan bahan kimia.

2.1.5 Produktiviti

Kesan psikologi ke atas pekerja akan wujud sekiranya IEQ tidak dititikberatkan seperti produktiviti pekerja terganggu, malas, cepat beremosi dan sebagainya. Kesan psikologi boleh diukur dari segi prestasi bekerja seseorang individu. Beberapa kajian-kajian lepas berjaya mengenalpasti kesan ketidakselesaan termal terhadap prestasi kerja seseorang. Kenyataan ini dibuktikan melalui kajian yang dilaksanakan oleh Roelofsen (2001), Jensen et.al (2009) dan Lan et.al (2011) Kajian-kajian ini telah membuktikan bahawa suhu dalam bilik atau bangunan boleh mempengaruhi produktiviti pekerja. Produktiviti merujuk kepada kecekapan keberkesanan penggunaan sumber di dalam syarikat atau organisasi. Kenyataan ini disokong oleh Farid Wajdi Akashah et. al,(2015) yang berpendapat produktiviti boleh terganggu kerana ketidakselesaan penghuni bangunan yang boleh menjejaskan prestasi kerja mereka. Ini secara tidak langsung akan memberi impak negetif kepada ekonomi syarikat. Kajian yang telah dilakukan oleh Fisk et. al (2011) turut mendapati peningkatan kualiti persekitaran dalam ruang bekerja berjaya meningkatkan pulangan keuntungan ekonomi tahunan dari $17 bilion kepada $26 bilion. Justeru itu untuk melahirkankan pekerja yang produktif pekerja perlu berada dalam keadaan selesa dan dilingkungi persekitaran yang menggalakkan. Keadaan fizikal seperti kecerahan, suhu, kebisingan dan keadaan lain boleh mengganggu keselesaan kerja (Natasha K & Husrul N. Husin 2009). Tahap kebisingan yang berlebihan, suhu yang tidak stabil dan kecerahan yang rendah memberi kesan yang negatif terhadap prestasi pekerja. Hal ini juga turut disokong oleh kajian yang dijalankan oleh Seppänen et.al (2003) yang melihat hubungan antara prestasi pekerja dengan suhu. Hasil kajian beliau mendapati bahawa prestasi pekerja menurut sebanyak 2% bagi setiap pertambahan 1°C dalam julat suhu di antara 25-32°C. Apabila seseorang pekerja memiliki produktiviti yang tinggi mereka turut mempunyai integriti dan sikap yang betul terhadap pekerjaan yang diamanahkan dan seterusya meningkatkan kecemerlangan dalam organisasi.

3. METODOLOGI KAJIAN

3.1 Pengenalan

Metodologi penyelidikan adalah salah satu prosedur yang perlu diberi perhatian dalam sesebuah penulisan. Bab ini merangkumi topik utama bagaimana kajian dijalankan; tajuk utama adalah pengenalan, metodologi, tinjauan literatur, instrumen untuk pengumpulan data, sampel kajian dan kaedah analisis data.

3.2 Data sekunder
Data sekunder adalah data yang diperoleh dari penyelidikan tidak langsung dan sumber yang ada. Contoh data sekunder adalah daripada bahan cetak dan dokumentasi seperti artikel, jurnal, dan buku, statistik kerajaan, dan sebagainya.

3.2.1 Sorotan Kajian
Menurut Amani Dahaman (2011), sorotan kajian adalah tinjauan maklumat yang diperoleh dari jurnal, buku, prosedur, dan penyelidikan masa lalu (tesis) yang berkaitan dengan penyelidikan yang baharu. Sorotan kajian merupakan rujukan dan panduan pengkaji dalam menjalankan kajian. Artikel, buku, dan jurnal yang digunakan membincangkan bagaimana IAQ, keselesaan termal, pencemaran bunyi, dan kualiti pencahayaan saling terkait dan memberi impak produktiviti di tempat kerja.

4. KEPUTUSAN

Jadual 3 menunjukkan rumusan kajian yang telah dibuat terhadap kepentingan IEQ kepada penghuni bangunan kepada penghuni bangunan kearah meningkatkan produktiviti di tempat kerja. Melalui kajian ini, data daripada responden telah menunjukkan bahawa mereka bersetuju bahawa IEQ penting untuk meningkatkan produktiviti di tempat kerja. Ini kerana keadaan persekitaran dalaman di tempat kerja secara langsung mempengaruhi prestasi kerja fizikal dan mental, tanpa mempengaruhi gejala kesihatan. Responden juga bersetuju bahawa persekitaran dalaman yang menarik akan membantu memberikan perkhidmatan yang lebih berkualiti. Keadaan ini secara langsung dapat mewujudkan penggunaan ruang secara optimum dan persekitaran kerja yang lebih bersih, bersih dan selamat. Dalam kajian ini juga mendapati bahawa IEQ berkait rapat dengan produktiviti, kesihatan dan kesejahteraan mereka. Ini perlu untuk memastikan penghuni merasa selesa dan berpuas hati dengan kualiti persekitaran dalaman bangunan khususnya di tempat kerja (IEQ). Produktiviti boleh terganggu kerana ketidakselesaan penghuni bangunan yang boleh menjejaskan prestasi kerja mereka. Oleh itu, hasil penyelidikan yang lepas telah membuktikan IEQ memainkan peranan penting dan mempunyai hubungan yang kuat dan langsung dengan output kecekapan pekerja.

5. KESIMPULAN

Berdasarkan hasil kajian ini, kualiti IEQ yang baik menghasilkan beberapa maklum balas positif di mana penghuni bangunan bekerja dalam persekitaran yang selesa dan seterusnya meningkatkan produktiviti dan prestasi kerja. Pemeliharaan keselesaan terma, kualiti udara dalaman, pencahayaan dan bunyi dalaman di dalam bangunan pejabat adalah perkara wajib untuk menjaga dan mempertahankan IEQ. Kesimpulannya, IEQ mempunyai hubungan langsung dengan produktiviti. Pembinaan bangunan harus mengutamakan penerapan IEQ untuk menjamin persekitaran yang lestari di tempat kerja. Di akhir kajian ini, rekabentuk bangunan yang sesuai untuk meningkatkan IEQ telah dicadangkan iaitu pereka bangunan perlu mengambil kira tahap kebisingan dan mengurangkan tahap kebisingan dengan memasang bahan kalis bunyi di dalam bilik. Pemilik bangunan perlu mempunyai perancangan yang baik dalam menjamin keselesaan penghuni bangunan. Bahan binaan berkualiti mesti digunakan dalam reka bentuk bangunan. Rekabentuk bertujuan dalam memberikan suasana yang selesa dan produktif kepada penghuni bangunan. Kualiti persekitaran dalaman dapat ditingkatkan dengan memastikan pemilik bangunan menitikberatkan elemen seperti keselesaan terma, kualiti udara dalaman, pencahayaan dan bunyi dalaman. Di samping itu, kualiti persekitaran dalaman yang baik dapat meningkatkan kesihatan dan kesejahteraan penghuni dan sekaligus mengurangkan ketidakselesaan di kalangan penghuni bangunan. Oleh yang demikian, pemilik bangunan di Malaysia perlu menerapkan elemen hijau sebagai bangunan mesra alam ke arah meningkatkan pekerja yang produktif sekaligus menjadikan Malaysia negara berpendapatan tinggi dan berteknologi tinggi.

Jadual 3: Rumusan kajian terhadap kepentingan IEQ kepada penghuni bangunan

Bil	Jenis Bangunan	Objektif kajian	Kaedah	Keputusan	Rujukan
1	Pejabat	i. Untuk menentukan tahap kepuasan dan persepsi penghuni di bangunan pejabat dari segi persekitaran dalaman iaitu keselesaan termal, pergerakan udara, keselesaan visual, pencemaran bunyi, dan kebersihan. ii. Untuk mencadangkan dan mengesyorkan cara untuk memperbaiki persekitaran dalaman pejabat.	Soal Selidik	1. Majoriti responden berada dalam tahap selesa dari segi kebersihan di dalam bangunan dan pencemaran bunyi. 2. Wlaubagaimanapun, responden tidak selesa di pejabat kerana sistem penyejukan (73%), pencahayaan siang semula jadi (53%), penyediaan pergerakan udara (40%) dan juga kualiti pengudaraan dalaman (47%). 3. Dari segi tahap keselesaan penghuni di unit bangunan, 40% responden berada pada peringkat sederhana sahaja. Sebilangan besar responden bersetuju bahawa produktiviti kerja mereka menurun kerana persekitaran dalaman yang tida memuaskan.	Natasha & Husrul (2009)
2	Lima buah bangunan di Universiti Malaya	Bagaimana keselesaan dan kepuasan mempengaruhi produktiviti penghuni di bangunan konvensional	Soal Selidik	1. Responden bersetuju persekitaran kerja di bangunan yang dirancang secara konvensional adalah baik dan selesa. 2. Walaupun bangunan yang dirancang secara konvensional tidak mengambil kira aspek kelestarian semasa peringkat pembinaan namu persekitaran di dalam bangunan tetap berfungsi dengan baik dan memberikan keselesaan serta kepuasan bagi produktiviti penghuni bangunan. 3. Bangunan-bangunan yang dirancang secara konvensional ini berpotensi dianugerahkan sebagai bangunan hijau. 4. Maklum balas positif responden kerana mereka bekerja dalam persekitaran kerja yang bahagia. Ini secara tidak langsung akan meningkatkan produktiviti dan prestasi kerja penghuni bangunan. 5. Hasil korelasi menunjukkan kualiti persekitaran yang baik dapat dihasilkan dari kesihatan dan kesejahteraan yang baik yang dapat mengurangkan ketidakhadiran di kalangan penghuni bangunan	Farid Wajdi Akashah et. al,(2015)

3	Empat bangunan pejabat kerajaan bertingkat di Kuala Lumpur dan Selangor	Bagaimana kualiti udara dalaman (IAQ) mempengaruhi prestasi psikologi dan kesan kesihatan kepada penghuni di bangunan pejabat tinggi di Malaysia.	Soal Selidik	1. Kajian menunjukkan semakin tinggi kualiti udara yang baik di dalam bangunan semakin tinggi produktiviti pekerjaan mereka dan semakin rendah tahap tekanan mereka di tempat kerja. 2. Pada asasnya, IAQ adalah satu elemen atau kualiti persekitaran dalaman satu bahagian (IEQ). 3. Penilaian yang dilakukan oleh penghuni bangunan merangkumi kepuasan bangunan IEQ. 4. Kualiti persekitran dalaman memberi kesan terhadap fizikal dan psikologi penghuni.	Kamaruzzaman & Sabrani (2011)
4	Bangunan di Malaysia	Untuk menjelaskan hubungan antara Kualiti Persekitaran Dalaman dan produktiviti	Sorotan Kajian	1. Terdapat hubungan langsung dan positif antara produktiviti kerja dan IEQ. 2. Terbukti bahawa IEQ mempengaruhi produktiviti dan prestasi kerja di dalam hasil perbincangan tentang Keselesaan Termal Berkualiti Udara Dalam Ruangan, Pencahayaan Dalam Ruangan dan Akustik Dalam Ruangan.	Naziatul et al. (2011)

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SMART SWEEPER MACHINE

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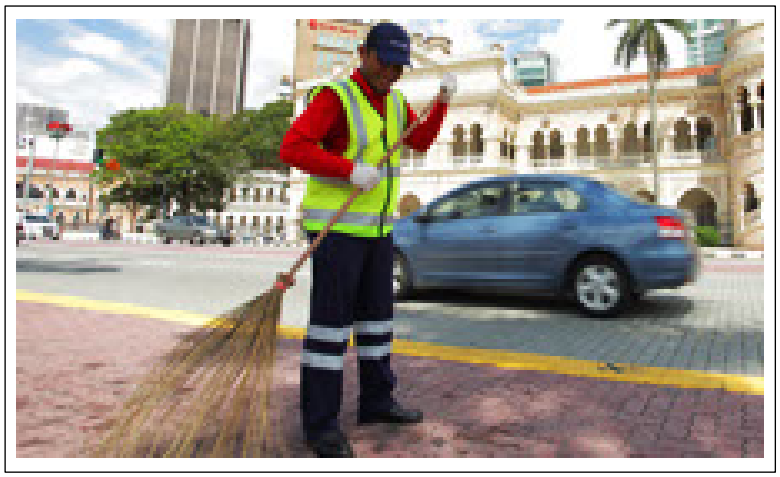
Abstrak. Majoriti syarikat kontraktor pembersihan di Malaysia masih menggunakan penyapu lidi untuk kerja sapuan jalan. Penyapu jalan konvensional yang digunakan memerlukan lebih banyak tenaga dan menyebabkan masalah ergonomik untuk jangkamasa panjang. Alternatif lain ialah penyapu jalan mini yang menggunakan bahan api namun begitu ianya menelan kos penyelenggaraan yang tinggi. Selain itu terdapat juga penyapu jalan mini yang menggunakan bateri di pasaran tetapi masih tidak dapat menjimatkan kos operasi. Inovasi untuk meningkatkan produktiviti aktiviti sapuan jalan disamping memelihara alam sekitar amat diperlukan di era revolusi industri 4.0 ini. Pada masa kini, sistem solar hibrid menjadi pilihan yang menarik dalam teknologi hijau dan digunakan secara meluas sebagai alternatif kepada tenaga yang dihasilkan oleh gas api fosil. Mesin ini menggunakan sistem solar hibrid untuk roda penggerak dimana bateri 12V untuk roda pemanduan disambungkan terus ke penyongsang. Sistem ini sangat sesuai untuk operasi pembersihan sampah dengan kesan minima kepada persekitaran. Mesin ini mempunyai dua berus yang digerakkan oleh motor, dua vakum dan tong sampah. Berus depan akan mengumpulkan sampah atau daun di sepanjang jalan. Selain itu, dua vakum dipasang untuk membentuk aliran udara berputar berkelajuan tinggi di dalam tong silinder; atau dikenali sebagai sebagai aksi "cyclone". Mesin ini dikendalikan tanpa wayar oleh alat kawalan jauh untuk jarak maksima 300 meter. Alat kawalan jauh akan mengawal pergerakan mesin, vakum, berus dan lampu keselamatan. Oleh itu masalah ergonomik yang berlaku pada penyapu jalan manual yang ada dapat diselesaikan.

Kata Kunci: Mesin Sapu Jalan, Teknologi Hibrid

1. PENGENALAN

Majoriti syarikat kontraktor pembersihan di Malaysia masih menggunakan penyapu lidi untuk kerja sapuan jalan. Antara peralatan yang diperlukan untuk aktiviti sapuan jalan ialah penyapu, penyodok dan tong sampah. Rajah 1 menunjukkan seorang pekerja Alam Flora Sdn Bhd sedang menggunakan penyapu jalan konvensional dengan pemegang yang Panjang untuk aktiviti sapuan jalan. Kegunaan penyapu ialah untuk mengumpulkan sampah dan kemudiannya akan dikutip dan dimasukkan ke dalam tong sampah atau plastic sampah. Penyapu jalan konvensional yang digunakan memerlukan lebih banyak tenaga dan menyebabkan masalah ergonomik untuk jangkamasa panjang.

Alternatif lain ialah penyapu jalan mini yang menggunakan bahan api namun begitu ianya menelan kos penyelenggaraan yang tinggi. Selain itu terdapat juga penyapu jalan mini yang menggunakan bateri di pasaran tetapi masih tidak dapat menjimatkan kos operasi. Inovasi untuk meningkatkan produktiviti aktiviti sapuan jalan disamping memelihara alam sekitar amat diperlukan di era revolusi industri 4.0 ini. Pada masa kini, sistem solar hibrid menjadi pilihan yang menarik dalam teknologi hijau dan digunakan secara meluas sebagai alternatif kepada tenaga yang dihasilkan oleh gas api fosil.



Rajah 1: Penyapu konvensional yang digunakan oleh Alam Flora Sdn Bhd

2. SOROTAN KAJIAN

Untuk fabrikasi mesin "Smart Sweeper", kami merujuk kepada pelbagai sumber dan membuat tinjauan tentang kaedah yang paling sesuai digunakan untuk pembuatan mesin ini. Mesin ini bergerak dengan menggunakan sumber tenaga berasaskan solar, yang lebih senang digunakan, lebih menguntungkan membandingkan dengan sumber tenaga lain. Tenaga solar adalah tenaga yang boleh diperbaharui, selamat digunakan, dan mesra alam sekitar (Dalal, 2016).

Panel solar adalah satu set modul fotovoltaik bersambung secara elektrik dan dipasang pada struktur sokongan. Modul fotovoltaik pula adalah merupakan sambungan sel-sel solar (Jain, S., Khalore, A., & Patil, S., 2015). Panel solar boleh digunakan sebagai komponen sistem fotovoltaik yang lebih besar untuk menghasilkan dan membekalkan elektrik di pusat komersial dan unit kediaman. Setiap modul dinilai berdasarkan kuasa hasil pengeluaran DC dalam keadaan ujian piawaian (STC), dan biasanya berkisar antara 100 hingga 320 watt. Satu modul solar hanya dapat menghasilkan sejumlah kuasa yang terhad dan kebanyakan pemasangan mengandungi bilangan modul yang banyak. Sistem fotovoltaik biasanya merangkumi panel atau modul solar, penyongsang, dan kadangkala bateri serta penjejak solar dan sambungan pendawaian (Dalal, 2016).

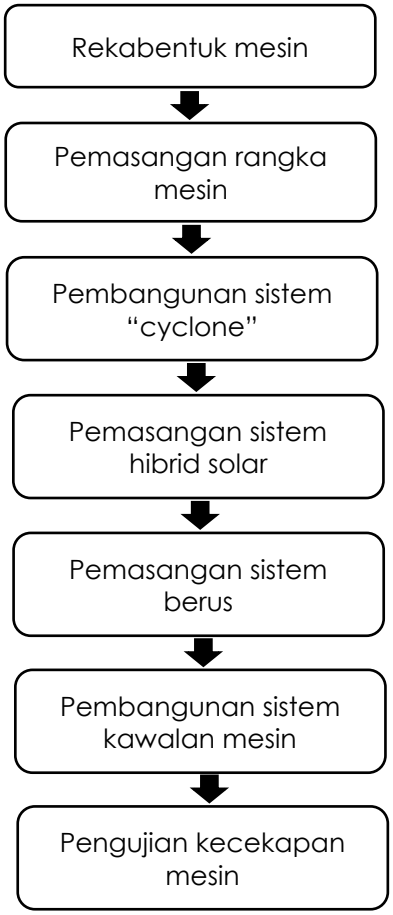
Modul sel solar menghasilkan elektrik ketika matahari sedang bersinar terik namun ianya tidak menyimpan tenaga. Sebahagian dari tenaga yang dihasilkan perlu disimpan untuk memastikan aliran elektrik tetap wujud ketika matahari tidak bersinar. Penyelesaian yang paling terbaik ialah dengan menggunakan bateri yang akan menyimpan elektrik. Bateri adalah kumpulan kimia sel elektro yang merupakan peranti yang menukar tenaga kimia menjadi tenaga elektrik dan disambung secara bersiri. Sel bateri terdiri daripada dua elektrod yang terbenam larutan elektrolit yang menghasilkan elektrik arus semasa litar terbentuk di antara mereka. Arus disebabkan oleh tindak balas kimia boleh disongsangkan antara elektrod dan elektrolit di dalamnya sel. Bateri yang boleh dicas semula dipanggil bateri sekunder. Ketika bateri sedang dicaj, tenaga elektrik disimpan sebagai tenaga kimia dalam sel. Semasa tidak dicaj, tenaga kimia yang tersimpan akan dikeluarkan dari bateri dan ditukar menjadi tenaga elektrik (Dalal, 2016).

3. METODOLOGI KAJIAN

Rajah 2 menunjukkan metodologi pembangunaan "Smart Sweeper Machine" di mana terdapat tujuh fasa utama untuk membangunkan mesin ini. Pembinaan mesin ini dimulakan dengan fasa rekabentuk mesin. Fasa rekabentuk mesin dimulakan dengan perbincangan bersama syarikat Alam Flora Sdn Bhd dimana beberapa perkara penting disenaraikan oleh

pihak syarikat untuk dijadikan garis panduan dalam merekabentuk mesin. Pihak penyelidik juga telah membuat lawatan ke Dataran Putrajaya bagi mendapatkan gambaran sebenar aktiviti sapuan jalan di lapangan. Setelah itu beberapa rekaan mesin telah disenaraipendek dan dibincangkan bersama syarikat Alam Flora Sdn Bhd bagi mendapatkan rekaan yang memenuhi kriteria yang ditetapkan. Mesin ini direkabentuk bagi kegunaan dataran yang landai serta tidak mempunyai cerun melebihi 15° sahaja.

Seterusnya proses pemasangan rangka mesin dilakukan berdasarkan rekabentuk mesin yang telah dipersetujui. Rangka mesin dibuat menggunakan besi geronggong segiempat dan disambung dengan menggunakan kaedah kimpalan. Proses fabrikasi rangka mesin ini mengambil masa lima hari untuk disiapkan. Fasa berikutnya ialah pembangunan sistem "cyclone" dimana sebuah tangki difabrikasi dan dipasangkan kepada rangka mesin. Proses pembinaan tangki ini memerlukan kemahiran kimpalan yang baik kerana tangki ini berbentuk silinder. Dua vakum dipasang untuk membentuk aliran udara berputar berkelajuan tinggi di dalam tangki silinder atau dikenali sebagai sebagai aksi "cyclone".



Rajah 2 : Metodologi Pembangunan Smart Sweeper Machine

Mesin ini menggunakan sistem solar hibrid untuk roda penggerak dimana dua buah bateri 7.2Ah 12V disambungkan secara selari menjadi 14.4Ah 12V untuk roda pemanduan yang disambungkan kepada motor 12 Ah. Panel solar yang digunakan ialah 5.56A 18V dimana memerlukan tempoh sejam sehingga dua jam untuk mengecaj bateri yang dipasangkan kepada penyongsang yang bersambung kepada motor roda penggerak. Bateri yang berkapasiti penuh mampu menggerakkan mesin sejauh 500 meter.

Sistem ini sangat sesuai untuk operasi pembersihan sampah dengan kesan minima kepada persekitaran. Mesin ini mempunyai dua berus yang digerakkan oleh motor, dua vakum dan

tong sampah. Berus depan akan mengumpulkan sampah atau daun di sepanjang jalan. Mesin ini dikendalikan tanpa wayar oleh alat kawalan jauh untuk jarak maksima 300 meter. Alat kawalan jauh akan mengawal pergerakan mesin, vakum, berus dan lampu keselamatan.

Proses terakhir ialah proses pengujian mesin di lapangan. Kemampuan mesin untuk menyedut sampah terutamanya ranting halus dan daun bersaiz 1 cm panjang diuji di Dataran Putrajaya. Proses pengujian mesin dibuat sebanyak dua kali bersama wakil syarikat Alam Flora Sdn Bhd. Proses pengujian mesin ini dilakukan bagi mendapat maklumbalas syarikat tentang kemampuan mesin ini dan setelah itu proses penambahbaikan dilakukan hasil daripada komen setelah mesin diuji.

4. ANALISIS DAN KEPUTUSAN

Mesin ini dapat melakukan kerja menyapu jalan seperti yang ditunjukkan dalam Jadual 1 dan Jadual 2. Jadual 1 menunjukkan jumlah kawasan yang dapat disapu dengan menggunakan Smart Sweeper Machine dalam tempoh satu minit dan satu jam. Mesin ini dapat menyapu seluas 1080 m^2 dalam satu jam.

Pasukan pengurusan dari Alam Flora Sdn Bhd menyatakan bahawa waktu bekerja untuk aktiviti menyapu adalah enam jam sehari pada waktu cerah dan kurang daripada 6 jam ketika hujan. Oleh itu, mesin ini diuji untuk berfungsi dalam enam jam berturut-turut. Hasilnya, Jadual 2 menunjukkan jarak sapuan jalan raya dalam enam jam operasi. Kelajuan untuk Smart Sweeper Machine boleh dipilih dari satu yang paling lambat hingga empat untuk kelajuan terpantas. Tetapan ini dibuat agar sesuai dengan keadaan operasi. Kelajuan paling lambat diperlukan selepas hujan kerana sampah menjadi basah dan lebat. Mesin ini mampu menyapu minimum 1.6 km dan maksimum 5 km selama enam jam bekerja. Hasilnya jauh lebih baik daripada aktiviti menyapu secara manual di mana seorang pekerja hanya dapat menyapu jarak 1 km dalam enam jam kerja.

Jadual 1: Keluasan Kawasan Sapuan Jalan

Masa	Keluasan
1 minit	18 m^2
1 jam	1080 m^2

Jadual 2: Jarak Sapuan Jalan Untuk Tempoh 6 Jam Bekerja

Smart Sweeper Machine		Penyapu Konvensional
Kelajuan Mesin	Jarak	Jarak
4	5 km	1 km
3	4 km	
2	2.6 km	
1	1.6 km	



Rajah 3: Smart Sweeper Machine

Sementara itu Rajah 3 menunjukkan Smart Sweeper Machine sedang digunakan oleh pekerja pembersihan. Ini jelas menunjukkan bahawa pekerja tersebut tidak mempunyai risiko mengembangkan MSD atau kecacatan lain yang berkaitan semasa mengendalikan mesin. Rajah 4 menunjukkan mesin yang diuji di Dataran Putrajaya dengan pekerja Alam Flora Sdn Bhd. Mesin ini telah diuji dua kali di Dataran Putrajaya dengan Alam Flora Sdn Bhd. Kedua-dua sesi ujian dilakukan untuk menilai keupayaan penyedut mesin ini. Vakum yang dibina dalam mesin ini dapat mengumpulkan daun dan ranting pokok kecil di sepanjang Dataran Putrajaya.



Rajah 4 : Pengujian di Dataran Putrajaya Bersama Alam Flora Sdn Bhd

5. KESIMPULAN

Melalui pelbagai kajian, analisis, pengembangan dan penambahbaikan yang dibuat semasa proses fabrikasi mesin ini, telah terbukti bahawa Smart Sweeper Machine yang menggunakan sistem solar hibrid mampu meningkatkan produktiviti aktiviti menyapu jalan raya berbanding dengan penyapu konvensional yang kini digunakan oleh Alam Flora Sdn Bhd. Mesin ini dapat

menyapu maksimum 5 km dalam enam jam bekerja. Hasilnya jauh lebih baik daripada aktiviti menyapu manual di mana seorang pekerja hanya dapat menyapu jarak 1 km dalam enam jam kerja. Teknologi ini juga dapat diklasifikasikan sebagai teknologi hijau di mana penggunaan hibrid suria dapat membantu mengurangkan penggunaan bahan bakar sebagai sumber tenaga untuk melakukan pekerjaan. Masalah ergonomik juga dapat dikurangkan secara tidak langsung dengan menggunakan mesin ini.

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PRODUCTION OF BIOPLASTIC BOTTLE FROM STARCH

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Abstract. The ecological problems caused by petroleum-based plastic have been issued every day. The usage of plastic and the method of disposable is ubiquitous every day and is much concerned with the environment. Bioplastics are degradable plastic known as green materials, promising ingredient to replace petroleum-based plastics. This study focuses on producing bioplastics from starch as alternative of most common plastic products. Three samples of starch: pure potato, potato/glycerine and sago/glycerine were prepared by hand lay-up process. Properties of crystallization behaviour, melting points, and glass transition were analysed using differential scanning calorimeter (DSC). Water absorption and biodegradability of bioplastic were observed. Potato/glycerine shows higher heat resistance and glass transition compared to pure potato starch, accounting from 60°C to 100°C and 40°C to 100°C respectively. Potato starch/glycerine has more heat resistance, ranging from 64°C to 87°C compared to sago starch/glycerine, ranging from 56.82 °C to 73.33°C. Therefore, bioplastic from starch-based product is a promising alternative to replace the existing conventional plastics such as high heat resistant to solve the environmental issues.

Keywords: bioplastic, glass transition, absorption, degradability

1. INTRODUCTION

Plastics are used in varied applications and have become an integral part of our society. The conventional petrochemical plastics are persistent in the environment and thus the production and disposal of plastics is a major problem throughout the world. The conventional plastics have also a costly impact on waste management. In the reaction to the environmental problems due to plastics dumped as waste in the oceans, the development of bio-composite materials such as bioplastics represent a paradigmatic shift to the evolution of conventional plastic practices. Bioplastics products help the saving environment by diminishing the usage of fossil and reduce the carbon emission. On top of that, bioplastics are often biodegradable and always available around the globe especially starch-based (Özdamar& Bale, 2016).

There are many significant environmental problems due to the use of synthetic polymer materials. The major contributor to the environmental pollution caused by solid waste such as plastic bottle and other municipal waste. It is because such waste can take up to a thousand years especially plastic bottle that take up to 400 to 450 to completely degrade from the surface of earth. (Azahari, N. A., Othman*, N. and Ismail, H. ,2011). The assess land filling caused to the environments as a result of not compostable materials in the ecosystems and endangering the marine life has encouraged decision-makers and the worldwide plastics

manufacturing to discover and develop durable bio-based alternatives in an attempt to efficiently minimize the aftermath effect of waste of plastics materials such as plastic bottles.(Ozdemir, M. and Floros, J. D., 2004) Thus, there are various method was taken to overcome this unruly issue of solid waste great. One of the ways to solve this problem is by creating and engineering a biodegradable material or also known as bioplastic material to overcome this serious environmental problem.

Bioplastics can be derived from starch such as polyactic acid (PLA), it is a starch extracted from corn, potato, sago, tapioca orpoly-hydroxybutyrate (PHB) which is also known as soy-based plastics and many more.**(**Narayan, R., 1997). Bioplastic based on starch have been studious in the field of engineering and material production but there are fewer attempts to discover the full capability as a substitute product for the plastic which takes up many years to completely vanish from the surface of earth. There are plenty researches which have discovered that blending starch with variety additives, for instance biopolymers, natural fibre such as pellet (compressed sunflower, canola and agricultural waste) and synthetic fibre shows the improvisation in strength and durability (Kahramanet al., 2020). Hence, this project is aimed to discover and engineer a bio-degradable bottle consisting of starch based as the main ingredient of bioplastic.

2. LITERATURE REVIEW

Bioplastic is a type of biodegradable plastic obtains from biological substances and organic substance rather than the normal petroleum based plastics. Bioplastic is a plastic that is made from organic matter and able to degrade much faster than non- organic plastic. Starch based bioplastic is a complex blend with another additives such as polylactic acid (PLA), polybutylene adipate terephthalate(PBAT), polybutylene succinate (PBS), polycaprolactone (PCL), and polyhydroxyalkanoates (PHA) to achieve improvisation in the water resistance, strength, durability, heat resistance and more mechanical and physical properties. The water absorption which is also known as the water taken defines as the amount of water or moisture taken to achieve the desired consistency and create a quality of end-product. The optimal amount of water for starch is to ensure that the mixture become sticky before proceeding further fabrication process. Biodegradability of a specific materials or objects is defining as capability of being decomposed by bacteria or other living organisms and thereby avoiding pollution and land filling with or without the help of oxygen while exposing into the natural environment. The thermal properties of starch can be estimated by thermal analysis to observed bioplastic behaviour under extreme temperature or pressure. Differential Scanning Calorimetry also known as DCS is a thermal analytical technique in which the amount difference of heat required to increase the temperature of a sample and reference is measured as a function of temperature. The hypothesis made from previous research shows bioplastic from starch have completely biodegraded within 28 days. Tensile strength ranges from 0.5 MPa to 2.57 MPa (Ismail et al., 2016). The temperature of the heated amorphous polymers of any polymer structure turns "viscous liquid or rubbery" or more elastic, called the Glass Transition Temperature (Tg). Glass transition is also defining as the temperature of an amorphous polymer takes on characteristic glassy-state properties such as the brittleness, stiffness and rigidity (Ebnesajjad, 2016). The melting point of a material is the temperature at which it changes from solid to liquid states in which the phase exists in equilibrium. Crystallization is known as a process where a chemical is converted from a liquid solution into a solid crystalline state. The crystallization is most commonly use as separation and purification step where most chemical processes utilize either as separation mechanism or final product engineering.

3. METHODOLOGY

3.1 The main ingredients

Potato starch powder, sago starch power, glycerine, acetic acid which also known as the vinegar and distilled water were weighed using digital scale, heated using heating plate with internal thermostat, moulded using silicon plate and silicon mould for specimen testing and

then dried in the drying oven. Figure 1 shows the main ingredient of starch bioplastic and its formation process.

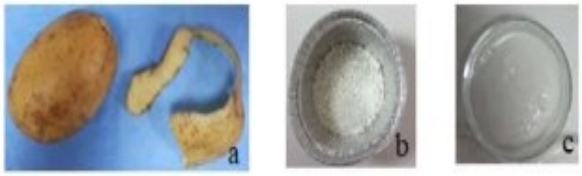


Figure 1: Main ingredient of starch bioplastic (a) potato peel (b) potato starch powder (c) bioplastic formation.

3.2 Water absorption method

Water absorption for three types of bioplastic material measured according to ASTM D570-81. The samples were weighed and dried in an oven at 50 °C for 2 to 3 days and again weighed after cooled. Bioplastics were submerged in distilled water at room temperature. The samples were removed after an hour and by using a paper towel to dry the samples surfaces. Then the samples were weighed immediately and re-submerged into raw potato starch as the first sample. Potato starch with glycerine and acetic acid is the second sample and sago starch with glycerine and acetic acid is the third specimen. After 24 hours, the samples were weighed again using the similar procedure. Calculations of the water absorption were calculated using the percentage of initial weight of the samples. The samples were weighed again, and weight loss of the samples was calculated using the difference in weight at the end of 24 hours. All water absorption measurements were performed according to the stated procedure.

3.3 Composting/degradation method

The biodegradability of the specimen was investigated in controlled environments. After weighing, three specimens were buried under moist soil. The samples, whose initial masses were recorded and were weighed after burying weekly. All water absorption measurements were performed according to the stated procedure. The cause for degradation is due to biological activity by enzymatic action which directing a significant change in the form of chemical structure of a material. The weight loss measurement is a standard method for biodegradation of polymer is the weight loss measurement which was calculated by the following represents in Equation 1. *Equation 1:* $WL(\%) = (\frac{(W_O - W)}{W_O}) \times 100\%$

W_0 and W are the initial and final weight of bioplastic specimen respectively whereas WL represents to the Weight Loss.

3.4 Method of Differential Scanning Calorimetry:

The result of heat resistance and glass transition is evaluated using DSC Q20 V24.11 Build 24. The DSC consists of two types sealed pans which are a sample pan and a reference pan or an empty sample pan. The aluminium compiles pans act as a radiation shield. The two pans are uniformly heated or cooled whereas the differences of heat flow within the two pans were monitored. This experiment is carried out in an isothermal temperature and also by altering the temperature at a constant rate which also known as temperature scanning. The DSC functions as to measure the difference between the heat resistance and a reference pan that are exposed to the same temperature program of given samples.

4. RESULTS AND DISCUSSION

4.1 Result of water absorption

Based on Figure 2, the analysis shows the weight taken of the three samples before the water absorption method and after the water absorption method following per hour.

1. The specimens were weighed before specimens were immersed in water.


pure potato starch


potato starch/glycerine/acetic acid


sago starch/glycerine/ acetic acid

2. After specimens were immersed in water, the specimens were weighed again for the determination of water absorption.


pure potato starch specimen


potato starch/glycerine/acetic acid


sago starch/glycerine/ acetic acid

Figure 2: The weighing result of three materials in the process water absorption

Based on Table 1 shows that the sample of pure potato starch has the highest value of average percentage of weight loss calculated which is 75%. The potato starch with glycerine and acetic acid has the lowest water absorption which is 24%. The average of percentage of weight loss for sago starch with glycerine and acetic acid is slightly higher than potato starch with glycerine and acetic acid but gradually lower than pure potato starch at 34.50%.

Table 1: The results obtained for the three materials during absorption method.

ASPECT	Pure Potato starch (g / %)	Potato/ Glycerine/ Acetic (g/%)	Sago/Glycerine/ Acetic Acid (g/%)
Initial weight	1.6g -	3.9g -	2.07g -
11.00pm	6.4g **70%**	5.7g **13%**	2.4g **32%**
12.00pm	6.9g **76%**	5.8g **20%**	2.6g **33%**
1.00pm	7.0g **77%**	6.0g **30%**	3.0g **35%**
2.00pm	7.1g **77%**	6.2g **33%**	3.1g **37%**
Average Percentage(%)	75%	24%	34.50%

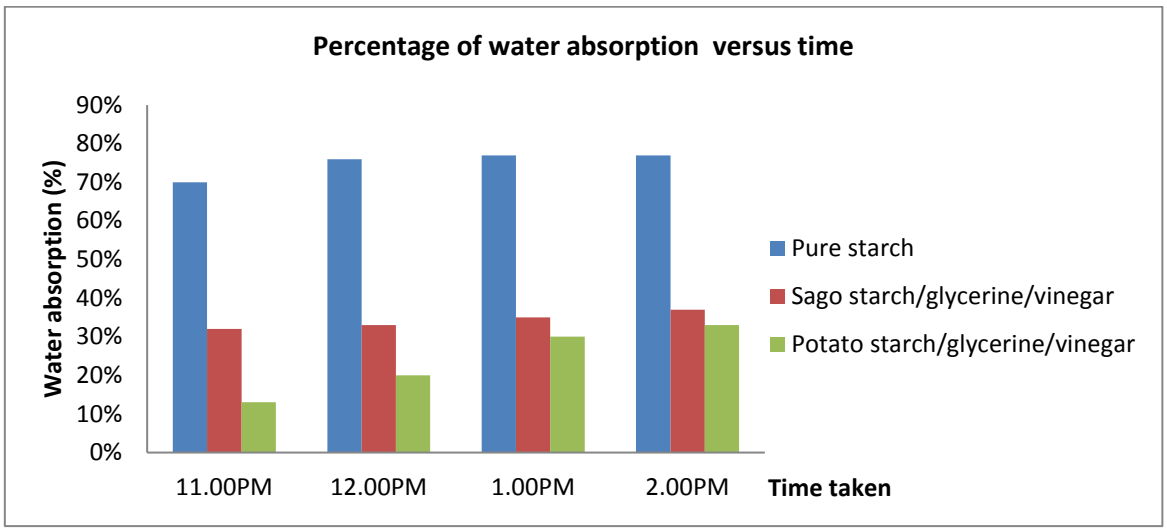


Figure 3: The bar graph of percentage of water absorption versus time taken

Based on the graph obtained from Figure 3, the percentage of water absorption for pure potato starch is highest. This is because the pure potato starch has higher tolerance to dissolve in water from70% to 77% in three hours. The samples with addition of glycerine and acetic acid took much longer to absorb water. The presence of glycerine causes the potato starch (13% to33% in three hours) and sago starch (32% to37% in three hours) to be more water resistance and naturally hygroscopic. The highly hydrophilic is shown by the increase in water absorption with respect to glycerol and starch. The function of adding glycerine as plasticizer to the biodegradable materials is to help to promote the mobility and increased mechanical properties.

4.2 Result of composting/degradation

Based on Figure 4, the analysis shows the weight taken of the three samples before the method of composting and after the method composting contrasting to days.

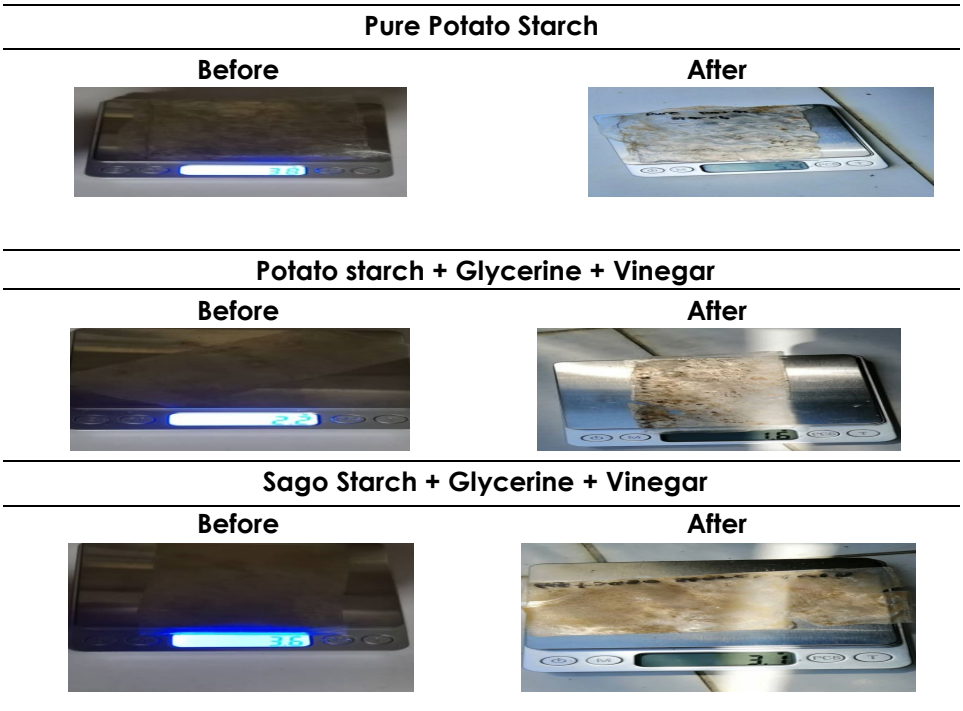


Figure 4: The weighing result of three materials in the process composting/degradation

Based on Table 2 shows that the pure starch (29.63%) not able to degrade or decompose compare to the other two samples which are potato starch and sago starch with glycerine and acetic acid. Referring to the table 2, the sample of potato with glycerine and acetic acid has the highest ability to degrade due to the lowest percentage changed which is -27.27%. The sago starch with glycerine and acetic acid has the intermediate degradability which is -16.13%.

Table 2: The results obtained for composting or degradation method of three materials.

SPECIMEN	MASS(g)		Percentage changed (%)
	Before	After	
Pure starch	3.8	5.4	29.63%
Potato/ glycerine/acetic acid	2.2	1.6	-27.27%
Sago/glycerine/acetic acid	3.6	3.1	-13.89%

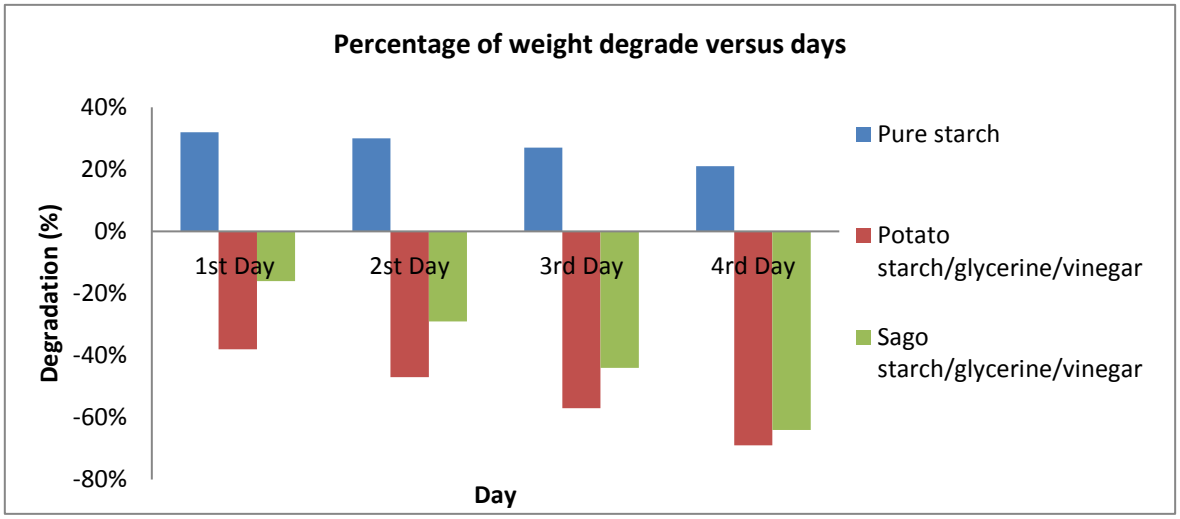


Figure 5: The bar graph of percentage of weight degrade versus days

The weight of pure starch increases 32% in first day while the weight of potato starch and sago starch which contains vinegar and glycerine decreases based on the Figure 5. The Sago starch with glycerine and acetic acid unable to compost faster than pure potato starch and Potato starch with glycerine and acetic acid due to the lower presence of number of celluloses. The presence of addition of glycerine and acetic acid helps the potato starch easily degrades in soil and non-toxic to soil.

4.3 Result of differential scanning Calorimetry (DSC)

Referring to Figure 6 to 7, it was analysed that the potato starch has more heat resistance which is from 60°C to 100°C compare to pure starch which is 40°C to 100°C. This is because the temperature of the amorphous bioplastic made from potato starch/glycerine/acetic acid has increased molecular mobility compare to just pure potato starch which results in significant changes in the thermal properties. The glass transition temperature value is the temperature at which amorphous material change from hard to soft.

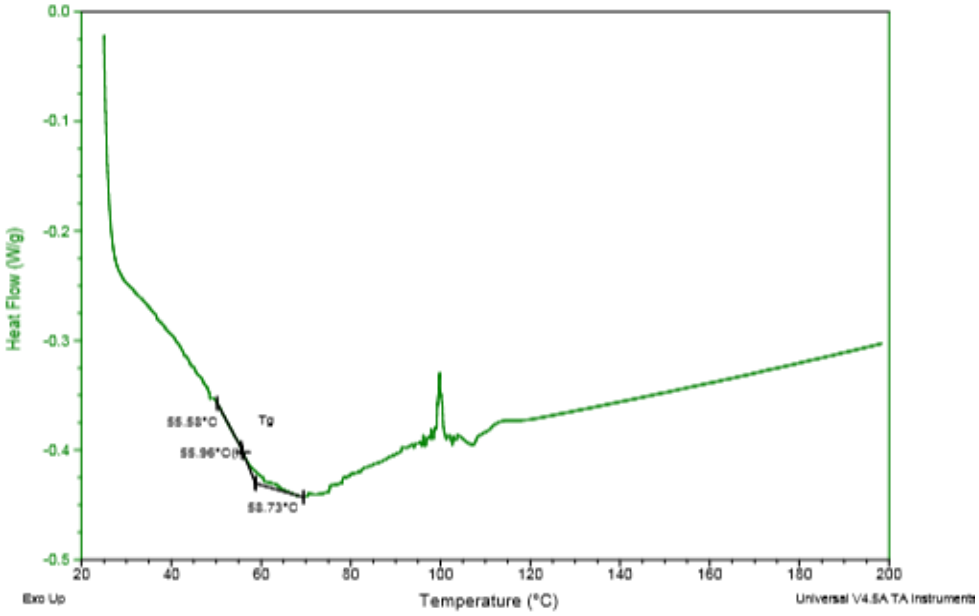


Figure 6: The pure potato starch graph analysed in DSC test.

Moving on referring to the Figure 7 and 8, potato starch/glycerine/acetic acid has more heat resistance which is from 64.28C to 87.37°C compare to sago starch/glycerine/acetic acid which is 56.82°C to 73.33°C. This is because the presences of air bubble during the making of this specimen cause deflect in the test analysed. The sago starch/glycerine/acetic acid (22.51%) absorbs more heat causes the temperature drops compare to the potato starch (26.43%).

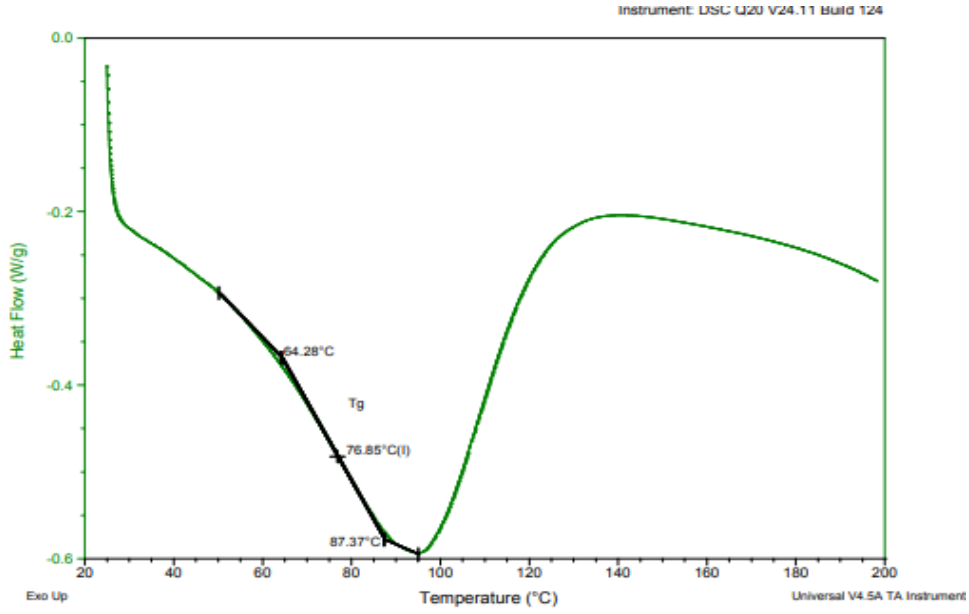


Figure 7: The pure potato starch/glycerine/acetic acid graph analysed in DSC test.

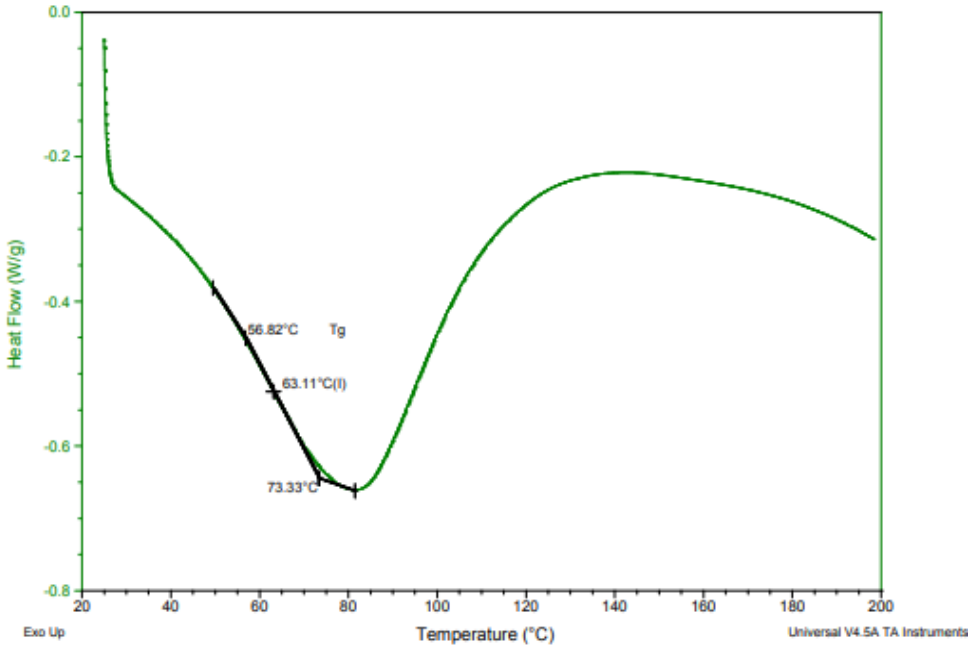


Figure 8: The sago starch/glycerine/acetic acid graph analysed in DSC test.

Finally, the analysis of the result by comparing the three samples, it is determined that potato starch with glycerine and acetic acid is the most compatible material to make the bioplastic bottle.

5. CONCLUSION

The results obtained from this study are bioplastic materials that able to degrade which are important in producing product of bioplastic bottles in the industry. The aim of this project was to determine the best suitable bio-based material to create bioplastic bottle that is eco-friendly using starch. From the results obtained from the data analysis, the differential scanning Calorimetry (DSC) of this starch-based material obtained shows its crystallization, melting point and its glass transition. Meanwhile, the absorption of water test shows that the most suitable materials with the lowest average percentage of adsorption as the production of bioplastic bottle which is potato starch with glycerine and acetic acid at 24%. Based on the study, the most promising starch-based bioplastic is potato starch with glycerine and acetic acid at 37.50%, which can resistant heat better than sago starch. Furthermore, the composting of this material in the soil shows that the definite materials used as the bioplastic bottle product that able to degrade faster compare to the conventional plastic bottles. Overall, the idea of this project will help to prevent the earth, ocean and also the environment from serious contamination and land filling that will affect the diversity and health of both humans and marine life. This material is made of what comes from our earth, and it can later on just as well end up in the soil without any risks for the nature.

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DEVELOPMENT OF SUSTAINABLE ENERGY LAKE RECREATION CENTER USING OFF-GRID SOLAR PHOTOVOLTAIC SYSTEM

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Abstract. Sustainable energy offers clean energy for all and able to reduce greenhouse gas emissions produced by the energy sector. By using renewable energy technologies as a key technology to reach the production of clean electricity will become a small-scale solution for lighting problems. This paper presents the development of the Sustainable Energy Lake Recreation Center (SELReC) using the solar photovoltaic (PV) system at the Politeknik Sultan Azlan Shah. This paper also calculates the energy cost savings and carbon emission reduction caused by using a solar PV system as a power supply for lighting at SELReC. The types of solar PV installed on this project are an off-grid solar PV system with energy storage and power capacity production is approximately 720W. The light is the main output load where a floodlight is installed at surround SELReC and powered by solar energy. The energy cost savings achieved are about RM321.67 per year based on the amount of electricity generated through solar without the use of fossil-based electricity. The value of the carbon emission preventable from the SELReC development area is 590.45 kg of CO_2. SELReC is one of the projects supporting the initiative towards creating a green campus.

Keywords: SELReC, off-grid solar photovoltaic, energy cost-saving, carbon emission.

1. INTRODUCTION

Malaysia government had announced at the 15th Conference of Parties (COP15) in Copenhagen that Malaysia committed to reduce greenhouse gasses emissions intensity of gross domestic product (GDP) up to 45% by 2030 compared to 2005 levels (*Energy Malaysia 2019*). This commitment shows that the Malaysian government gives fully supports the initiative for addressing greenhouse gas (GHG) emissions to provide sustainable environmental.

Accordance with the National Renewable Energy Policy and Action Plan where stated the vision to enhance the utilization of renewable energy resources in Malaysia then the various solar project was introduced. As supporting the National Green Technology Policy, educational institutions are also implementing renewable energy (RE) projects on their campuses.

Among the educational institutions involved are Politeknik Sultan Azlan Shah (PSAS). PSAS has a lake and it is used for recreation and water sports training area. However, this lake area has no electricity and internet facilities. The cost of installing electricity supply lines and long term energy bill costs are uneconomical. This situation leads to the design and development of the Sustainable Energy Lake Recreation Center (SELReC) at the lake site. The development of SELReC PSAS using solar energy has been implemented to achieve the reduction of carbon emission levels in PSAS campus while reducing energy costs.

2. LITERATURE REVIEW

In Malaysia, higher education institutions such as universities and polytechnics directly contribute to the high level of energy use in the educational sector. The proactive action to reduce energy consumption at their institutions needs to be taken starting from now. Referring to the green campus policy as outlined in the Polygreen Blueprint document (*Malaysian Polytechnic POLYGreen Blueprint 2015*). PSAS installing an off-grid solar photovoltaic (PV) system at SELReC. The action taken by PSAS to develop this 720W small scale solar project are in line with RE policy. However, the development cost of this solar project that uses off-grid solar systems typically involves high initial costs (Kristiawan, Widiastuti, & Suharno, 2018). Other research conducted by (Hsu et al., 2017) at National Taiwan University also using a solar PV system for self-consumption without connected to the grid system. However, the authors found that the energy generation efficiency for solar PV quite low due to the unbalance between variations of solar radiation and its battery. The research conducted by (Tarigan, 2018) also studies solar PV but focusing on the rooftop PV and conducted at the University of Surabaya, Indonesia. In this research, the authors calculate greenhouse gas emission (CO_2) reduction due to applying solar PV. The research by (Othman & Rushdi, 2014) has calculated the potential energy solar production with consideration in Malaysia based on an average of 4.5 hours to 8 hours of free bountiful sunshine every day. Therefore, the development of SELReC also needs to calculate the energy generated by the solar PV system and it as the input to calculate energy cost-saving at PSAS. This paper is an extended version of the paper by (Syahrunizam & Firdaus, 2019). This paper presents the development of the SELReC using the off-grid solar PV system at Politeknik Sultan Azlan Shah. This paper also calculates the energy cost savings and carbon emission reduction caused by using a solar PV system as a power supply for lighting at SELReC.

3. METHODOLOGY

This project will develop an off-grid solar PV system for SELReC and use the energy produced to power up floodlights around the lake. The methodology proposed always refers to the Malaysian Standard MS 1525:2007, Code of practice on Energy Efficiency, and Use Renewable Energy for Non-Residential Building. SELReC will enhance the capacity of innovation in Green Technology development in a higher education institution. Furthermore, this research provides a platform that will ensure sustainable development and conservation of the environment become a priority in the educational institution.

3.1 System design

Installation of the off-grid solar PV at SELReC involves equipment such as 3 x 240W monocrystalline photovoltaic panel, PWM solar charger controller 12/24V, 3000W power inverter with fully automatic DC-AC inverter and industrial power battery type sealed lead acid 3 x 12V 110Ah use~~d~~ to operate 20 units of 10W and 20W floodlight. Even though the solar radiation only in the daytime but the system~~s~~ installed at SELReC was designed to operate in two-mode, that is day and night. During the daytime, the solar PV panel will absorb the ultraviolet light sources and produce electricity then stored that electrical energy to the energy storage known as battery. At night mode, the system will operate with distributing electricity to the floodlights. An inverter will convert DC to AC, then supply that energy to the lights. Figure 1 shows the single line diagram for the off-grid solar PV system at SELReC PSAS.

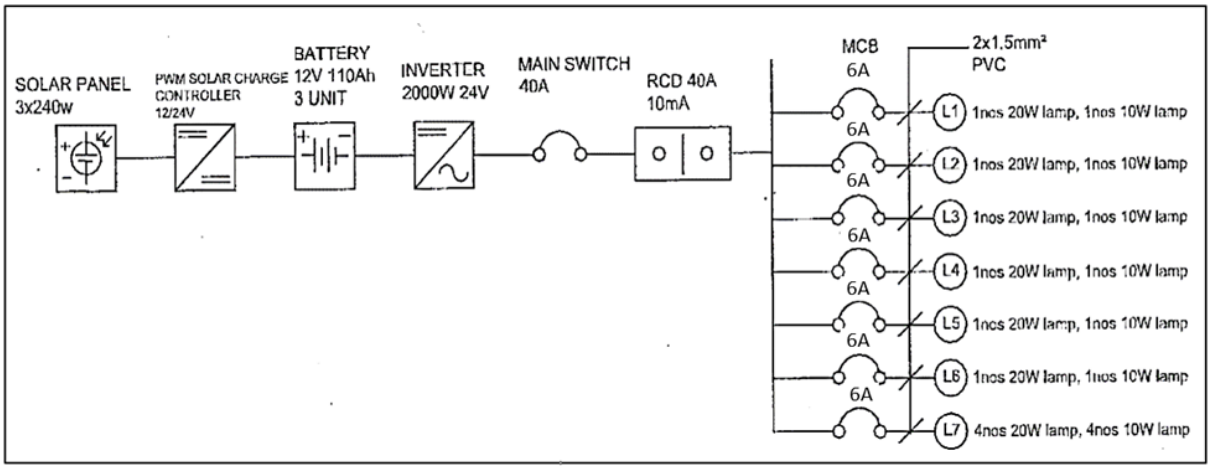


Figure 1: Single line diagram for off-grid solar PV system at SELReC (Syahrunizam, 2019)

3.2 Development process

The objective of this project is to produce a power capacity of approximately 720W as the supply energy for the lighting system around the lake. SELReC is installed with an off-grid solar PV system with energy storage. The first process is light intensity analyze where the effect of intensity on solar PV has been checking (Amajama, 2016). This step is very important to check the relationship between solar intensity and the output of the solar PV panels. This is to examine the percentage of the efficiency solar panel produces electrical energy if the panel is installed in the tested area. The next development process is setting up the feeder pillar where all the equipment involved in the solar PV system has been installed. The main function of the feeder pillar is to take in the supply of electrical energy from the solar PV panel and transfer it to the load. Besides that, it provides protection and control in the system equipment is involved. Figure 2 shows the installed feeder pillar boxes have been installed at SELReC.

The next process is the installation of a PV frame as a support to hold the solar PV panels. After the installation the PV frame has completed, 3 units of solar PV panel has installed on top of the frame. Figure 3 shows the 3 solar PV panels already installed at the lake site. The development process continued by focusing on the load section where the process to put underground cable trunking is performed. Then, the floodlight installation process at 10 points around the lake is implemented.



Figure 2: Feeder pillar boxes have been installed at SELReC



Figure 3: Three solar PV panel installed at the SELReC

4. RESULT AND DISCUSSION

4.1 Off-grid Solar Photovoltaic System at SELReC

Figure 4 shows the scenery of SELReC in the daytime after the off-grid solar PV system installation is completed. Figure 5 shows the scenery at SELReC during the nighttime when the floodlights have been successfully installed and tested.



Figure 4: Scenery at SELReC during daytime



Figure 5: Scenery at SELReC during nighttime

4.2 Energy cost

The potential of carbon reduction and energy cost saving has been calculated after the solar PV system is fully operated. Based on ideal case calculation without considering the other energy losses occur, the system at SELReC generates about 881.280 kWh of energy a year by using solar energy sources without involving energy generated by fossil fuel from Tenaga Nasional Berhad (TNB). Referring to the solar PV system at SELReC, the power generated by the three panels in 4 hours of sunshine are 720 Watt. By assuming the efficiency of the solar panel is 85%, the energy generated by the solar PV system per month is calculated. The calculation is shown below:

Energy generated / month = power generated x total hour x efficiency x 30 days

Energy generated / month= 0.72 kW x 4 hours x 0.85 x 30 days = 73.440 kWh/month.

The amount of energy generated by solar PV panels subsequently supplied to the battery is 73.440 kWh per month and 881.280 kWh per year. Table 1 shows the total energy cost-saving per year from SELReC. PSAS is under tariff block category Commercial C1 which refers to medium voltage general commercial tariff. The charge rate for this tariff is RM0.365/kWh for total kWh in a month
("Tenaga Nasional Berhad,")

Table 1: Energy-saving cost per year based on C1 tariff schedule

Tariff block	Energy consumption (kWh)	Rate (RM)	Energy Cost Saving (RM)
Commercial C1	881.280	0.365	321.67

4.3 Carbon Emission Reduction
The development of the off-grid solar PV system at SELReC helps to reduce Greenhouse Gases (GHG) emissions to the environment. The potential of carbon emission reduction has been calculated using the formula below:

Electricity energy generated by solar PV = 881.28 kWh/year

GHG = Electricity energy generated by solar PV x Emission Factor (EF) (Academy Science Malaysia, 2013)
= 881.28 kWh x 0.670
= 590.45 kg CO_2

5. CONCLUSION

SELReC is developed using solar energy and become a platform to support sustainable development and conserve the environment. It also supports education, awareness, and promote the widespread application of the National Green Technology Policy. Based on the research, the development of the SELReC using an off-grid solar PV system will allow PSAS to achieve energy cost savings of about RM321.67 per year. While the value of the carbon emission preventable from SELReC development area is 590.45 kg of CO_2.

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KEBERKESANAN PENGGUNAAN KAD IMBAS INTERAKTIF BAGI KURSUS *CIVIL ENGINEERING MATERIALS*

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Abstrak. Pelaksanaan pengajaran menggunakan kad imbas dan e-pembelajaran semakin banyak digunakan dalam penyampaian pengajaran dan pembelajaran (pdp) untuk memberi kemudahan kepada pelajar dalam proses mengingat dengan cepat dan meningkatkan pemahaman dalam proses pembelajaran. Objektif kajian ini adalah mengenalpasti persepsi pelajar dan pensyarah terhadap penggunaan kad imbas interaktif sebagai bahan bantu mengajar, menentukan tahap kepuasan penggunaan kad imbas *dan* membandingkan tahap pencapaian peperiksaan akhir pelajar sebelum dan selepas penggunaan kad imbas interaktif bagi kursus *Civil Engineering Material*. Ini berdasarkan pencapaian pelajar Diploma Kejuruteraan Awam dalam peperiksaan akhir bagi kursus *Civil Engineering Materials* agak kurang memberangsangkan. Oleh itu, kad imbas ini dihasilkan bagi menambahbaik pencapaian kursus *Civil Engineering Material* dengan penghasilan nota ringkas interaktif yang dilengkapi latihan, video dan nota lengkap yang boleh diakses melalui aplikasi *QR Code*. Dapatan kajian menunjukkan penggunaan kad imbas interaktif dalam pdp secara keseluruhannya memberi persepsi yang positif dengan dapatan skor min pada skala tinggi. Manakala dapatan bagi tahap kepuasan responden terhadap penggunaan kad imbas interaktif dalam pdp adalah pada tahap positif. Hasil analisis trend pelajar gagal yang diperolehi dari keputusan peperiksaan akhir sebelum dan selepas penggunaan kad imbas interaktif juga menyokong keberkesanan penggunaan kad imbas interaktif dalam pdp. Analisis ini menunjukkan trend pelajar gagal semakin menurun setiap semester bagi kursus *Civil Engineering Materials*. Kesimpulannya kad imbas ini sesuai dijadikan pemudahcara untuk pelajar mempelajari topik *Civil Engineering Materials* dengan lebih mudah dan pantas. Kaedah pembelajaran yang kreatif dan santai secara tidak langsung mewujudkan suasana pdp yang lebih menyeronokkan, berkesan dan bermakna kepada pelajar.

Kata kunci: kad imbas, nota ringkas, interaktif, alat bantu mengajar

1. PENDAHULUAN

Pembelajaran pada abad ke-21 mendorong para pendidik dalam menentukan proses pengajaran dan pembelajaran secara kreatif di dalam kelas dengan berpusatkan pelajar. Hal ini selari dengan pendapat MacMath (2008) bahawa penting bagi pendidik memupuk daya kreativiti dalam mempelbagaikan kaedah pengajaran bagi memastikan semua pelajar dapat melibatkan diri dalam aktiviti pembelajaran dan pemudahcara yang dijalankan. Mengikut definisi Witt dan Orvis (2010), pendidikan abad ke-21 perlu dapat menghasilkan warga negara global yang mempunyai kemahiran, pengetahuan, dan motivasi untuk menangani isu-isu kemanusiaan dan persekitaran yang mampan serta mampu saling hormat-menghormati dan terbuka kepada dialog. Teknologi sepatutnya memainkan peranan sebagai pengupaya atau merupakan alat pembelajaran yang lebih relevan dan berpusatkan pelajar (Institut Aminuddin Baki, 2017). Oleh yang demikian, teknologi perlu digunakan secara menyeluruh bagi

menyokong pembelajaran dan pemudahcara pelajar untuk belajar melalui kaedah pembelajaran akses kendiri dan amalan pdp yang inovatif.
Pembelajaran akses kendiri dengan menggunakan kad imbas adalah satu pendekatan pembelajaran berpusatkan pelajar dan pembelajarannya berlaku atas daya usaha pelajar itu sendiri. Kad imbas sesuai dijadikan sebagai bahan bantu mengajar di sekolah rendah, sekolah menengah mahupun di institusi pengajian tinggi di Malaysia. Menurut Teng, F., & He, F. (2015) menyatakan bahawa kad imbas adalah merupakan sekumpulan kad yang mengandungi maklumat seperti perkataan, gambar, nombor yang dicetak pada kedua-dua belah bahagian kad atau pada satu bahagian sahaja yang digunakan sebagai latihan dalam kelas atau pembelajaran secara kendiri.

Pembelajaran interaktif dikenali sebagai e-pembelajaran merupakan kaedah pembelajaran secara aktif di dalam kelas dengan menggunakan medium internet (Faridah & Afham, 2019). Ini turut disokong oleh Paula (2002) yang menyatakan e-pembelajaran merujuk pada penggunaan teknologi internet untuk menyampaikan maklumat yang dapat meningkatkan pengetahuan dan ketrampilan seseorang. Oleh yang demikian, bahan bantu mengajar yang interaktif perlu dihasilkan bagi membantu meningkatkan pencapaian pelajar yang lemah dalam kursus *Civil Engineering Materials.*

1.1 Penyataan Masalah
Kajian ini dijalankan bagi menentukan tahap keberkesanan penggunaan kad imbas interaktif bagi kursus *Civil Engineering Materials* untuk pelajar Semester 1 yang mengikuti program Diploma Kejuruteraan Awam (DKA) di Jabatan Kejuruteraan Awam Politeknik Sultan Azlan Shah. Kursus *Civil Engineering Materials* ini mengandungi sembilan topik teori yang berkaitan dengan bahan binaan kejuruteraan awam. Berdasarkan pencapaian kursus peperiksaan akhir pelajar bermula pada sesi Disember 2014 sehingga sesi Disember 2016 merekodkan peratusan tertinggi pelajar yang gagal adalah sebanyak 41.67%. Analisa CORR (Course Outcome Review Report) kursus mendapati tahap penguasaan pemahaman pelajar dalam kursus bahan binaan adalah di bawah nilai 50%. Oleh yang demikian, inovasi telah dilakukan dalam pengajaran dan pembelajaran dengan menghasilkan kad imbas interaktif bagi kursus *Civil Engineering Material* sebagai penambahbaikan CQI (Continuos Quality Improvement) kursus.

1.2 Objektif Kajian
Objektif kajian ini dijalankan untuk mengenalpasti persepsi pelajar dan pensyarah terhadap penggunaan kad imbas interaktif sebagai bahan bantu mengajar dan menentukan tahap kepuasan penggunaan kad imbas interaktif bagi kursus *Civil Engineering Material*. Selain itu, kajian ini dijalankan dengan membuat perbandingan trend prestasi pelajar melalui keputusan peperiksaan akhir pelajar sebelum dan selepas penggunaan kad imbas interaktif bagi kursus *Civil Engineering Material*.

2. KAJIAN LITERATUR

Abdul Rashid (2011) dalam kajiannya menjelaskan penggunaan alat bantu mengajar yang menarik bersesuaian dengan tahap kebolehan pelajar semasa merencanakan isi pelajaran dapat merangsang minat pelajar dan bermotivasi untuk terus belajar. Jamalludin, Baharuddin dan Zaidatun (2001) menyatakan penggunaan grafik juga dapat menyampaikan maklumat dengan lebih berkesan kerana segala bentuk mesej yang diterima oleh manusia melalui penglihatan mempunyai daya ketahanan serta daya ingatan yang lebih tinggi sekiranya direka bentuk dengan tepat. Kad imbas yang dihasilkan perlulah dapat menarik minat pelajar, bermotivasi, mudah digunakan, mudah difahami, mempunyai informasi yang sistematik dan berurutan, paparan yang berwarna dan mempunyai kelebihan interaktif. Menurut Kohyama dan Shimada (2005) menyatakan penggunaan kad imbas mendorong para pelajar membuat refleksi semasa belajar dan bertanggungjawab terhadapnya. Melalui pembelajaran kendiri pelajar lebih termotivasi untuk belajar dan berusaha sedaya upaya dengan kebolehan mereka.

Kaedah pembelajaran interaktif merupakan kaedah interaksi antara dua hala di dalam proses pembelajaran yang diperoleh berdasarkan bahan rangsangan sama ada rangsangan berbentuk gambar, dialog, tutorial dan maklumbalas jawapan (Harlina, Zubaidah & Ainee, 2017). Pembelajaran interaktif memberi impak pembelajaran atau peluang yang luas kepada pelajar menerusi penglibatan aktif pelajar, koloboratif, memberikan banyak kelebihan kesan positif kepada pelajar dan pensyarah dalam prestasi keseluruhan pengajaran di dalam kelas dan menggalakkan pembelajaran seumur hidup (Faridah & Afham, 2019). Sehubungan itu, pendekatan interaktif dapat diaplikasikan dalam penghasilan kad imbas sebagai alat bantu mengajar di dalam kelas. Bahan bantu mengajar hendaklah direkabentuk dengan mengambil kira tahap kebolehan pelajar dan digunakan secara optimum dalam pembelajaran agar menghasilkan pembelajaran yang bermakna dan meninggalkan kesan positif dalam diri pelajar.

Inovasi dalam pengajaran dan pembelajaran ini dibangunkan bagi menghasilkan kad imbas interaktif bagi kursus *Civil Engineering Material* untuk pelajar semester satu yang mengikuti program Diploma Kejuruteraan Awam (DKA) di Jabatan Kejuruteraan Awam Politeknik Sultan Azlan Shah. Hasil dapatan penyelidik mendapati bahawa pencapaian pelajar dalam peperiksaan akhir bagi kursus *Civil Engineering Materials* ini agak kurang memberangsangkan. Pemahaman bagi setiap konsep dalam kursus berkenaan amat penting bagi kelangsungan kursus-kursus yang berkaitan dengan penggunaan bahan bagi semester seterusnya. Di samping itu, penggunaan kad imbas yang dihasilkan ini lebih menarik dan berinteraktif dengan adanya nota padat, latihan, paparan video menggunakan web 2.0, penggunaan perisian QR Code yang dimuatkan dalam satu kad. Kad imbas interaktif ini dihasilkan sebagai pemudahcara untuk pelajar mempelajari setiap topik dengan lebih mudah, cepat dan pantas.

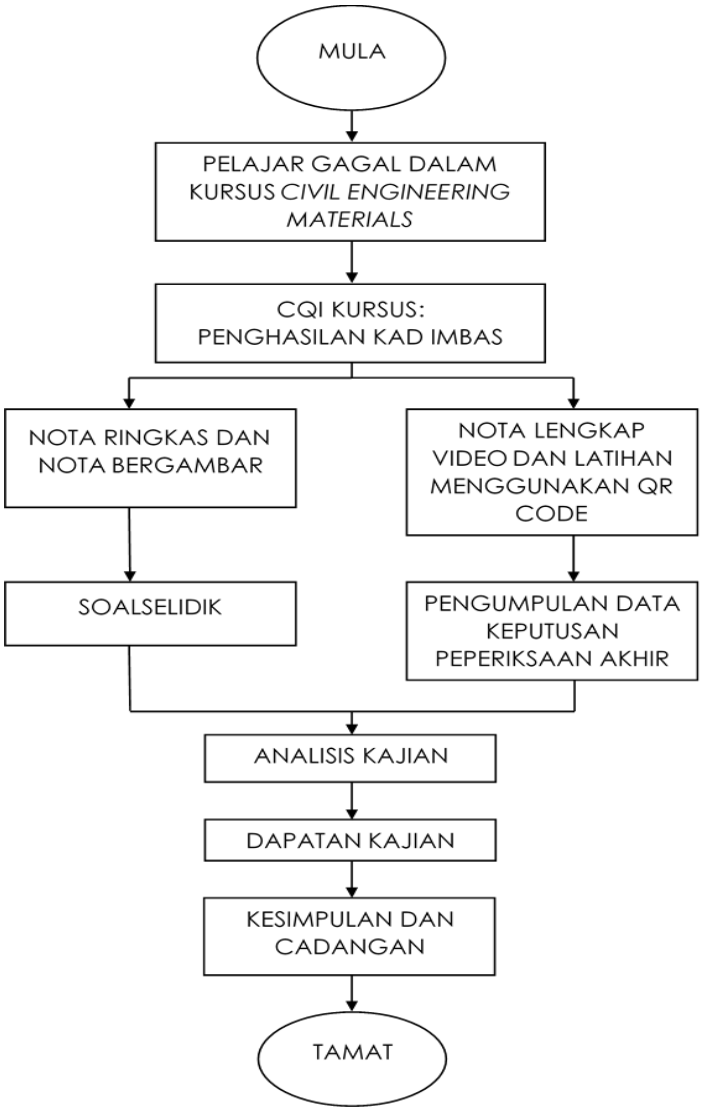
Rosnah (2016) telah menggunakan kerangka konseptual kajian dari Teori Behaviorisme dan Teori Kognitif bagi menentukan keberkesanan penggunaan kad imbas interaktif. Teori Behaviorisme dikenali sebagai teori tingkah laku di mana berlakunya perubahan sikap apabila stimuli, tindakbalas dan latihan dilakukan secara berulang-ulang. Manakala Teori Kognitif pula adalah berkaitan dengan perkembangan kognitif iaitu kebolehan individu untuk berfikir, memberi pendapat, memahami, mengingati perkara-perkara yang berlaku di persekitaran masing-masing yang melibatkan aktiviti mental seperti ingatan, mengkategori, merancang, menaakul dan lain-lain lagi. Oleh yang demikian, pelajar dapat mengulangkaji pelajaran melalui kad imbas interaktif secara kendiri dengan mudah dan lebih kerap bagi mengukuhkan pemahaman mereka. Berdasarkan kedua-dua teori ini jelaslah digunakan untuk mencapai objektif kajian melalui persepsi pelajar dan tahap kepuasan penggunaan kad imbas interaktif bagi penambahbaikan kualiti berterusan (CQI) bagi kursus *Civil Engineering Material* dalam merangsang pembelajaran pelajar yang lemah.

3. METODOLOGI KAJIAN

Kajian ini dijalankan dengan menggunakan instrumen soal selidik diedarkan kepada responden yang terdiri daripada kalangan pelajar dan pensyarah. Seramai 42 orang pelajar Semester 1 DKA dan 7 orang pensyarah kursus *Civil Engineering Material* yang terlibat. Soal selidik yang dihasilkan menggunakan soal selidik dari *Google Form*. Soal selidik ini terbahagi kepada tiga bahagian iaitu bahagian pertama mengumpulkan demografi responden kajian, manakala pada bahagian kedua mengenalpasti persepsi pelajar terhadap penggunaan kad imbas interaktif sebagai bahan bantu mengajar dan menentukan tahap kepuasan penggunaan kad imbas interaktif bagi kursus *Civil Engineering Material*. Seterusnya pada bahagian akhir soal selidik adalah cadangan daripada responden kajian. Soal selidik telah diedarkan kepada para pelajar yang mendaftar kursus *Civil Engineering Material* setelah penggunaan kad imbas digunapakai bermula pada sesi Disember 2017. Soal selidik yang diedarkan kepada responden adalah menggunakan kaedah secara atas talian menggunakan *Google Form*.

Rajah 1 menunjukkan carta alir metodologi kajian dalam menentukan rekabentuk kajian keberkesanan penggunaan kad imbas interaktif bagi kursus *Civil Engineering Material*. Kajian ini dilaksanakan berdasarkan dari dapatan *Course Outcome Review Report (CORR) untuk penambahbaikan kualiti berterusan (CQI) kursus Civil Engineering Material*. Oleh itu, penyelidik telah menginovasikan kaedah pengajaran dan pembelajaran melalui penghasilan kad imbas interaktif sebagai bahan bantu mengajar untuk membantu meningkatkan prestasi pelajar Semester 1 Diploma Kejuruteraan Awam di Jabatan Kejuruteraan Awam, PSAS. Perbandingan trend prestasi pelajar melalui keputusan peperiksaan akhir pelajar bagi kursus *Civil Engineering Material* dalam tempoh 5 semester sebelum dan 4 semester selepas penghasilan kad imbas *Civil Engineering Material* telah dijalankan.

Analisis data kajian telah dijalankan dengan menggunakan perisian SPSS versi 19 untuk mendapatkan nilai min bagi menentukan tahap persepsi dan tahap kepuasan pengguna kad imbas interaktif bagi kursus *Civil Engineering Material.* Daripada dapatan kajian, terdapat penambahbaikan perlu dilaksanakan iaitu pembangunan *e-flash card material* bagi memudahkan capaian pelajar secara lebih efektif dengan menggunakan capaian laman *google* ataupun menggunakan aplikasi yang menarik.



Rajah 1 : Carta alir metodologi kajian

4. ANALISIS DAN KEPUTUSAN

Analisis data merupakan satu proses merekod dan mengumpul data berdasarkan soal selidik yang diedarkan kepada pelajar dan pensyarah yang terlibat dengan kursus *Civil Engineering Materials*. Selain itu, pengumpulan data pencapaian peperiksaan akhir semester pelajar juga telah dilakukan. Data tersebut diperolehi daripada pensyarah yang mengajar kursus tersebut dari sesi Disember 2014 sehingga sesi Jun 2019. Penggunaan kad imbas interaktif dalam pengajaran dan pembelajaran bagi kursus *Civil Engineering Materials* adalah bermula pada sesi Disember 2017.

4.1 Keputusan soal selidik persepsi pelajar terhadap penggunaan dan tahap kepuasan penggunaan kad imbas bagi kursus *Civil Engineering Material*
Kajian yang dijalankan melibatkan responden seramai 49 orang yang terdiri daripada 7 orang pensyarah kursus dan 42 orang pelajar Diploma Kejuruteraan Awam Politeknik Sultan Azlan Shah yang mengikuti kursus *Civil Engineering Materials*. Soal selidik diedarkan secara atas talian dengan menggunakan *Google Form* kepada pelajar selepas penghasilan kad imbas interaktif ini dan digunapakai dalam pdp bermula pada sesi Disember 2017.

Pengkaji menggunakan lima skor Skala Likert berpandukan rujukan kajian daripada Nurul Azean dan Mohd Safiee (2011) seperti yang ditunjukkan dalam Jadual 1. Skor ini dikelaskan pada 2 skala penunjuk iaitu jawapan yang positif dan negatif.

Jadual 1: Skor Skala Likert

Skor	Skala	Penunjuk
1	Sangat Tidak Setuju	Negatif
2	Tidak setuju	
3	Tidak pasti	Positif
4	Setuju	
5	Sangat Setuju	

Dalam kajian ini, pengkaji menggunakan statistik deskriptif iaitu nilai min dan diinterpretasikan bagi memastikan data yang diperolehi boleh dipercayai. Interpretasi min yang diperolehi dikelaskan kepada tiga bahagian iaitu interpretasi rendah, sederhana dan tinggi sebagaimana yang ditunjukkan pada Jadual 2.

Jadual 2: Jadual Deskriptif Skor Min Yang Diubah Suai Dari Jadual Landell

Skor Min	Interpretasi
1.00 – 2.33	Rendah
2.34 – 3.679	Sederhana
3.68 – 5.00	Tinggi

(*Sumber : Adaptasi daripada Nurul Azean dan Mohd Safiee, 2011*)

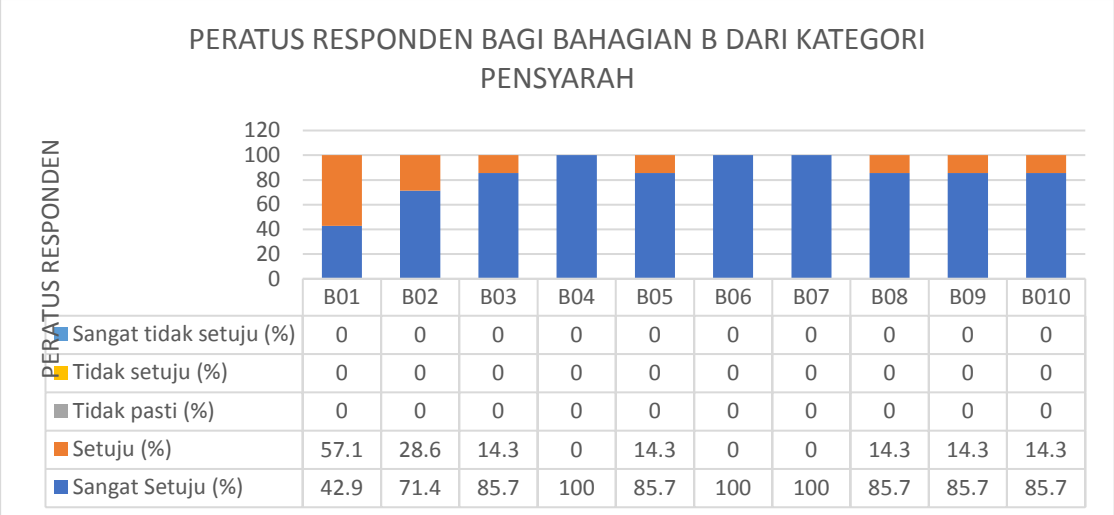
a) Demografi responden
Bahagian A merupakan demografi responden yang terdiri dari kategori pensyarah dan pelajar. Bilangan keseluruhan responden seramai 49 orang terdiri daripada responden lelaki mewakili peratusan 29.6% manakala responden perempuan adalah 70.4%. Responden di kalangan pensyarah mewakili peratusan sebanyak 14.3% dan responden merupakan pensyarah yang mengajar kursus *Civil Engineering Materials*. Jumlah peratusan responden pelajar adalah sebanyak 85.7% yang telah mendaftar dan mengikuti kursus *Civil Engineering Materials* dalam program Diploma Kejuruteraan Awam.

b) Analisis Soal Selidik

Di bahagian B terdapat 10 soalan dikemukakan kepada responden kategori pensyarah dan pelajar melalui capaian *Google Form*.

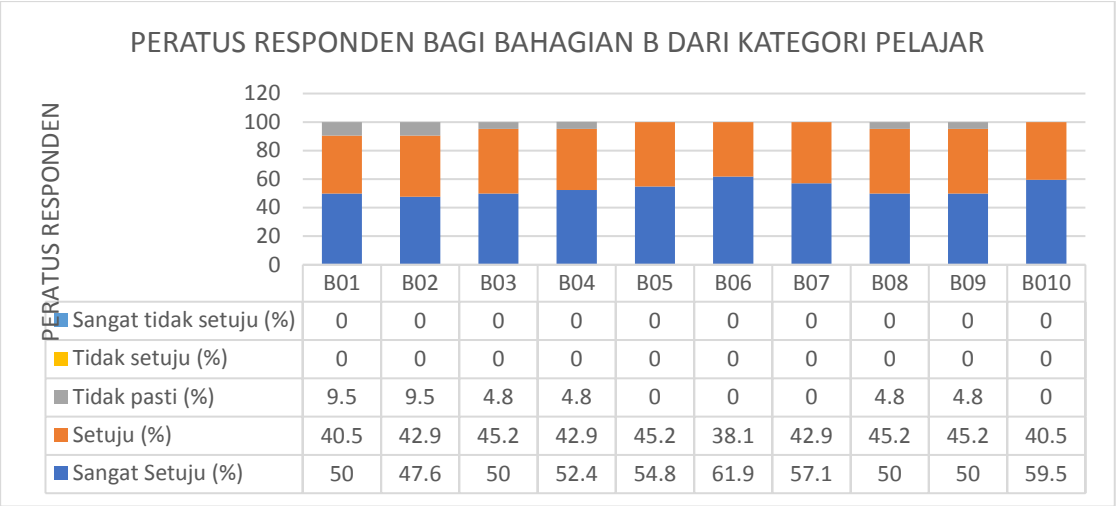
Jadual 3 : Nombor soalan dan item yang dikemukakan kepada responden

No. Soalan	Item
B01	Kad imbas merupakan alat bahan bantu mengajar secara atas talian dan secara salinan keras
B02	Kad imbas memudahkan saya untuk memahami topik yang diajar.
B03	Kad imbas ini memudahkan saya menghubungkait elemen sebenar dengan pembelajaran teori di dalam kelas.
B04	Kad imbas ini amat sesuai digunakan sebagai alat bahan bantu mengajar semasa proses pdp.
B05	Pengendalian kad imbas adalah mudah dan menarik.
B06	Penggunaan elemen visual (video, *powtoon*) menambahkan topik yang diajar lebih mudah difahami.
B07	Kad imbas memudahkan dan menjimatkan masa dalam mendapatkan info daripada pensyarah.
B08	Maklumat berkaitan dengan topik dalam kad imbas mudah di akses menggunakan QR Code.
B09	Penyampaian topik dan subtopik kursus lebih menarik menggunakan kad imbas.
B010	Membantu saya untuk memperluaskan pengetahuan berkaitan kursus yang di ajar.



	B01	B02	B03	B04	B05	B06	B07	B08	B09	B010
Sangat tidak setuju (%)	0	0	0	0	0	0	0	0	0	0
Tidak setuju (%)	0	0	0	0	0	0	0	0	0	0
Tidak pasti (%)	0	0	0	0	0	0	0	0	0	0
Setuju (%)	57.1	28.6	14.3	0	14.3	0	0	14.3	14.3	14.3
Sangat Setuju (%)	42.9	71.4	85.7	100	85.7	100	100	85.7	85.7	85.7

Rajah 2 : Peratusan responden bagi soalan di bahagian B dari kategori pensyarah



Rajah 3 : Peratusan responden bagi soalan di bahagian B dari kategori pelajar

Jadual 4 : Nilai min dan sisihan piawai

		Min		Sisihan Piawai	
	KATEGORI	**PENSYARAH**	**PELAJAR**	**PENSYARAH**	**PELAJAR**
NO.SOALAN	B01	4.43	4.40	0.535	0.665
	B02	4.71	4.38	0.488	0.661
	B03	4.86	4.45	0.378	0.593
	B04	5.00	4.48	0	0.594
	B05	4.86	4.55	0.38	0.504
	B06	5.00	4.62	0	0.492
	B07	5.00	4.57	0	0.501
	B08	4.86	4.45	0.378	0.593
	B09	4.86	4.45	0.378	0.593
	B010	4.86	4.60	0.378	0.497

Merujuk Rajah 2 dan 3, didapati kedua-dua kategori responden memberikan petunjuk positif terhadap penggunaan kad imbas berinteraktif dalam pdp kerana kebanyakan responden menjawab pada skala sangat setuju dan setuju. Berdasarkan hasil analisis Jadual 4, menunjukkan nilai min berada pada tahap tinggi dan membuktikan penggunaan kad imbas interaktif ini sesuai digunakan dalam pdp.

Penetapan item 1 hingga 8 merupakan persepsi pengguna terhadap kad imbas bagi kursus *Civil Engineering Materials*. Kedua-dua kategori responden bersetuju menyatakan kad imbas merupakan alat bahan bantu mengajar secara atas talian dan secara salinan keras dengan min masing-masing 4.43 dan 4.40 dengan sisihan piawai 0.535 dan 0.665. Penggunaan kad imbas berinteraktif memudahkan pengguna untuk memahami topik yang diajar juga memberikan penunjuk positif kerana kedua-dua responden memberikan keputusan min pada tahap tinggi dan sisihan piawai yang rendah. Tetapi 9.5% responden dari kategori pelajar tidak pasti dengan penggunaan kad imbas dalam pdp. Responden juga bersetuju dengan min masing-masing 4.86 dan 4.55 bahawa kad imbas berinteraktif yang digunakan memudahkan mereka menghubungkait elemen sebenar dengan pembelajaran teori di dalam kelas. Kad imbas yang digunakan juga amat sesuai digunakan sebagai alat bahan bantu mengajar semasa proses pdp. Responden memberikan penunjuk yang positif dengan min pada tahap tinggi dengan persepsi tersebut. Penggunaan elemen visual dan berinteraktif juga banyak membantu pengguna kad imbas ini untuk memahami topik yang dipelajari. Ini dapat dilihat apabila penunjuk positif diperolehi dari kedua-dua kategori responden dengan min tahap

tinggi. Kemudahan pengguna untuk mengakses nota dengan menggunakan QR Code daripada kad imbas juga memberikan penunjuk positif.

Item 9 dan 10 merupakan tahap kepuasan pengguna kad imbas interaktif. Penyampaian topik dan subtopik kursus lebih menarik menggunakan kad imbas telah memberikan penunjuk yang positif dengan min pada tahap tinggi dan sisihan piawai yang kecil. Kad imbas juga membantu pengguna memperluaskan pengetahuan berkaitan kursus yang di ajar. Ini dapat dilihat apabila kedua-dua responden memberikan penunjuk yang positif dengan min pada tahap yang tinggi.

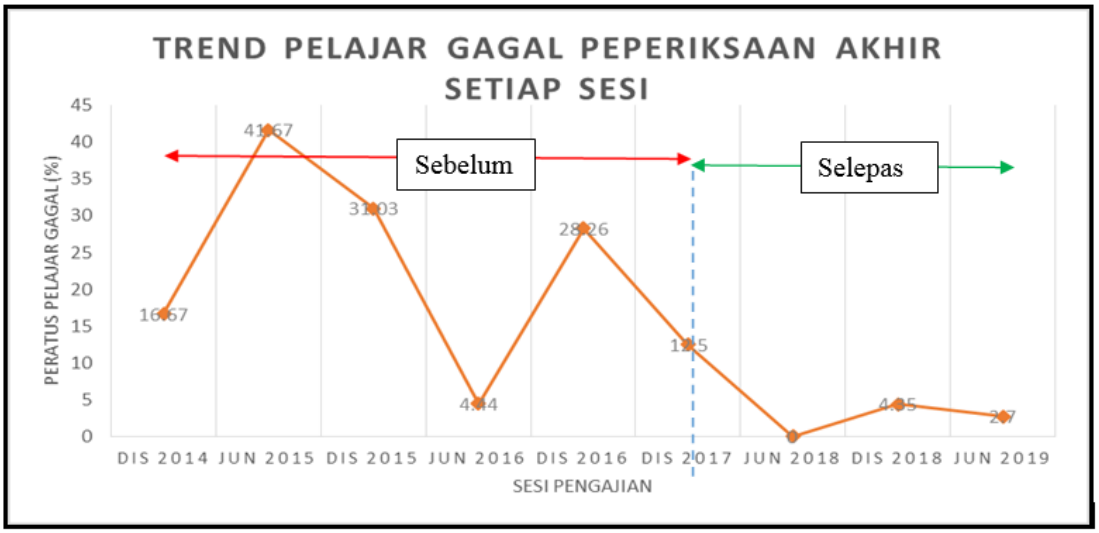
4.2 Perbandingan tahap pencapaian peperiksaan akhir pelajar sebelum dan selepas penggunaan kad imbas interaktif dalam kursus *Civil Engineering Materials*
Data pada Jadual 5 yang diperolehi merupakan bilangan pelajar yang mendapat gred markah dalam peperiksaan akhir setiap semester bagi kursus *Civil Engineering Materials.* Pada Jadual 6 pula menunjukkan peratusan pelajar gagal dalam peperiksaan akhir sebelum penggunaan kad imbas interaktif dari Sesi Disember 2014 sehingga Disember 2016 dengan selepas penggunaan kad imbas interaktif pada sesi Disember 2017 hingga sesi Jun 2019.

Jadual 5 : Bilangan pencapaian pelajar mengikut gred setiap semester bagi kursus *Civil Engineering Materials* sebelum dan selepas penggunaan kad imbas.

SESI	GRED MARKAH														JUMLAH
	LULUS											GAGAL			
	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	E	E-	F	
SEBELUM PENGGUNAAN KAD IMBAS															
DIS 2014	0	0	0	0	2	3	4	8	4	5	9	7	0	0	42
JUN 2015	0	0	0	2	0	3	0	4	4	4	4	13	1	1	36
DIS 2015	0	0	0	1	2	3	3	5	4	1	1	7	1	1	29
JUN 2016	0	2	2	3	10	10	7	5	3	1	0	1	1	0	45
DIS 2016	0	0	0	0	2	4	4	4	10	3	6	5	3	5	46
SELEPAS PENGGUNAAN KAD IMBAS															
DIS 2017	0	0	0	1	1	1	3	2	4	0	2	2	0	0	16
JUN 2018	0	0	2	3	5	5	9	3	1	0	0	0	0	0	28
DIS 2018	0	0	0	3	2	3	3	6	3	1	1	1	0	0	23
JUN 2019	0	3	0	1	8	9	7	4	0	3	1	1	0	0	37

Jadual 6 : Peratusan pelajar gagal pada setiap semester bagi kursus *Civil Engineering Materials*

SESI	BILANGAN PELAJAR GAGAL	PERATUSAN PELAJAR GAGAL (%)
SEBELUM PENGGUNAAN KAD IMBAS INTERAKTIF		
DIS 2014	7	16.67
JUN 2015	15	41.67
DIS 2015	9	31.03
JUN 2016	2	4.44
DIS 2016	13	28.26
SELEPAS PENGGUNAAN KAD IMBAS INTERAKTIF		
DIS 2017	2	12.50
JUN 2018	0	0.00
DIS 2018	1	4.35
JUN 2019	1	2.70



Rajah 4 : Trend pelajar gagal peperiksaan akhir setiap semester sebelum dan selepas penggunaan kad imbas berinteraktif

Merujuk Rajah 4, menunjukkan peratusan pelajar gagal berkurangan selepas kad imbas interaktif diperkenalkan dalam kursus *Civil Engineering Materials*. Semasa awal pelaksanaan kad imbas interaktif, peratus pelajar yang mendapat keputusan gagal mencapai sehingga 12.5% sahaja berbanding sebelum penggunaan kad imbas interaktif nilai peratusannya tinggi iaitu sebanyak 41.67%. Walaubagaimanapun trend keputusan peperiksaan akhir ini semakin menurun selepas kad imbas interaktif digunapakai dan mencapai nilai peratusan 0% kegagalan pada sesi Jun 2018. Berdasarkan trend yang ditunjukkan ini, menunjukkan penggunaan kad imbas interaktif dalam kursus *Civil Engineering Materials* adalah sangat berkesan dalam meningkatkan prestasi pelajar dan tahap pemahaman pelajar dalam kursus tersebut.

5. KESIMPULAN DAN CADANGAN

Secara keseluruhannya, persepsi dan tahap kepuasan penggunaan kad imbas interaktif bagi kursus *Civil Engineering Materials* memberikan penunjuk yang positif dan interpretasi skor min adalah pada tahap tinggi. Manakala dari segi keberkesanan penggunaan kad imbas interaktif ini juga memberikan keputusan yang positif apabila trend pelajar gagal pada peperiksaan akhir setiap semester selepas penggunaan kad imbas interaktif didapati trend yang menurun hingga mencapai 0% kegagalan pada Sesi Jun 2018. Justeru itu, kajian ini juga dibuat bertujuan penambahbaikan kualiti berterusan (CQI) kursus *Civil Engineering Materials* yang perlu dilakukan supaya bahan pengajaran lebih berinteraktif, menarik dan meningkatkan pencapaian keputusan peperiksaan akhir pelajar. Pendidikan tidak hanya tertumpu pada pengetahuan dan gred yang baik dalam peperiksaan semata ia mencakupi usaha peningkatan potensi diri pelajar dan berupaya mengatasi cabaran persekitaran pembelajaran. Pensyarah harus berusaha mempelbagaikan teknik dan gaya pengajaran supaya pelajar mempunyai semangat dengan kursus yang diikuti. Oleh itu, pelajar didedahkan teknik kendiri supaya mampu mencari dan memahami maklumat secara kendiri apabila ketiadaan pensyarah.

Cadangan yang boleh dikemukakan dari kajian ini adalah penggunaan kad imbas berinteraktif boleh diaplikasikan pada kursus lain untuk penambahbaikan prestasi pelajar dalam analisis CORR kursus. Selain itu, dicadangkan penggunaan kad imbas boleh dicapai secara atas talian bagi memudahkan capaian pelajar dengan lebih efektif. Cadangan daripada responden juga perlu di ambil kira di dalam kajian ini iaitu pelajar mencadangkan agar penggunaan kad imbas perlu diperluaskan penggunaannya dalam pdp. Responden

juga mencadangkan proses pengajaran dan pembelajaran menggunakan alat bantu mengajar diperluaskan penggunaannya secara digital.

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EXPLORING ONLINE SILENCE IN AN ORGANIZATION: REVIEWING THE RELEVANT THEORIES, CONCEPTS AND PROPOSING THE RESEARCH METHODOLOGY

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Abstract. Communication in an organization is essential as it is a way for employers to disseminate information and work towards achieving organizational key performance indicators. As for employees, effective and positive communication could enhance their performance, commitment, and productivity. The concern is raised when employees opt for silent responses. Hence, there is a need for employers to delve into the phenomenon and understand why employees are behaving in such a way. The study aims to explore and understand the phenomenon of silent responses in computer-mediated communication (CMC) among top administrative employees of a government institution. As the research is still at the preliminary stage, this paper intends to review the theories and concepts related to workplace silence, understand its causes and effects as discussed in the previous literature, in the context of CMC. The paper will also propose the research design and the methodology on how the study will be conducted.

Keywords: silence at a workplace; computer-mediated-communication; communication in organizations; online silence

1. INTRODUCTION

Employee silence has become a critical issue to organization management as it can lead to many unfavorable outcomes such as absenteeism (Carla, 1996), distortion in organizational commitment (Vakola & Bouradas, 2005), encourage corruption (Ashforth & Anand, 2003), delay workplace innovation (Argyris & Schon, 1978) and create other undesired organizational behavior (Carla, 1996). Employee silence is defined as deliberate intentional withholding of information, opinions, suggestions, or concerns about potentially important organizational issues (Dyne, Ang, S. & Botero, 2003; Pinder & Harlos, 2001; Wang & Hsieh, 2013). Individuals who intentionally restrict themselves from communication suffer from stress and physiological problems (Morrison & Milliken, 2000) and contribute to organizational dysfunctions. However, in reality, many individuals in organizations opt to remain silent despite encouragement to speak from the management. Therefore, investigating the factors that are related to silence remains a fundamental issue in organizational management.

In the new era of communication technology, especially during the spread of Covid-19 pandemic, computer-mediated communication (CMC) has been widely used as a communication tool. CMC has been applied especially in business organizations to keep businesses going despite the killing pandemic and to maintain interpersonal relationships especially in terms of business-to-business relationships. At the organizational level, CMC is used to disseminate information from management to employees and also to get opinions, problems, and innovative ideas from employees for continuous organizational development.

However, for some individuals, the new normal blocks the opportunity to speak even more. The lack of facial expressions and the speed of the internet could be one of the reasons that hinder smooth communication in CMC application. This silence behavior is a serious organizational issue as it distorts the speed of organizational activities of which can result in unfavorable outcomes especially in terms of financial and organizational innovation.

The paper aims to review some theories and concepts that underpin the area of silence at workplace and CMC in organizations, as well as what past studies have enlightened us about issues and concerns in these areas. Hence this review will provide a theoretical basis for the full research. The subsequent subheading discusses silence in organizations, the identified factors that cause silence, followed by the impact of employees' silence.

2. METHODOLOGY

This paper presented a review of the empirical and theoretical literature and discussed the related concepts, contemporary and past research contexts that direct the design of the proposed study. A systematic review matrix was employed whereby the relevant past studies were arranged in a matrix classifying the context, the method, the respondents/ participants, and the result findings. This enables the researchers to evaluate, compare, contrast, and summarize the input from the literature.

3. SILENCE AT WORKPLACE

Silence is defined as being deliberately withholding of information (Van Dyne et al., 2003) and Being making mindful decisions to refuse in sharing information (Kirrane et al., 2017). Exploring the silence spans at the workplace across different issues on how and why employees choose to be silent rather than voicing their disquiets is important. There are different types of reasons why employees are reluctant to raise. According to Vemuri (2019) probabilities are associate with risks and not all silence is bad and harmful. Further, it is discussed the importance to identify whether that majority of being silent relates to the organizational context. Psychologists have characterized the "mum effect" with employees who remain silent about their concerns at the workplace (Rosen & Tesser, 1970). The extra role in communication behavior and others provide vivid pictures of employees having discomfort to voice up about any concerns. This can lead to real damage to the organization and impact on employees' psychology when they feel unable to voice their concerns. Thus, it may be most appropriate to think conversation failures may lead to damaging employees' morale and engagement in relationships and the company principles (Vemuri, 2019).

The rate and the duration of the communication between employees and administrators contribute to the enhancement of relationships (Perkins, 2014). Research shows that employees' communication takes place only when they feel secure psychologically (Brinsfield, 2013). Emotions like fear may result in avoidance in contributing to communication (Coan & Allen, 2004) and it is strongly linked to defensive silence (Van Dyne et al., 2003). Showing anger and fear invades to being silent. These emotions contribute to the dynamics of silence at the workplace (Kirrane et al., 2017). Therefore, to have a conducive and friendly work environment the decline of silence should be practiced.

In an organization where employees having dissatisfaction, the environment can create silence at the workplace. This situation can develop into anger. According to Kirrane et al., (2017) anger can be associated with staying silent. However, it is not always a negative emotion but can be positive if the situation can be solved by allowing the organization to know about their concerns or objections to any issues. The employees may speak up to immediate superior because the immediate superior has a greater influence on the emergence of silence (Perkins, 2014).

3.1 Factors contributes to silence

Research on issues that contributes to silence is a more recent construct which refers to the withholding to voice potentially input and fails to share what is in their mind. This is more of protecting themselves from voicing as viewed by Brinsfield (2013). This is identified as having motives for silence to protect oneself and the protection of others. This is supported by Van Dyne et al. (2003) as employees remaining silent and intentionally withhold work-related ideas and opinions. According to Pinder and Harlos (2001) employees remain silent to express effective evaluations of the company circumstances to the organizational improvement in making effective change or redress. If voices are withheld the consequences may be substantial. The sharing of ideas, suggestions, opinions, and information which could be viewed as evidence for a dynamic and successful company would be lacking when employees chose to remain silent. One of the factors is when managerial leaders are unaware of the tendency when employees remain silent.

Factors and conditions that suppress employee voice as reported by Peterson (2018) and Pinder and Harlos (2001), there are two main behaviors in which employees remain in silence. The first is on fear and anger based which is termed as quiescent silence and the other is futility and resignation-based silence and termed as acquiescent silence. Both types of silence need to be understood not just conditions of the withdrawal to speak up when they have suggestions, information, or opinions, and questions but also the reasons. Thus, a stimulated, sizable amount of research attention should be carried out to find the factors and conditions that stifle employee voice.

In recent years, employees' silence around workplace bullying is also a contribution to workplace silence. The employees' silent behavior is a part of harassment and mistreatment by the management (Karen & Michael, 2018). This is further strengthened by Chou and Chang (2017) who believe that employee silence is workplace bullying and mistreatment, which is rampant and dangerous to employees from being productivity at the workplace. Studies conducted by Brinsfield (2013) on multimethod research with studies involving induction and deduction. There are six silence scopes identified and the most relevant to bullying situations are defensive silence (referring to retaliatory actions), diffident silence which was referred to lack of confidence, ineffectual silence referring to lack of benefit in speaking up, and disengaged silence referring to eliciting oneself from the situation. In contrast, Whiteside and Barelay (2013) in a multimethod study, found that acquiescent and quiescent silence had been likely made employees remain in silence at the workplace in mediating the role of being unfairness and productivity. Employee silence, in particular, due to workplace bullying where the withholding of key information to involve in an organizational issue to an expression of voice can be an emerging problem. According to Harlos et al. (2017), a bullied employee may lead to health decrements, lack of performance, and may not reveal ill-treatment to the organization.

In a recent study by Harlos et al. (2017) found bullied was predicted more by individual factors such as being negative and gender, than situational factors. In addition to bulling, it is perceived organizational support and emotional neglect are part of the employee silence. Contradicting to bulling, Detert and Edmondson (2011) mention being unclear about job requirements, feeling of ambiguity, and feeling emotionally neglected are positively related to silence. Unfortunately, existing reasons for employees remaining silence raised from many issues and interconnect divergent views that an employee is or is not engaging in speaking up.

In addressing the employees being uncomfortable in conveying information about probable problems or issues to those superior to them also leads to silence. Numerous studies have shown that subordinates frequently misrepresent information. This arises from the fact they convey to their superiors, communicating with fear, and with minimized information (e.g. Read, 1962; Athanassiades, 1973;). The feeling of discomfort to voice out results in climates of silence which occurs when there is a common unwillingness to speak up about critical issues (Morrison & Milliken 2000). Soon thereafter, Pinder and Harlos (2001) define employee silence as the silencing of any method of conversation and expression on voicing views which brings

effect in the change or redress in any organization. Subsequent studies had been carried out on Pinder and Harlos's (2001) definition, expanding from silence related to injustice to silence in critical issues of concern (Milliken et al. 2003; Tangirala & Ramanujam 2008a). Despite the many research suggesting to employees feel uncomfortable to voice out their views to their bosses, there are more reasons why employees often remain silent. Although past research guides some of the reasons which contribute to silence at the workplace, there is a need to conduct studies on situations that made the employees remain silent about their concerns related to issues and problems at work.

3.2 Impact of employees' silence

It is highly possible reasons for employees remaining silent that are abnormal to every occupation. Therefore, the organization should be responsible for their employees to reduce the amount of employee silence happens in workplaces. Employers need to be aware of keeping and protect employees from physical, mental, and emotional harm. Understanding employees on their needs, the bad, and the ugly aspects of silence at the workplace should be addressed to overcome the impact of their emotional feelings. The impact of the silence by the employee gives great influence to the company (Vemuri, 2019). Therefore, employees being silent will lead to the company's loss.

The employees are the asset to the company, therefore, ignoring them and keeping them in silence can lead to a major loss to the company. Their creativity and innovation and vital information being wasted. Besides that, the impact on those who are silenced is less likely to meet the organization's goals. This gives an impact on labor productivity (Vemuri, 2019).

Conversely, the impact of employee silence at the workplace may trigger different behavioral responses to either remain silent or speak up. This may give a positive or negative impact on the company's growth. Some studies have identified positive concerns looking at employee silence but outshining in their self-confidence, creativity, and independence and encourage self-interest (Wang & Hsieh, 2013). Nevertheless, Kirrane et al. (2017) view the negative outcomes of such behavior. This is supported by Morrison and Milliken (2000) whereby, silence will lead to a lack of performance, lack of job satisfaction, and isolation. Silence at the workplace may develop in approaching to eliminate where employee isolation and fear to progress positive voice and engagement (Kirrane et al., 2017). Hence, managing silence in the workplace is curial in all organizations. Although there are different practices of silence at the workplace provoke different emotional reactions, but the negative responses to silence are obvious to a greater loss for the company. Kirrane et al. (2017) suggest adopting a broader view and responsibilities in identifying the employees' workplace silence will give a positive impact on their performance.

In an organization, if employees remain silent, there is potential for them to lose the opportunity for being creative and innovative. Eventually, this will lead to employee dissatisfaction, unhappiness at the workplace which leads to stress, and anxiety (Vemuri, 2019). If employee silence is not recognized by administrators, there is high potential in losses in improving innovation and productivity improvements with current needs (Vemuri, 2019). Additionally, silent employees also influence negative attitudes and feelings at the workplace (Vemuri, 2019). In particular, recognizing the employees' creativity, innovation, and capability will make them feel more important to employers. Thus, the silence needs to be broken to promote production.

The outcomes of silence are identified as lost for most of the organizations. Silence is identified as loss of trust, social rejection, diminished power (Ashford et al., 1998; Morrison & Milliken, 2000), and feelings of isolation, anger, and resentment (Perlow & Williams, 2003). Therefore, the climate of an organization should be established in a positive environment. All the emotions related to forms of silence such as being defensive, willing, and connected to action tendencies to voice should be removed to progress. In essence, to be a productive organization there is a need for credibility and the use of informal relationships to gain information and cooperation from all employees. Evidence indicates that effective

management of silence will benefit to promote employees' welfare as they are the essentials of an organization who contribute as a contented workforce (Vemuri, 2019).

4. COMPUTER-MEDIATED-COMMUNICATION (CMC) IN ORGANIZATIONS: SALIENT THEORIES, CONCEPTS AND PAST STUDIES

Communication in organizations has become much easier with the fast-growing modern technology. Instant messaging (IM) such as WhatsApp and Telegram are now a common tool to communicate in organizations as it enables interaction to be instant and real-time, both for personal and group interactions. Some organizations do opt for more comprehensive platforms that incorporate multiple forms of information and communication technologies (ICTs) such as MS Teams, Slack, and Zoho. These platforms combine multiple applications including workplace chat, meetings, notes, and attachments. They allow employees to have spontaneous discussions on work-related tasks and to share documents and files in various formats. They ease interaction, deliver messages, complete tasks, and save time simultaneously. Moreover, it could be said that almost all organizations would have at least one WhatsApp group that functions to disseminate information or discuss work-related tasks and projects, which further strengthens the role of CMC in organizations. Past literature however exhibited both affirmative and dissentious findings from different perspectives. The following section discusses studies and concepts related to the area of CMC in organizations.

4.1 ICT succession theory

ICT succession theory is a theory proposed by Stephens (2007). This theory argues that in communication when messages are sent via two or more types of communication channels, it amplifies the efficiency and effectiveness of communication for certain types of tasks. The repetition of a task being sent via more than one channels, ideally should be more effective compared to the one sent to a single medium, where no repetition of the message is involved. Since ICT tends to embed auditory, visual, or textual features, Stephens claims that by combining these modalities at the maximum, "people can likely complete tasks more successfully" (p.496). Stephens' proposal, however, has long been recommended by Koehler et al. (1976) in the era where the development of ICT had not yet been as advanced as now. In the context of organizational communication, Koehler et al. (1976) suggest that "combination of oral and written (printed) media are more effective in achieving employee understanding than either oral or written messages alone" (p. 204).

A study that is underpinned by this theory is conducted by Pi et al. (2008). The investigation was done among 303 employees from 15 organizations in China. The study focused on four aspects of the use of IM which are (i) the factors influencing the IM usage behavior in organizations, (ii) their perception of IM capability, (iii) computer self-efficacy, and (iv) non-routineness of tasks. The results confirmed that IM could reduce costs but improve the efficiency of communication in companies. It seemed that the use of IM among the employees was influenced by their colleagues. Meanwhile, the employees believed that IM is "immediate, informative, and editability" because it provides all information needed about tasks assigned, and it has a user-friendly interface (Pi et al. 2008: 8). Finally, the use of IM also increases satisfaction communication among employees. The use of CMC in organizations is viable because of the combination of multiple interactive features of ICTs that could accommodate both formal and informal characteristics of face-to-face communication. IM for instance is mostly used for brief and unplanned communicative functions which facilitate the execution of work-related tasks, coordination of group activity, the transmission of office culture, and social functions such as team building (Rajendarn et al., 2019). Hence this reflects the principles embedded in ICT Succession Theory.

4.2 Media richness

Media richness (also known as rich media, or information richness theory) is a theory coined by Daft and Lengel (1986). This theory explains that the greater-bandwidth media can be more efficient in reducing equivocality in organizational decision making, by incorporating

multiple verbal and nonverbal cue systems. The theory is constructed on four subdimensions which are "(i) the number of cue systems supported by a medium, (ii) the immediacy of feedback provided by a medium, (iii) the potential for natural language (compared with the more formal genre of memoranda, business letters, or data printouts), and (4) message personalization (i.e., the degree to which a message can be made to address a specific individual)" (Walther 2011:448). In communication, face-to-face is ranked as the richest mode of communication since it is packed with multiple cue-systems, real-time exchanges between communicators, natural language, and personal messages. In contrast, there is a paucity of these elements in CMC, and the level of paucity increases in a written medium of communication such as letters and memos. The second principle is the equivocality of a message. This refers to the ambiguity level of information received by recipients and its openness for multiple interpretations. Thus, effective media should have a higher level of media richness to reduce equivocality.

This specific theory supports many studies that examined the interpersonal relationship and leadership styles in organizations. One of them is investigated by Aripin et al. (2011) whose respondents were 379 companies with MSC status in Malaysia. Quantitative data were collected via a survey and chat exchanges were obtained from five samples of IM chat from 5 different organizations, analyzed qualitatively employing conversational analysis. The study examined the frequency and purposes of IM use in these organizations. Results indicate that slightly more than a three-quarter of the respondents used IM for work purposes, which are giving instructions, obtaining information, maintaining relationships, and expressing feelings. The respondents used symbols and emoticons in their conversations to show their feelings and emotions. Due to this, the instructions sounded less obtrusive and authoritarian which indirectly affects how instructions are interpreted by staff. Other than that, the use of IM helps them to overcome distance, time, and geographical factors to communicate about requirements of job-related tasks and personal matters. This facilitates the development and maintenance of relationship among employees which significantly contribute to communication satisfaction among employees and with the management. The findings from this study encapsulate the salient principles advocated in media richness, whereby the multiple cue systems that resemble face-to-face communication included in CMC helps to maintain relationships, improve communication and promote a healthy working environment in organizations.

4.3 Social Information Processing Theory (SIP) in online silence

This subheading narrows down to a theory related to online silence, i.e. silent responses in organizations contextualized in CMC tools and platforms. In defining the online silence, Kalman (2007) describes online silence as "extensive and diverse", "can be intentional or unintentional; it can be psycholinguistic, interactive or socio-cultural; it can be arbitrary, contemplative, visual, and so on" (Kalman 2007, p.20). But in his research, he contextualizes silence as "..failure to communicate or reply", for examples, an unanswered e-mail message, a posting to an online forum/ discussion board, IM such as WhatsApp and Telegram, "which does not receive a response, or an unanswered instant message" (ibid. p21). It is common for online silence to be linked with latency which refers to messages or postings that are answered, but slow or delayed.

One of the concepts that explain silence and latency in CMC is Social Information Processing (SIP) theory. SIP is a theory that explains online interpersonal communication without nonverbal cues and how people develop and manage relationships in a computer-mediated environment. SIP argues the interpersonal relationship in the computer-mediated context needs more time to develop compared to a relationship formed in the traditional face-to-face environment. This is due to the missing nonverbal cues such as the body language and facial expressions, hence more text exchanges are needed for CMC users. This means the missing nonverbal cues may result in longer response times as users have to interpret the message and to be more cautious with their responses (Walther, 2011). This is important as it may affect how well an interpersonal relationship is developed.

The second element of SIP is the "temporal dimension" (Walther, 2011:459), whereby Walther exemplifies in the use of asynchronous media. It is the nature of CMC that enables a user to create a message at one time, while another user may choose to obtain it later. Hence, this could also contribute to what is seen as silence and latency in online communication. In another perspective, a research conducted by Westerman et al. (2008) confirms that delays could also be due to different media bandwidth, and the types of format. Meaning, lesser bandwidth media will send less information per exchange, and some formats of media are transmitted faster while others are slower. For instance, photos or videos are transmitted in a respective time interval compared to information sent in IM exchanges (Walther, 2011). Finally, scholars warn that interpreting silence should be done cautiously since it is complex and highly context-dependent (Kalman, 2007). Moreover, not being able to interpret online silence could cause uncertainty and problems at the workplace, affect teamwork and performance (Cramton, 2001).

This section reviews several pertinent theories and concepts in the area of CMC. As the proposed research will be focusing on silence at the workplace, hence the discussion on the theories and concepts is narrowed down to silence in CMC at workplaces.

5. THE PROPOSED STUDY

The future study aims to explore and understand the reasons why employees in a government institution do not respond to the top management staff when questions or messages are posted in MS Teams channels. The study will employ a qualitative research method to fulfill and achieve the aim of the study. To understand the phenomenon, chats and post exchanges in WhatsApp groups and MS Teams channels will be gathered and analyzed using conversation analysis (Sacks et al., 1970) framework. Meanwhile, to explore an in-depth understanding of the respondents' views and feelings concerning the reasons or causes of their silence, interviews will be employed. The data will be analyzed thematically using Saldana (2009) thematic framework. The concepts and theories discussed in the earlier sections will be the foundation of the research, and it will also guide the interview questions that will be asked to the respondents, as well as the emerging themes from both discourse texts and interview data.

6. CONCLUSION

Silence in organizations is a critical issue that should be taken seriously by employers. This is because organizational targets and achievements can only be attained via effective communication. Therefore, employers need to identify the reasons that caused silence among their employees. From employees' perspectives, clear instruction, detailed description of tasks, well-defined missions, and visions from the top management are essential as these will affect their understanding and interpretations that will result in their attitude, emotion, actions, and performance. While organizations nowadays keep abreast with the advancement of ICT, CMC tools and platforms seem to be a more pragmatic alternative. Yet silence remains despite different mediums are employed. It is a part of employers' responsibility to look into issues concerning the workers' silence. Thus future research anticipates identifying the causes and effects of organizational silence, provide recommendations, and adding to the literature in the area.

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DEVELOPMENT A WARNING SYSTEM FOR UNATTENDED CHILD IN A PARKED VEHICLE

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Abstract. Safety features always as an important thing to be built in a vehicle. Many features have been invented and built, but there are still have incidents like a child which been left in a parked vehicle. The development of the project is to prevent deaths of children due to heatstroke when accidently left in parked vehicle. The development a warning system is design to acknowledge or trigger the driver and people surrounding the vehicle. This system is designed to detect load and any caused by the children that had been left in a vehicle. This system also will allow the windows to be automatically rolled down when both load sensor and motion sensor trigger. By using Global System for Mobile Communication (GSM) modem as a medium to interact and communicate with the module, a Short Messaging System (SMS) have been sent to the driver as a notification to take actions for the child safety.

Keywords: parked vehicle, unattended child, heatstroke

1. INTRODUCTION

Nowadays, there are still the incidents that involve to death of children which been left in cars by their parents. The affected from this mistake is most of them are involved in fatal incidents because of shortage of oxygen or the intense surrounding's temperature or heatstroke.

By refers to American Academy of Pediatrics (AAP), heatstroke is also known as hyperthermia (Pediatrics, 2015). The hyperthermia will cause a child's body heats up three to five times faster than an adult. A child's major organs will begin to shut down when left in a hot car while his or her body temperature reaches 104 degrees Fahrenheit (F). All of this happened because of drivers careless to make sure nobody passenger or occupant left inside before or after the vehicle have been park. Sometimes, it occurs when the driver always forgets and think that they are ride alone without bringing children together.

On the latest vehicles, there is no longer a system capable of detecting passengers left in the vehicle. This causes passengers, especially children, to be at risk for heatstroke if left for a long time. Some safety features need to be built to prevent the mistake and avoid any unwanted incidents to be occurred. The vehicle must be equipped or provided with sensors and complete system to warn the owner or surround people if there were any occupant left when the driver parked and left the vehicle. Hence, a notification like Short Messaging System (SMS) must be send to the driver as an alert message to inform the driver for occupant left in the vehicle. It will be access by using long range phone communication such as Global System for Mobile Communication (GSM). Besides the information sent to the driver, others safety system was installed like automatic windows roll down and warning sound for the other people in the surrounding of the vehicle. It will help either the driver or other people more alert if there are unattended child in a parked vehicle and can avoid any unwanted problem occurred.

2. LITERATURE REVIEW

Most problems of the heatstroke risks involved due to vehicle heating dynamics. Base on a case study, temperature inside of vehicles can quickly reached to 134 to 154 degree from 86-degree Fahrenheit when the vehicle parked at the open space. For the first 10 minutes, average temperature inside a vehicle increases 19 degrees. This quick increases of temperature inside the vehicle will affect or become fatal for the children. So, for the parked vehicle at 90 degrees in 10 minutes, temperature inside of vehicle can become fatal for the children (National Security Council, 2008).

Refer to Figure 1 and Figure 2, the directly exposure of window's car to the sun will heat the air in the vehicle adjacently by conduction and convection. This situation will increase the air caught in the vehicle hence will rise the temperature rapidly (Clarksville, 2011). Since the bodies of babies warm at quicker rate than grown – ups, it cannot decrease the warming rate of the vehicle's internal air even the windows are partially closed (Luethi et al., 2009).



Figure 1: Temperature's reading for a tight and closed vehicle elapsed in 10 minutes



Figure 2: Temperature's reading for a tight and closed vehicle elapsed in 20 minutes.

The increases of inside temperature are based on the outside temperature and the differentiate medium of heat transfer to internal cabin of vehicle. There are several factors of medium which is ambient temperature, partially open window, cracked window and fully closed window. The increase level of interior vehicle temperature will be reflected due to the different level of the heat transfer access from the outside. Figure 4 shows minor difference of trend to faster heating between closed windows and crack opened windows. In 20 minutes, the heats rise with 6.25°F per 5 minutes for closed windows while the temperature increase 5.5°F per minutes with the windows cracked open. When ambient temperature spanning 72 to 96°F, internal vehicle temperatures will increase approximate 40°F that will risk the safety of child (McLaren et al., 2005).

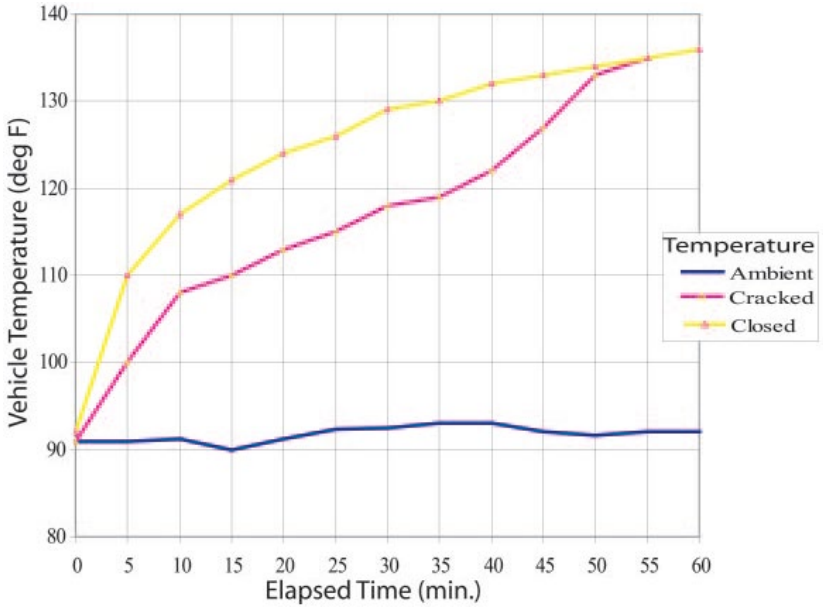


Figure 4: Interior vehicle temperature over time

In a previous research, the presence of a child was design by using the presence sensor while the range distance between child's seat and wireless receiver was determine by using proximity sensor. When the child still on the car seat, proximity sensor will determine distance either still in range or not and wireless receiver will trigger to produce an alarm to notify parents or driver as shown in Figure 5. For safety temperature, a thermoelectric and temperature control unit was added in the design to reduce the risk of heatstroke among the child (Owens, 2011).

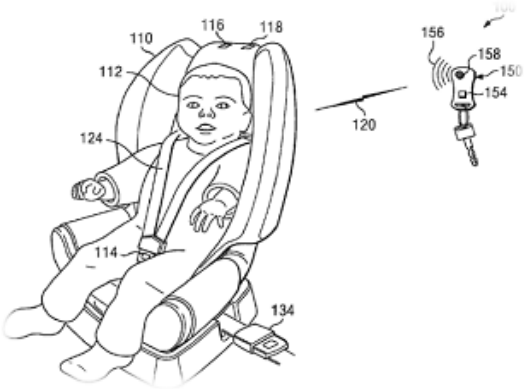


Figure 5: Layout of child safety seat system equipped with sensor and notification setting proposed by Owens (2011)

Table 1: Details of numbering in Figure 5

No.	Details	No.	Details
110	child safety seat	124	a restraint
112	a child	134	seat belt of vehicle
114	presence sensor	150	wireless receiver
116	proximity sensor	154	proximity sensor
118	a transmitter	156	an alert
120	wireless signal	158	a speaker

For a previous research, sensors used to detect any types of voice or movement and will be sent to their parent. The motion sensor will be trigger when there are any movement inside the vehicle and the microprocessor will create an alert message to the GSM module to be sent as an SMS text message to the driver as shown in Figure 6. This system uses several parameters such as the vehicle's door have been locked, the automatic transmission gear is set to 'P' position or the engine ignition is off (Hashim et al., 2014).

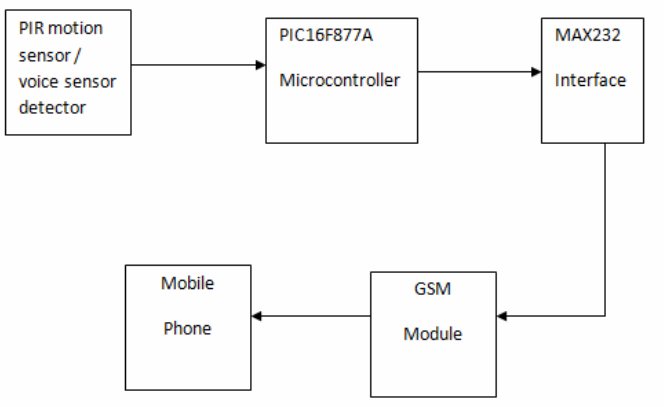


Figure 6: Block diagram of a flow to send an alert message to the driver (Hashim et al. 2014)

3. RESEARCH METHODOLOGY

The development a warning system for unattended child in a parked vehicle is begins with the study of the parameters to be established to achieve the objective of the project. The studies are based on load sensor for baby weight, position or movement of baby in the vehicle and ability to trigger and make a movement for power windows system. The other criteria need to be measure is material selection because it will be related to the existing vehicle components for assemble process.

Figure 7 shows the flow chart of the development to build a warning system for the driver and surrounding peoples. To implement the system to the vehicle, a related circuit from various sensors need to be design. To make the circuit, the function of each component needs to be identified before construct and combined all together to make it as one system to the vehicle.

This project uses various sensors and actuators to send a warning message to the parent or driver. This alert system by using controller for current technology which is Arduino and the system will start activating when a driver switches off the engine. Power supply source still used main battery supply from the vehicle.

Refer to block diagram in Figure 8, Arduino is the main controller for the whole system. Arduino Uno ATmega was used in this development to increase rate of data transfer and to store more memory. The Arduino will start to monitor the motion sensor and load sensor to been trigger. The load cell is placed under the passenger seat as a detector for weight of the baby that has been left inside the vehicle. It will convert the load into electronic signal and send the data to Arduino.

For motion detection, the propose ideas is to use pyroelectric sensor which will develop energy when expose to the heat. It will detect any movement produce by the human by levels of infrared radiation. Everything emits some low-level radiation, and the hotter something is, the more radiation is emitted.

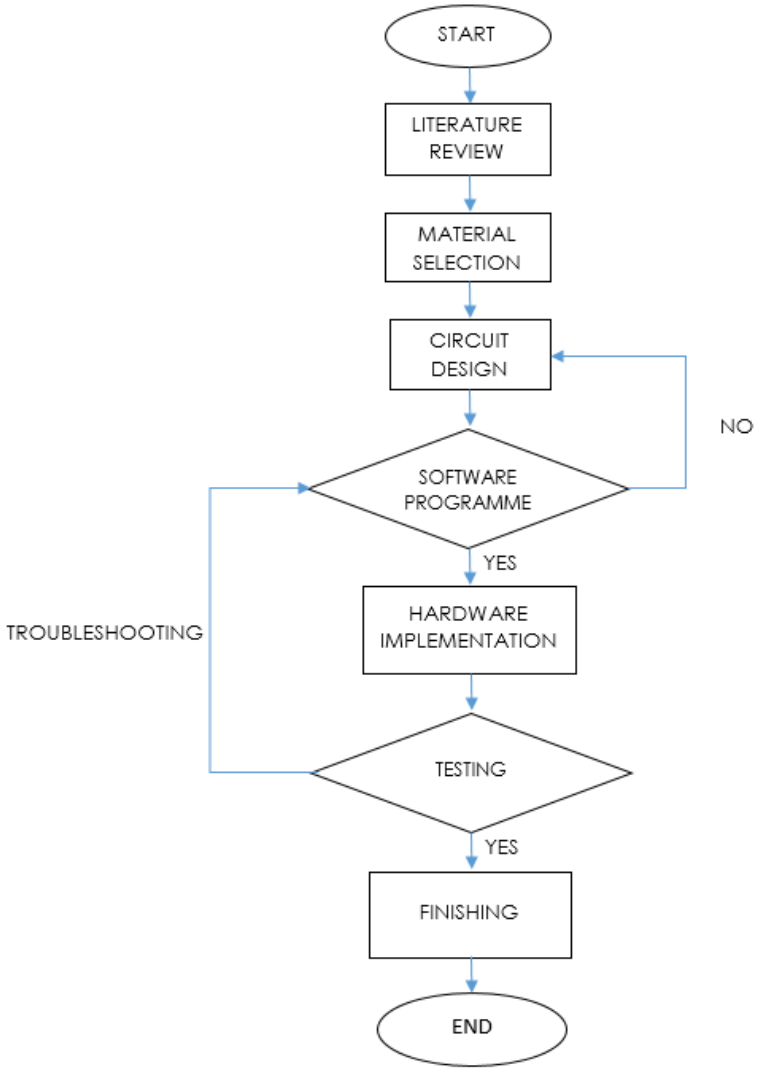


Figure 7: Flowchart of the development

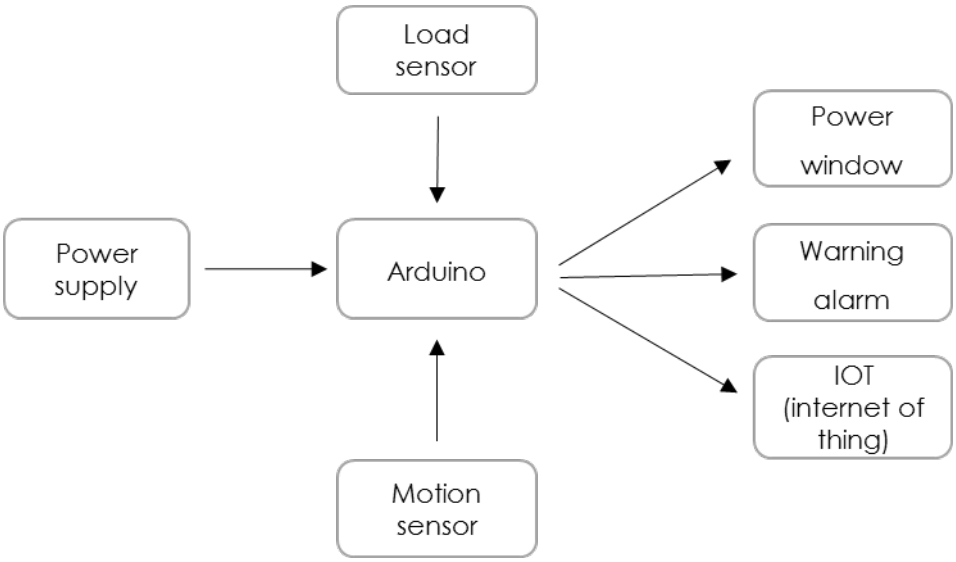


Figure 8: Block diagram for warning system for unattended child in a parked vehicle

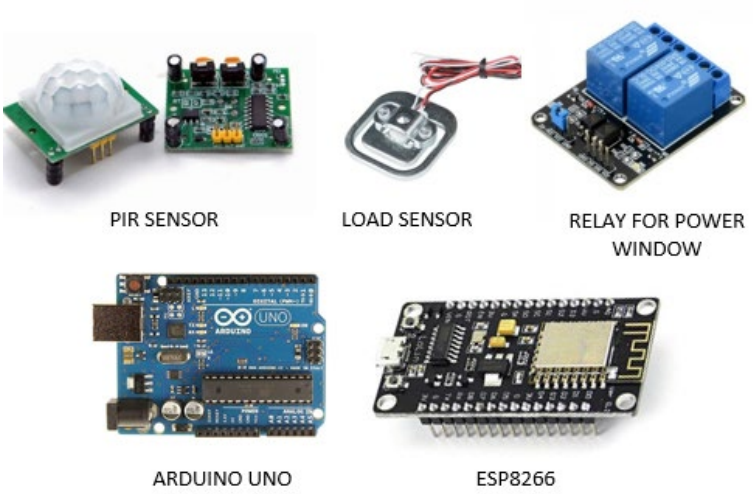


Figure 9: Components use for development of warning and safety systems

In development process, all components in Figure 9 are relate together to achieve and combine as one system to be actuate to power windows system, warning alarm and notification to the driver.

This development a warning system for unattended child in a parked vehicle is proposed to be used for parent which always not properly monitor the vehicle or in a hurry when left the vehicle. Load sensor was used and put inside the passenger seat when the child always been left unattended. Another sensor used is PIR motion which is locate under the roof of the vehicle.

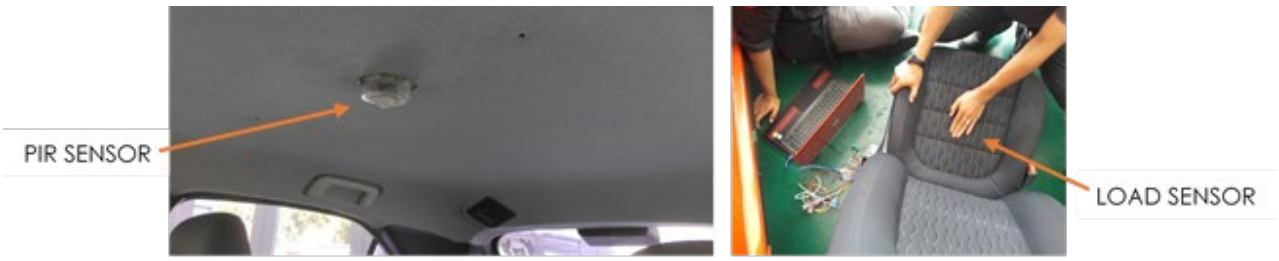


Figure 10: Position of sensors in the development warning system

4. RESULTS AND DISCUSSIONS

Achievement of the development in hardware and software are identified as a result for objective and suitability for real application.

4.1 Hardware

Both load sensor and PIR motion sensor will be trigger when there is child with minimum weight 3 kilograms (kg) has been left in the vehicle or any movement made by child in the vehicle. The system only start been trigger while the engine was turn off. The system controlled by connected with Arduino Uno as controller to send output when the sensor was triggered.

Buzzer and power window have been used as actuators in the system. Sound of buzzer will actuate when load sensor has been triggered. In addition, power windows will automatically down by 3cm when both sensors were trigger before a notification has been sent to the driver. The results in detail based on the parameters that have been set can be referred in Table 2.

4.2 Software

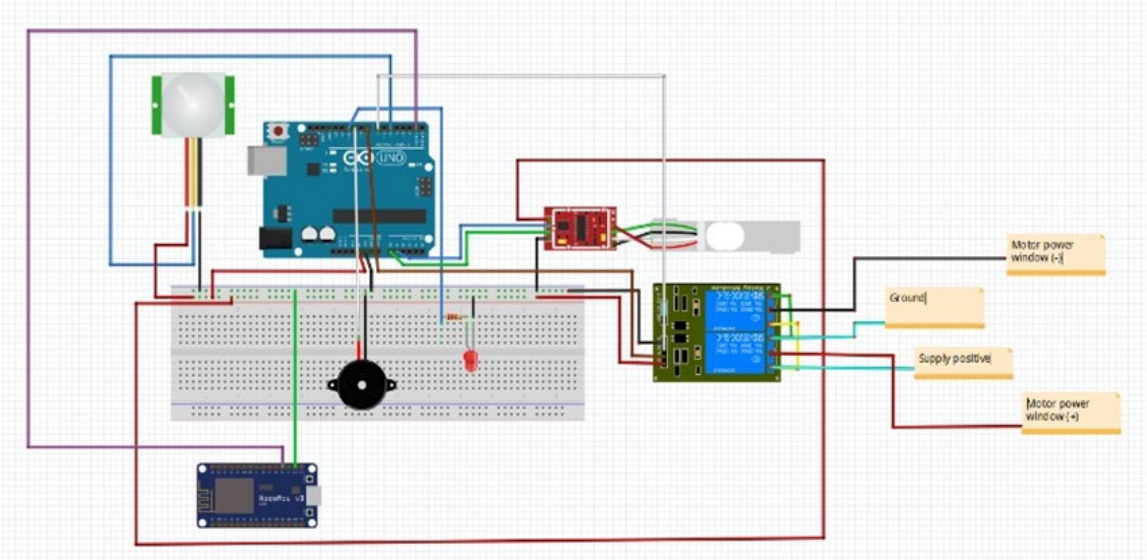


Figure 11: Circuit diagram for warning system for unattended child in a parked vehicle

For software application, Arduino software and programming were used to read data from the sensors before actuators are triggered. The system is included with internet of thing (IoT) programming by using wifi modules esp8266 components on Arduino board.

The whole warning system will active when the driver switches off the engine. After both motion sensor and load sensor triggered, the input will be sent to Arduino controller. It will activate power windows system to automatically down by 3cm and alert the driver or people surrounding by the sound of buzzer. At the same time, output from Arduino also will integrate with internet of thing (IoT) code. This Wi-Fi module will read and send notifications in the form of email and Blynk application to mobile phones.

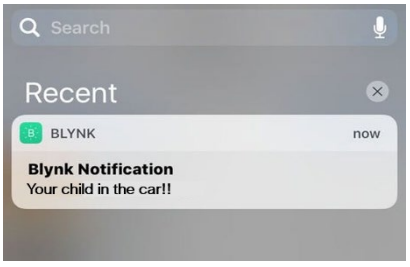


Figure 12: Example notification received by using wi-fi module in the vehicle

The notification will help the driver to alert if the children was left in the car as soon as possible when the sensors were triggered.

Table 2: Findings for sensors triggered in the system

Load Sensor	Motion Sensor	Findings
Load 2 kg	Without motion	No action because the load has not reached the minimum level set
Load 2 kg	With motion	No action because the load has not reached the minimum level set

Load 4 kg	Without motion	The buzzer sounded as the driver started to leave the vehicle
Load 4 kg	With motion	The buzzer sounded as the driver started to leave the vehicle and power windows automatically down for 3cm. A notification is also sent to the driver's phone as a reminder

Based on the findings, power windows automatically down when both load sensor and motion sensors trigger. This will help heat transfer process between inside and outside vehicle. The increase level of interior vehicle temperature will be reflected due to the different level of the heat transfer access from the outside. So, the reducing inside cabin temperature will reduce heatstroke risks involved (National Security Council, 2008).

5. CONCLUSION

In this project, the aim is to develop and test the system that will detect unattended child in the vehicle and will notify the driver or surrounding people for the safety of the child. This notification will help prevent the driver from leaving the child in the car for a long time.

Based on the project development, the system has successfully used inputs or sensors that can detect the presence of children left unattended in the vehicle. In the early stages, warnings were given through a buzzer when a child's weight was detected through a weight sensor. Once the child is active in the environment, an email notification or Blink application is sent to the driver and the power window is automatically down. The internet of thing (IoT) system with the use of Wi-Fi module adds more security features in the system even if the driver is far from the vehicle.

The results may facilitate improvement from the previous design, but still need to be continued in research with concomitant changes in time with the developer and equipped with a latest technology. The aim of the system is to overcome the case of accidents involving children left unattended in the vehicle. Hopefully, parent will be more responsible for their children's safety. This system development will help to reduce the forgetful parents to leave the child in the vehicle.

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STATIC ANALYSIS OF MOTORCYCLE SWING ARM USING THE FINITE ELEMENT METHOD

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Abstract. A swing arm is the main component of the rear suspension of most modern motorcycles. It is used to link the rear wheel and the frame while providing a place to attach the suspension. This study aims to determine the deformation and stress distribution area at the rear fork. In this paper, a Honda Wave 125 swing arm is being studied. The finite element method software is used to study the static analysis. A swing arm made from carbon steel AISI 1010 will be modelled in a Solid Works and analysis will be carried by using MSC Nastran software. The results of the analysis conclude that the swing arm has good characteristics. It shows the maximum deformation is 0.193 mm and maximum stress is 56.68 MPa. In this case Von-Mises stress obtained is below the yield strength of the material.

Keywords: swing arm, finite element, deformation, Von-Mises stress

1.0 INTRODUCTION

A motorcycle suspension system absorbs the road bumps and giving the comfort of riders by absorbing the vibrations. It also provides good handling and contributes to the braking. The motorcycle suspension components consist of fork tubes on the front and a swing arm at the rear. The swing arm is the main component of the rear suspension system. It forms a crucial element in the working of a motorcycle since it is responsible for connecting the rear wheel assembly to the motorcycle frame. The swing arm also help to manage the load distribution and adjust the center of gravity of motorcycle.

There are two basic designs of swing arm which are single sided and double-sided swing arm. Double sided swing arm is the commonly used due to its simplicity and symmetric design. In this design, the absorber is connected to the frame and H-shaped swing arm itself. The single sided swing arm is a newer version. The function and design is similar to the double sided except that one side has been remove so a tire can easily change and service. This type mostly used for track or racing motorcycles.

Finite Element Method simulation is used to determine the ability of the swing arm in accepting the loads by the results of the stress and maximum changes of structure. The forces acting on motorcycle will be taken by the swing arm such as weight of motorcycle, rider weight, vibrations, cornering force and impact loads at bumps. It is important to determine the swing arm stiffness characteristics. In this study, the motorcycle Honda Wave 125 swing arm is being studied to analysis of static characteristics.

1.1 Objectives

This project aim to analyse of motorcycle swing arm using the finite element method (FEM). The main objectives of this project are as follow:

a) Perform static analysis deformation plot in MSC Nastran.
b) Perform static analysis to find Von-Mises stress.

2.0 LITERATURE REVIEW

Smith B. and Kienhofer F. (2015) discussed that the stiffness of the swing arm plays a vital role in the responsiveness and stability of the motorcycle. It is important to determine the characteristics of the swing arm, which will allow the designer to understand how the motorcycle responds.

Powar A. et.al (2016) describes the optimization of the swing arm of a motorcycle. The modification process is based on material, topology modification and validation using finite element analysis. The results obtained are compared with the evaluation results of the original components. The purpose of the experiment is to reduce the mass of components without affecting other related factors.

Jagwinder S. and Siddhartha S. (2015) studied a static structural analysis to find out the stress, deformation and safety factor of the components. The model analyzed using the finite element analysis techniques by applying loads and boundary conditions. The optimization approach is carried out to increase the structural strength of the component.

Syed H. A et.al (2018) utilized the shape optimization technique to further optimize a current MotoGP swing arm. The optimization is based on multi-axis load analysis of the CAD model of the swing arm. It has been observed that a 15% reduction in total weight is achieved without compromising safety factors. Sariman F. et.al (2019) says that the carbon steel swing arm has good characteristics. This study aims to determine the static conditions of the motorcycle swing arm. By using finite element method, static analysis was simulated to get the value of stress and displacement.

3.0 METHODOLOGY

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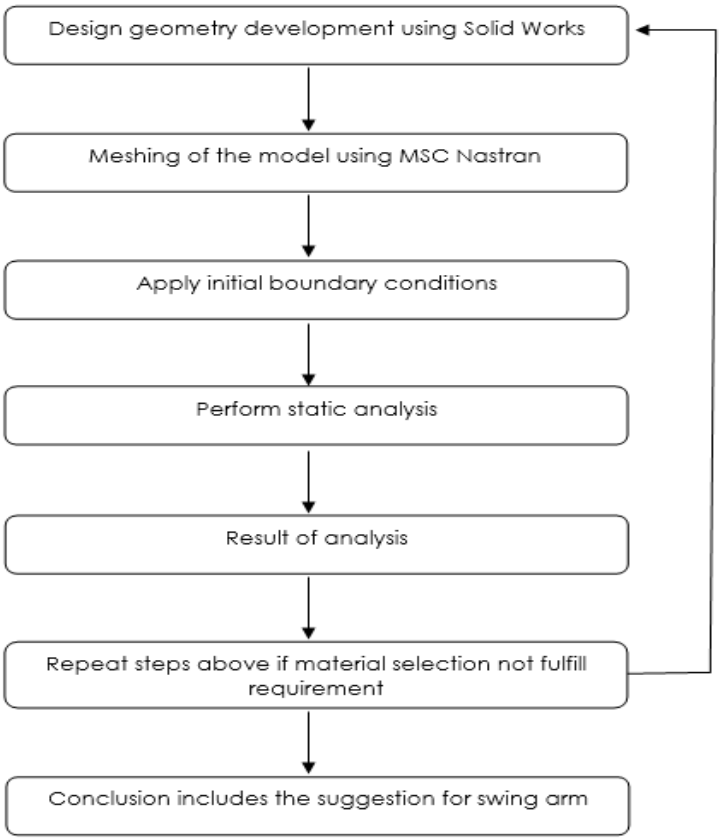


Figure 1: Methodology of project

This research was carried out to measure the stress and deformation of motorcycle swing arm by applying loads and boundary conditions. All the dimensions are measured and recorded on the drawing

Figure 1 shows the methodology of the project start from the development of the 3D model until performing the static analysis to find out the deformation and Von-Mises stress. Then the result will compare to the properties of material selection to analyse the characteristic of the swing arm.

3.1 Modelling
Figure 2 and figure 3 are show dimension and modelling of the swing arm and its component are carried out by using Solid Works software.

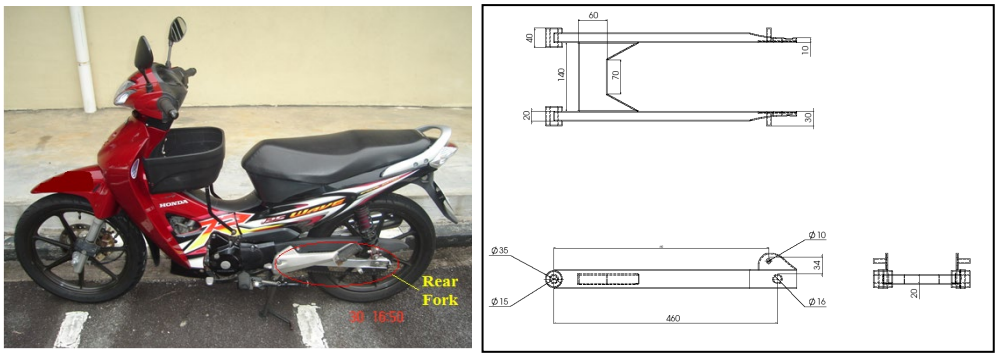


Figure 2: Honda Wave 125 swing arm (left) and dimension model (right)

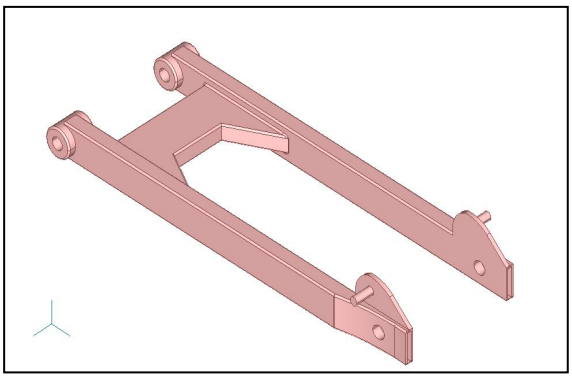


Figure 3: 3D model of swing arm

3.2 Boundary conditions
The boundary conditions set for swing arm are:

a) A swing arm model are set for stress and deformation.
b) Constrain is applied at the end of the rear fork.
c) The input force applied is 1667.7 N (170kg)

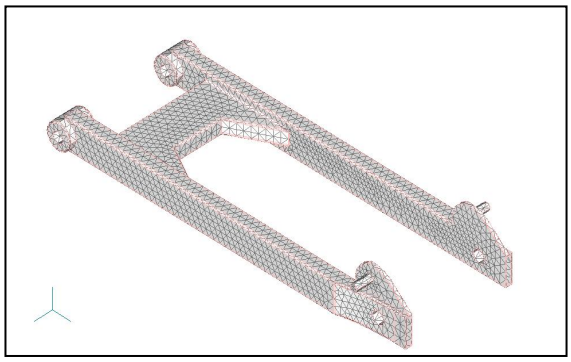


Figure 4: Meshed model

3.3 Material selection

There are variety of materials in this world and each material will have different grades. The materials chosen for the swing arm is carbon steel AISI 1010. The material properties are summarized below in Table 1.

Table 1: Material properties for swing arm

No	Property	AISI 1010 Steel
1	Tensile strength (MPa)	365
2	Yield Strength (MPa)	305
3	Elastic modulus (GPa)	210
4	Poisson's ratio	0.3
5	Density (×1000 kg/m3)	7.7 - 8.03

4.0 RESULTS AND DISCUSSION

The results obtained will be discussed in this chapter. The load applied to the swing arm is 1667.7 N (170 kg). Each of rider and passenger carry 80kg and the loads is 10kg. The results are showing in different directions (x, y and z axis). Regarding the results, the maximum deformation which occurs at the rear fork is represented by the red color and the purple color represents the minimum deformation. The results of deformation and Von-Mises stress are shown in figure below

4.1 Deformation analysis

The deformation analysis shows that the swing arm will deflect from its original position when the force applied at the end of the rear fork.

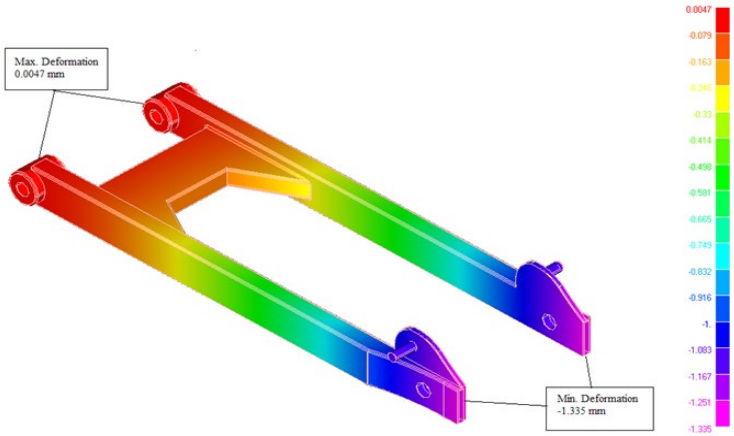


Figure 5: Maximum deformation at X-direction (0.0047 mm)

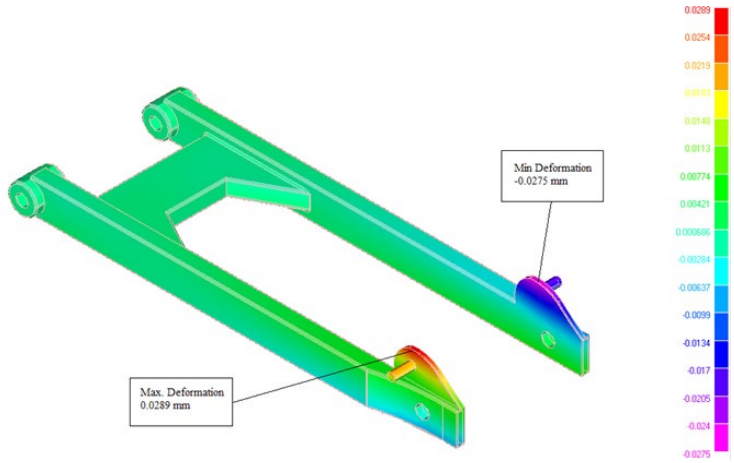


Figure 6: Maximum deformation at Y-direction (0.0289 mm)

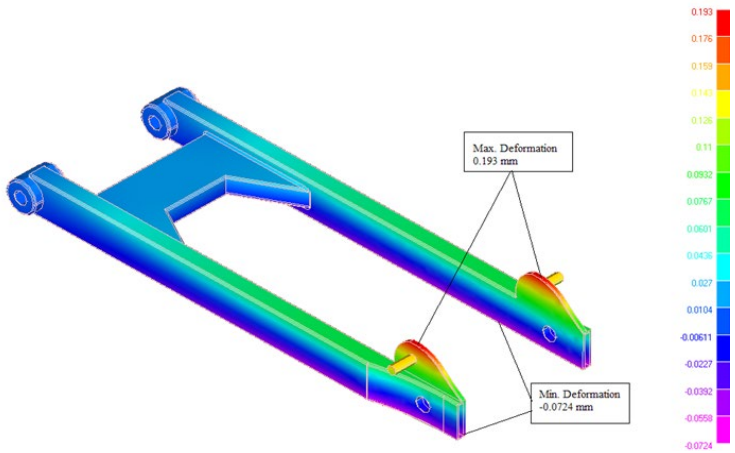


Figure 7: Maximum deformation at Z-direction (0.193 mm)

4.2 Von-Mises stress analysis

The result of stress analysis will be shows the condition of material with some data as the input. The material will begin to melt when the Von-Mises stress is reached the yield strength.

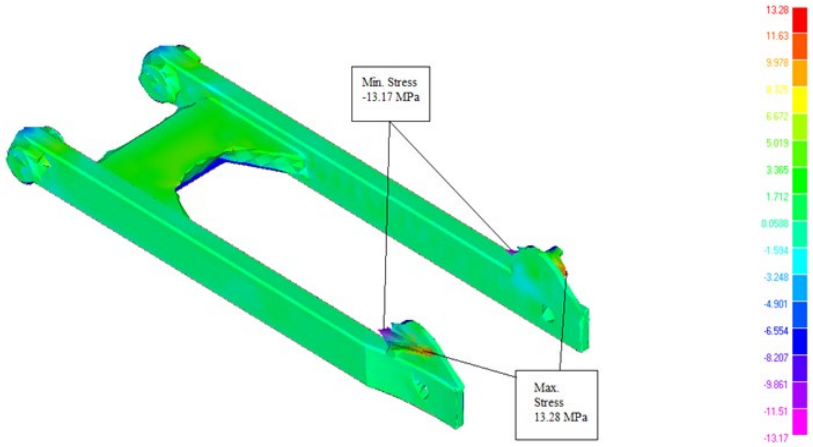


Figure 8: Maximum stress at X-direction (13.28 MPa)

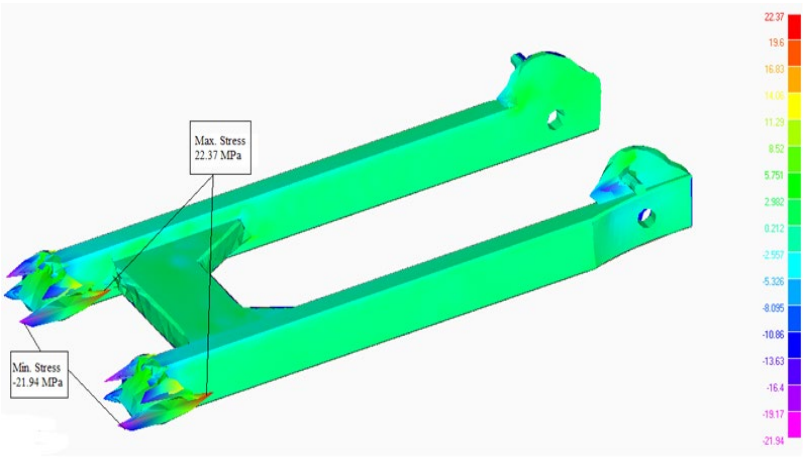


Figure 9: Maximum stress at Y-direction (22.37 MPa)

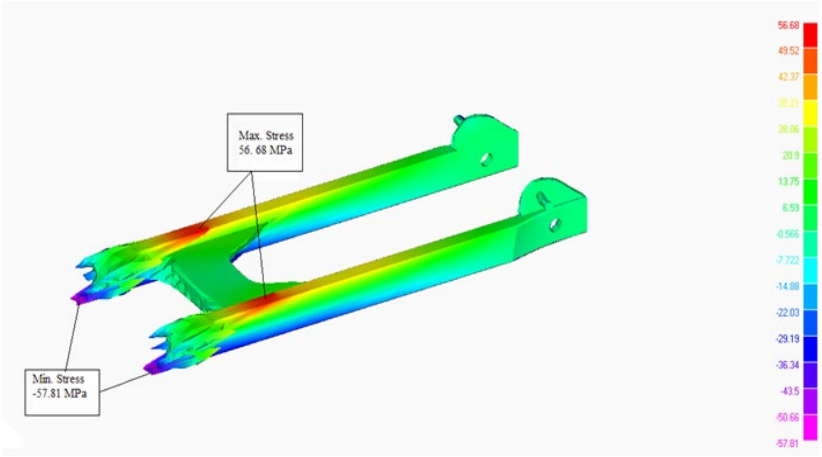


Figure 10: Maximum stress at Z-direction (56.68 MPa)

The deformation should be within the limits and the maximum deformation obtained in this analysis is 0.193 mm. It shows that AISI 1010 carbon steel has good formability and ductility.

Then, the maximum value of stress obtained is 56.68 MPa. Failure of structural design often occurs when a structural material experiences a value larger than its yield strength. The Von-Mises stress obtained is below the yield strength of the material AISI 1010 carbon steel which is 305 MPa. Thus, the swing arm is safe and has good characteristics in static conditions. The summary of the results of maximum deformation and maximum stress are shown in table 2.

Table 2: Static analysis for the swing arm

No	Direction	Max. deformation (mm)	Max. stress (MPa)
1	X- axis	0.0047	13.28
2	Y-axis	0.0289	22.37
3	Z-axis	0.1930	56.68

5.0 CONCLUSION

From the above discussion, it can concluded that carbon steel AISI 1010 is suitable material for motorcycle swing arm. Based on simulation result, the maximum deformation and Von-Mises stress are 0.193 mm and 56.68 MPa respectively when the force of 1667.7 N is applied at the end of the rear fork. The stress obtained is below the limits. It is clear that the swing arm has good performance in actual working condition. Further study may be needed to investigate other suitable materials for motorcycle swing arm.

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TRANSFORMASI INSINERATOR KEPADA PELUPUSAN SISA ORGANIK TANPA PEMBAKARAN

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Abstrak. Sisa organik di Malaysia mempunyai kandungan lembapan yang tinggi dan sukar untuk dibakar. Masalah sisa domestik yang lembap agak sukar dibakar dan mengeluarkan asap yang banyak. Permasalahan tersebut merupakan salah satu punca kepada kegagalan insinerator sedia ada di Malaysia. Justeru kajian pelupusan sisa organik tanpa proses pembakaran dicadangkan. Mesin pelupusan sisa dibangunkan dengan tiga fungsi utama iaitu; penapisan, pengisaran dan pengeringan. Kajian dijalankan terhadap sampel tiga sisa kulit buah-buahan dengan pemboleh ubah jisim sebelum dan selepas pengeringan serta masa pengisaran. Model pelupusan sisa yang diterbitkan adalah polinomial dan kuadratik menggunakan *Curve Fitting Toolbox* (CFT) didapati memuaskan di mana nilai R^2 dan *adjusted* R^2 menghampiri 1 manakala *Root Mean Squared Error* (RMSE) menghampiri sifar.

Kata Kunci: Insinerator, Pelupusan Sisa, Sisa Organik, Pengeringan

1. PENGENALAN

Masalah pengurusan sisa sampah di Malaysia semakin hari semakin rumit. Menurut laporan akhbar Berita Nasional (Shahrul Annuar, 2019) rakyat Malaysia menghasilkan kira-kira 37,890 tan sisa setiap hari dengan anggaran setiap individu menjana sekurang-kurangnya 1.17 kilogram(kg). Ini melibatkan kos yang sangat tinggi bagi pelupusan sampah secara berkelompok oleh SWCorp yang mencecah RM2 billion per tahun atau 5.6 juta per hari. Selain itu kesan terhadap alam sekitar juga amat membimbangkan. Ini kerana tapak sanitari yang digunakan untuk melupus dan merawat sampah mempunyai jangka hayat 20-25 tahun bergantung kepada keluasannya dan ia juga tidak boleh digunakan sekurang-kurangnya dalam tempoh 20 tahun. Justeru impak pengurusan sedia ada sampah yang sangat besar, pengurusan sampah perlu dipertanggungjawabkan secara individu dan penerapan nilai murni tersebut perlu dilaksanakan seawal yang mungkin. Di samping amalan cara pembuangan, pelupusan dan perawatan diuruskan dengan betul dan dipraktiskan, suatu alternatif lain perlu dikaji bagi menangani perkara ini daripada aspek teknologi kejuruteraan.

Insinerator adalah satu sistem yang melibatkan pembakaran sisa buangan pepejal. Terdapat beberapa proses utama iaitu pembuangan sisa, pembakaran bahan buangan dalam suatu tempat khas, proses sisa menjadi abu, proses pelepasan gas dan haba yang terhasil. Pembakaran sisa dalam insinerator melibatkan proses teknologi aplikasi tenaga seperti pengegasan, pirolisis dan pencernaan anaerob. Walaupun teknologi pembakaran dan gasifikasi adalah sama pada prinsipnya, tenaga yang dihasilkan daripada pembakaran bersuhu tinggi manakala gas mudah terbakar sering merupakan produk tenaga utama hasil daripada proses pengegasan. Pembakaran dan gasifikasi juga boleh dilaksanakan tanpa pemulihan tenaga dan bahan.

Insinerator mempunyai manfaat yang sangat baik untuk rawatan jenis sisa tertentu dalam bidang khusus seperti sisa klinikal dan sisa berbahaya tertentu di mana patogen dan toksin dapat dimusnahkan oleh suhu tinggi. Contohnya tumbuhan yang mengandungi kimia

dengan aliran toksik beracun atau sangat toksik, tidak boleh disalirkankan ke loji rawatan air sisa konvensional.

Pembakaran sisa amat popular di negara-negara seperti Jepun, Singapura dan Belanda, di mana tanah adalah sumber yang terhad. Denmark dan Sweden telah menjadi pemimpin dengan menggunakan tenaga yang dihasilkan daripada pembakaran selama lebih dari satu abad, dalam gabungan haba dan kemudahan kuasa yang disokong oleh skim pemanasan daerah. Pada tahun 2005, pembakaran sampah menghasilkan 4.8% daripada penggunaan elektrik dan 13.7% daripada jumlah penggunaan haba domestik di Denmark. Beberapa negara Eropah yang lain banyak bergantung kepada pembakaran secara insinerator untuk pengendalian sisa perbandaran, khususnya Luxembourg, Belanda, Jerman dan Perancis.

Walau bagaimanapun insinerator sedia ada adalah berskala besar dan menguruskan pelupusan sisa secara berpusat menimbulkan isu hangat berkaitan pelepasan gas dan kesesuaian sisa di Malaysia. Justeru penyelesaian terkini adalah cadangan projek mesin sisa mikro. Salah satu proses mesin sisa mikro ialah proses pengisaran dan pengeringan di mana terdapat persoalan kajian berkaitan tempoh proses ini dan pengeringan sisa dapat dihasilkan. Artikel ini memfokuskan sisa kulit buah-buahan sebagai pra ujian bagi menentukan berat sisa sebelum dan selepas pengisaran serta masa pengeringan sisa.

2. SOROTAN KAJIAN

Terdapat beberapa jenis insinerator iaitu *Co-incineration, Fluidized-Bed Incineration, Multiple-hearth, Rotary Kiln, Single Chamber/Liquid Injection, Multiple Chamber dan Starved-Air Combustion or Pyrolysis*. Kajian oleh Rahman et al. (2007) menyatakan perbezaan jenis-jenis insinerator ialah daripada aspek reka bentuk, pengambilan udara, pengumpalan sisa, mekanisme pembakaran dan keupayaan insinerator. Walaupun insinerator merupakan pilihan terbaik sebagai agen pelupusan sisa, ia tidak boleh diterima secara universal. Kelemahannya ialah kos permulaan yang tinggi untuk pembinaan insinerator yang besar. Faktor penyumbang lain yang memerlukannya kemahiran dalam urusan bahan bakar dan suhu operasi bagi mengekalkan pembakaran. Jenis pelupusan sisa ialah kitar semula, pengkomposan, insinerator, tapak pelupusan sanitari dan tapak pelupusan biasa.

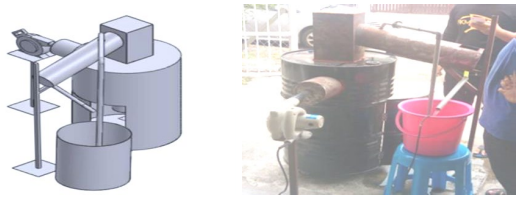
Kajian prestasi insinerator bermula pada tahun 2007 di UiTM Shah Alam. Kajian tersebut dilaporkan oleh Sharifah et al. (2008) yang menunjukkan insinerator kilasan berputar (RKI) sesuai dengan sisa daripada aspek kecekapan pembakaran iaitu suhu dan kandungan kepekatan kimia yang dihasilkan. Pengukuran ciri-ciri pembakaran, ramalan aliran udara di dalam insinerator semasa proses itu juga disiasat. Pengkaji Abd Rahman (2013) melaporkan dalam kajian beliau terdapat lima insinerator dengan kapasiti kurang daripada 100 tan setiap satu di Pulau Langkawi (100 tan / hari), Pulau Tioman (10 tan / hari), Pulau Pangkor (20 tan/hari), Cameron Highlands (40 tan/hari) dan Labuan (60 tan/hari). Penyelidik juga mendedahkan insinerator yang dicadangkan di Broga Selangor ditutup atas arahan mahkamah apabila mendapat bantahan penduduk dua bandar kerana isu pencemaran udara dan bahan kimia.

Program kitar semula dan pengurangan sisa sampah telah dilaksanakan kerajaan dengan menetapkan sasaran untuk mencapai kadar kitar semula 22% pada tahun 2020. Penetapan sasaran dibuat dengan meningkatkan kadar kitar semula sebanyak 1% setiap tahun. Walau bagaimanapun, hasil kajian oleh Abd Jalil et al. (2015) melaporkan sasaran amat sukar untuk dicapai susulan pencapaian kadar kitar semula di Malaysia hanya pada tahap 5 hingga 6% pada masa tersebut. Berbanding pencapaian negara maju lain seperti Jerman 60%, Belgium 71%, Austria 67% dan Belanda 66%. Malaysia berada di tahap yang sangat rendah. Salah satu sebab kadar kitar semula yang rendah adalah kerana kekurangan respon dan penyertaan daripada orang awam.

Suatu kajian kes insinerator di Pulau Pangkor oleh pengkaji Ibrahim et al. (2016) mendapati operasii insinerator dihentikan kerana isu rekabentuknya yang dikatakan tidak dapat mengawal jumlah pengeluaran asap mengikut kadar yang ditetapkan. Dalam tempoh itu, sisa pepejal terpaksa dilupuskan di tapak pelupusan sisa pepejal sedia ada. Walau bagaimanapun, tapak pelupusan tersebut pula terbakar pada bulan Februari 2015 dan tidak dibenar untuk digunakan lagi. Oleh itu, sisa yang diangkut telah ditimbunkan di kawasan loji insinerator tersebut. Kesan alam sekitar pada masa itu dikatakan sangat tidak terurus dan pemandangannya tercemar.

Sampah yang dijana menyebabkan bahaya kepada manusia dan alam sekitar jika tidak diuruskan dengan efisien (Omoregie & Odibi, 2017). Sumber berita terkini menyatakan terdapat 148 tapak pelupusan sampah di Malaysia dan 18 daripadanya adalah tapak pelupusan sanitari. Penaiktarafan tapak sanitari itu adalah supaya proses pelupusan sisa pepejal lebih bersih selain menjimatkan penggunaan tanah untuk tapak pelupusan sampah baharu. Didapati pada tahun 2018, Malaysia dianggarkan membuang sampah sehingga 38,000 tan metrik sampah setiap hari dan RM1.5 bilion terpaksa dibelanjakan untuk kerja pengutipan sampah setiap tahun. Justeru, kadar kitar semula dan pengasingan sisa hanya 24 peratus manakala 76% dihantar ke tapak pelupusan sampah. Penggunaan tanah dalam pengurusan tapak sanitari mengambil masa 20-25 tahun untuk pulih dan sedia diguna semula. Pengurusan pelupusan sisa secara insinerator berpusat bergantung kepada industri besar menyebabkan kos yang tinggi. Menurut Bashir et al. (2019) sisa pepejal yang dikeluarkan Malaysia pada tahun 2020 meningkat dengan unjuran 9% pada 10 tahun akan datang. Pada masa kini sebanyak 50% pusat sanitari akan ditutup kerana telah mencapai had maksima operasi. Malaysia menghadapi masalah dalam mengurus sisa pepejal perbandaran (MSW) kerana perkembangan pesat urbanisasinya. Tidak semua sisa yang dihasilkan sesuai dibakar. Ia memerlukan saringan pengasingan terlebih dahulu. Walau bagaimanapun tiada medium bagi proses pengasingan atau pelupusan sisa tersebut (Omoregie & Odibi, 2018).

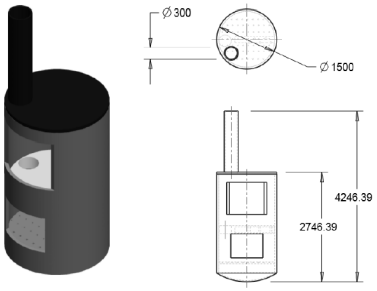
Kajian insinerator mudah alih tanpa asap telah dibangunkan oleh Din et al. (2018). Rajah 2.1 menunjukkan insinerator mudah alih tanpa asap ini amat praktikal dalam proses pembakaran sisa. Pembakaran siklon dihasilkan oleh pergerakan udara yang ditiup dari blower adalah cara yang paling berkesan untuk memastikan pembakaran lengkap dan kesan sampingan yang terhasil adalah minimum. Konsep yang digunakan untuk insinerator ini juga adalah berskala kecil dan memberi kelebihan kepada pengilang dan pelanggan kerana mudah alih dan mudah diselenggara. Kajian ini juga berjaya membuktikan kecekapan pembakaran insinerator mudah alih hanya mengambil masa 40 saat berbanding pembakaran terbuka yang mengambil masa yang lama.



Rajah 2.1 Insinerator Mudah Alih Tanpa Asap
Sumber: Din et al., 2018

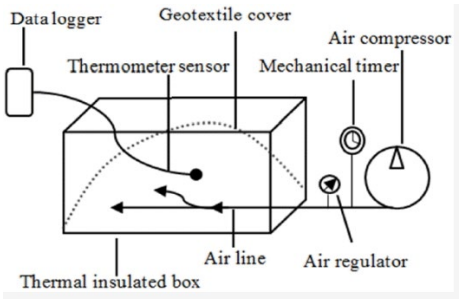
Penyelidik Akpe et al. (2016) mengkaji keperluan oksigen menggunakan *fuzzy logic* untuk pembakaran lengkap serta tahap pencemaran insinerator daripada sumber sisa domestik, institusi, perubatan dan perindustrian yang direka. Rajah 2.2 menunjukkan insinerator yang dibangunkan adalah relau berkembar bersuhu maksimum 760 ° C di ruang bawah dan 1000 ° C di ruang atas. Dinding penebat terdiri daripada bata tahan api 55mm yang tebal dengan keluli berkarbon setebal 2mm sebagai dinding luar. Hidrogen Klorida (HCl) dan *Nitrous oxides* (NO) x adalah gas yang digunakan untuk menunjukkan model *Fuzzy Inference*

System (FIS). FIS dibina dengan lima pemboleh ubah input (Makanan, PVC, Polythene, Kertas dan Tekstil) dan tiga pemboleh ubah input dengan dua fungsi keahlian.



Rajah 2.2 Insinerator Rekabentuk Fuzzy Logik
Sumber: Akpe et al., 2016

Pengeringan secara bio menggunakan konsep biologi dan mekanikal bagi mengeringkan sisa pepejal telah dikaji oleh Ab Jalil et al. (2016). Ini kerana Di Malaysia, sisa pepejal perbandaran tidak diasingkan dan mengandungi kelembapan yang tinggi. Penyelidik ini melaporkan bahawa antara faktor utama yang menyebabkan penggunaan teknologi seperti pembakaran sisa pepejal (insinerator) tidak berjaya. Sisa bahan organik boleh diproses secara semula jadi sehingga kandungan lembapan sisa dikurangkan. Beliau telah menjalankan kajian pengkomposan sisa perbandaran pada skala makmal seperti rajah 2.3 untuk mengukur pengurangan peratus kadar kelembapan dan memantau corak suhu di bawah tempoh pengudaraan yang berlainan. Kajian tersebut telah dijalankan selama 14 hari untuk semua sampel. Keputusan menunjukkan bahawa masa pengudaraan optimum adalah 10 minit, dengan pengurangan kadar kelembapan sebanyak 81.84 %.



Rajah 2.3 Skematik Rektor Pengeringan Bio
Sumber: NA Abd Jalil et al., 2016

3. METODOLOGI KAJIAN

Proses kajian mempunyai EMPAT peringkat utama;

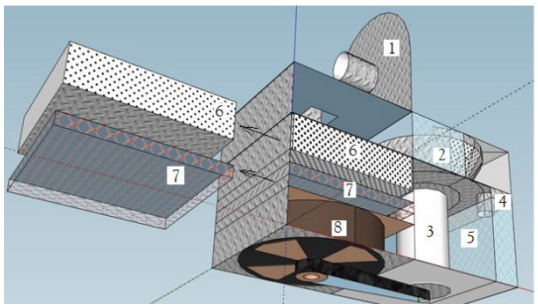
- Peringkat rekabentuk prototaip
- Peringkat pembinaan model pembolehubah bagi proses pelupusan
- Peringkat pembinaan prototaip
- Peringkat pengujian prototaip

3.1 Rekabentuk Prototaip

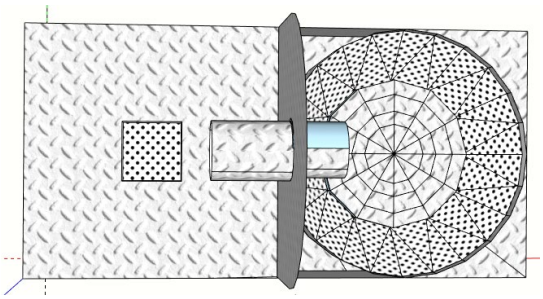
Rekabentuk mesin sisa mikro ditunjukkan dalam Rajah 3.1 mempunyai ciri utama yang berbeza dengan kajian sedia ada iaitu insinerator ini tidak ada proses pembakaran. Komponen utama insinerator mempunyai tiga ciri utama ini ialah penapisan sisa pepejal yang mengandungi air, pengisaran dan pengeringan mengunakan haba dan angin. Bahan-bahan utama untuk membina prototaip ini ialah logam, kayu, penapis, kipas dan motor pam DC. Rajah 3.1 (a) menunjukkan komponen iaitu 1) Penutup pengisar, 2. Pengisar, 3. Motor,

4. Salur air sisa, 5. Bekas air sisa, 6. Laci pengering, 7. Dawai pemanas dan 8. Kipas. Rekabentuk insinerator dari pandangan atas menunjukkan filter penapisan. Prosedur kerja adalah seperti berikut;

a) Petik/tekan suis untuk menghidupkan motor, pastikan pengisar ditutup. Masukkan sisa makanan melalui lubang pada penutup ke dalam tempat pengisar.
b) Proses pengisaran dan pengeringan berlaku. Air lebihan sisa *(leachate*) akan keluar melalui lubang aliran ke bahagian air sisa.
c) Hampas sisa akan keluar ke laci
d) Setelah sisa kering, tarik laci pengeringan untuk mengeluarkan hampas.



Rajah 3.1 (a) Pandangan 3D komponen



Rajah 3.1 (b) Pandangan atas

Rajah 3.1 Rekabentuk projek

3.2 Ujian Komponen Mesin Sisa Mikro

Konsep mudah alih dan pengasingan sisa organik amat dititik beratkan dalam projek ini. Ini kerana sisa pepejal ialah sisa organik/makanan yang paling banyak di Malaysia. Sisa makanan tidak boleh dikitar semula dan paling lembap (Abdul Jalil, 2015). Justeru ujian rekabentuk pengisaran dan pengeringan sisa organik menggunakan pengisar dilaksanakan bagi menguji keupayaan pengisar dan sisa yang digunakan. Parameter model kajian yang dijalankan ialah jisim sisa, suhu dan masa pengeringan.

3.3 Pembinaan Model *Curve Fitting Tool (*CFT) Pelupusan Sisa Organik

Kajian pelupusan sisa fasa 1 ialah ujian pengisaran sisa dan penjanaan model menggunakan *Curve Fitting Tool (CFT)* bagi pengesahan tiga pembolehubah utama. Pemboleh ubah yang pertama ialah jisim sisa sebelum proses pengisaran, kedua ialah jisim selepas pengisaran dan yang ketiga ialah masa proses pengisaran. Bagi membina model proses fasa pertama bagi projek kajian pelupusan sisa makanan di rumah, pencerapan pembolehubah menggunakan sisa makanan sebenar untuk menguji kebolehupayaan proses pengisaran bagi prototaip dan mendapatkan model yang sesuai. Berikut langkah penjanaan model iaitu;

- Langkah pertama penyediaan bahan sisa untuk ujian eksperiment proses pengisaran
- Langkah kedua pencerapan data
- Langkah ketiga penjanaan model

Data jisim sisa organik yang boleh digunakan ditetapkan antara 800 g kepada 1 kg. Masa kisaran 1min hingga 3 min dan suhu adalah 50 C hingga 80 C dengan masa pengeringan kurang 5 minit. Rekabentuk juga menggunakan data numerikal sahaja dan tiada data kategori. Ketiga-tiga pembolehubah ini dianggap independen (faktor) iaitu input yang boleh dikawal manakala masa kering dan jisim kering adalah pembolehubah dependen (*respondent*) iaitu pembolehubah yang terhasil (*output*).

3.3.1 Curve Fitting Tool (CFT) GUI MATLAB Version 12b

Aplikasi CFT ini merupakan salah satu aplikasi bagi penerbitan model eksperimen. Ia berpotensi untuk membina, memplot dan membandingkan pelbagai model yang *fit* dan

sesuai. Terdapat beberapa pilihan model sama ada model *linear, nonlinear regression, interpolation, smoothing,* dan *custom equations*. Aplikasi ini boleh memaparkan *goodness-of-fit statistics, confidence intervals* dan *residuals, remove outliers* serta memadankan *fits* dengan data yang *valid*. Seterusnya apabila data secara automatik dijana dalam bentuk kod ia juga boleh dipaparkan dalam bentuk grafik. Terdapat enam langkah bagi proses penerbitan model iaitu 1) Memasukkan data cerapan dalam *workspace*, 2) Membuka aplikasi CFT, *cftool* 3) Memilih data x, y dan z, 4) Pilih model yang sesuai dengan data contoh Polynomial, 5) Model yang dipilih akan dijana sama ada sepadan dan fit bagi data cerapan dan 6) Menjana kod model untuk paparan sama ada dalam jadual dan bentuk grafik.

Rekabentuk model telah menggunakan *Curve Fitting Tool* (CFT) MATLAB 12b. Algoritma ini memilih titik yang meminimumkan kepelbagaian varians ramalan merentasi ruang reka bentuk. Penjanaan model pelupusan sisa dengan menetapkan faktor dan respon (pembolehubah tidak bersandar dan bersandar). Kemudian setiap pembolehubah disetkan *limit* atau *interval* secara numerikal untuk bertindak sebagai kawalan. Seterusnya data cerapan dimasukkan dalam aplikasi CFT *workspace* bagi setiap sisa yang berlainan. Bilangan data sebanyak 22 x 1 mempunyai nilai minimum, maksimum, nilai purata, *mean* dan nilai sisihan piawai (std.) mengikut sisa masing-masing.

4. KEPUTUSAN DAN ANALISIS

Berikut hasil keputusan ujian yang telah dijalankan bagi mengukur jenis sisa organik dan alat pengisar yang digunakan mengikut parameter yang telah ditentukan.

4.1 Keputusan Ujian Pengisaran
Sisa bagi kajian ini ialah kulit limau, kulit manga dan kulit lobak. Ini bagi memastikan proses kisaran adalah sesuai dan memenuhi spesifikasi pengeringan sisa yang digunakan. Gambar Rajah 4.1 menunjukkan sisa sebelum dan selepas proses pengisaran.

Sisa sebelum proses pengisaran	Sisa selepas proses pengisaran
	

Kulit limau, kl




Kulit manga, km





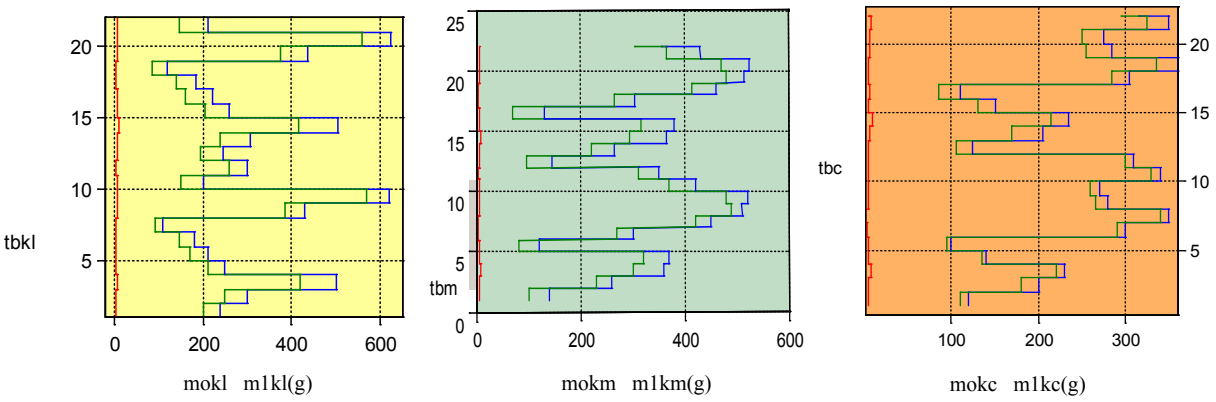
Kulit lobak, kc

Rajah 4.1 Gambar Sisa Organik Kulit Sebelum dan Selepas

Berikut pencerapan data sebanyak 22 sampel semasa proses pengisaran iaitu sisa kulit limau, kulit manga dan kulit lobak dipaparkan seperti di Jadual 4.1. Cerapan data mentah ini ditimbang secara rawak bagi jisim awal, mo manakala masa kisar, tb ditetapkan sama bagi semua jenis sisa. Graf Rajah 4.2 menunjukkan jisim sebelum pengisaran, m_o diwakili garis berwarna biru manakala selepas pengisaran, m_1 berkurangan bagi semua sisa diwakili garis berwarna hijau. Jadual 4.2 menunjukkan perbandingan peratusan jisim sisa sebelum dan selepas proses pengisaran dan pengeringan. Didapati sisa kulit limau mempunyai peratusan perbezaan jisim lebih tinggi iaitu 18%, diikuti kulit manga 14% dan kulit lobak 7%. Masa purata pengisaran ialah 5 saat.

Jadual 4.1 Cerapan Proses Pengisaran

Sisa	Kulit Limau, kl		Kulit Mangga, km		Kulit Lobak, kc		
	Jisim awal, mo(g)	Jisim akhir, m1(g)	Jisim awal, mo(g)	Jisim akhir, m1(g)	Jisim awal, mo(g)	Jisim akhir, m1(g)	Masa kisar, tb(s)
1	240	200	140	100	120	110	4
2	300	250	260	230	200	180	4
3	500	420	360	300	230	220	8
4	250	210	370	320	140	135	4
5	210	170	120	80	100	95	4
6	180	145	300	270	300	290	3
7	110	90	450	420	350	340	2
8	430	385	510	490	280	265	5
9	620	570	520	480	270	260	5
10	200	150	420	370	340	330	5
11	300	260	350	310	310	300	4
12	245	195	145	95	125	105	5
13	305	240	265	220	205	170	6
14	505	415	365	295	235	215	9
15	260	205	380	315	150	130	5
16	220	160	130	70	110	85	6
17	185	140	305	265	305	285	4
18	120	85	460	415	360	335	4
19	435	375	515	480	285	255	6
20	625	560	525	470	275	250	6
21	210	145	430	365	350	325	7
22	305	255	355	305	315	295	5



Rajah 4.2 Graf Perbandingan Jisim Sebelum dan Selepas Semua Sisa

Jadual 4.2 Peratus Perbezaan Jisim Sisa Sebelum dan Selepas Proses Pengisaran

Sisa	**Pemboleh ubah**	**Purata Bacaan**	**Peratus Perbezaan jisim awal dan akhir (%)**
Kulit Limau, kl	Jisim awal, mo(g)	307.045	18.255
	Jisim akhir, m1(g)	255.682	
Kulit Mangga, km	Jisim awal, mo(g)	348.864	14.086
	Jisim akhir, m1(g)	302.955	
Kulit Lobak, kc	Jisim awal, mo(g)	243.409	7.357
	Jisim akhir, m1(g)	226.136	
	Masa kisar, tb(s)	5.045	

4.2 Model Proses Pengisaran Sisa Bio

Terdapat tiga model daripada tiga sisa yang berlainan dihasilkan. Tiga sisa ini diasingkan kerana untuk mengenalpasti keupayaan kulit tadi dikisar dan kesan pengeluaran jus air daripada sisa tersebut.

Model bagi sisa kulit limau yang dihasilkan adalah daripada model Linear Polynomial 11 seperti berikut;

f (x, y) = -3.941e-15 - 0.1*x + p10 + 0.1 *y ------(a)

Model ini adalah memuaskan dengan tahap keyakinan sempadan 95 %. Nilai fit sepadan SSE: 0.8135*, R-square*: 0.9846 dan *adjusted R-square*: 0.983 dan RMSE: 0.2026.

Model kulit mangga dijana dengan model *locally weighted smoothing quadratic regression*

f (x, y) = *loess (quadratic) smoothing regression* ------(b)

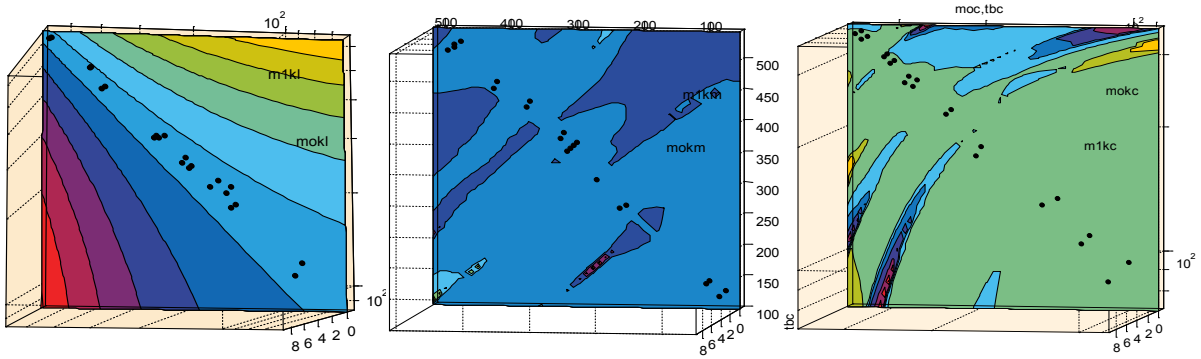
Fungsi (b) yang ditentukan daripada *coefficient structure* di mana x adalah normal dengan nilai mean 303 dan sisihan piawai (std) 131.6 manakala y juga adalah normal dengan nilai mean 348.9 dan sisihan piawai (std) 130. Fungsi model memenuhi SSE: 0.8092, R-square: 0.9847, adjusted R-square: 0.9779 dan RMSE: 0.2362

Model kulit lobak diterbitkan dengan model *locally weighted smoothing quadratic regression*

f (x, y) = *loess (quadratic) smoothing regression* ------(c)

Fungsi (c) ditentukan daripada *coefficient structure* di mana x dan y adalah normal dengan nilai mean 243.4 dan std 86.64. Fungsi model memenuhi SSE: 0.05984, R-square: 0.9989, adjusted R-square: 0.9984 dan RMSE: 0.06424.

Rajah 4.3 menunjukkan graf *linear polynomial* bagi kulit limau dan dua model bagi kulit manga dan kulit lobak ialah daripada model regresi kuadratik. Ia menunjukkan bahawa jisim awal model adalah signifikan antara satu sama lain dengan jisim selepas pengisaran. Kulit limau menunjukkan perubahan ketara antara dua jisim kerana kulit limau lebih lembap berbanding kulit manga dan kulit lobak. Hasil model-model ini menyumbang kepada faktor kaedah pelupusan bagi mengenalpasti sama ada sisa organik memerlukan pengasingan atau boleh dicampurkan. Justeru ketiga-ketiga sisa ini boleh dicampurkan bagi proses model yang lebih memuaskan. Model ini juga boleh dijadikan rujukan untuk model- model cerapan sebenar kajian akan datang.



a) model poly sisa kulit limau b) model kuadratik sisa kulit manga c) model kuadratik sisa kulit lobak

Rajah 4.3 Graf Model Sisa Organik Kajian

5. KESIMPULAN

Isu insinerator telah lama dibincangkan dan ditolak sebagai tidak sesuai dilaksanakan di Malaysia oleh sebilangan kumpulan. Tanpa disedari masalah pengurusan sisa semakin bertambah tanpa penyelesaian yang jitu. Walaupun pelbagai kempen dilancarkan penggunaan insinerator secara total tidak mungkin berlaku. Hasil kajian daripada penyelidik mencadangkan kaedah terbaik pada masa sekarang ialah menggunakan kombinasi atau multi kaedah iaitu pra-rawatan pengeringan bio, tapak pelupusan, atau loji biogas. Walau bagaimana pun cadangan tersebut perlu dibuat secara berperingkat dan tidak mungkin boleh menyelesaikan masalah sisa yang berlaku di Malaysia secara pukal tanpa pengubahsuaian mengikut keadaan lokaliti dan persekitaran. Justeru matlamat kajian ini adalah untuk menghasilkan satu kaedah pelupusan sisa yang berpotensi untuk dilaksanakan. Kaedah yang dicadangkan juga sekali gus dapat mendidik masyarakat dalam pengurusan pengasingan sisa dan tanggungjawab secara individu. Selain itu dengan projek inovasi ini, kajian model pelupusan sisa menggunakan CFT juga dapat dijana secara optimum bagi pembolehubah-pembolehubah yang telah ditetapkan untuk penambahbaikan secara berterusan. Projek inovasi ini mampu dan berupaya dilakukan kerana kos dan skala yang kecil dan pengurusan sisa secara independen tanpa perlu pergantungan kepada pihak tertentu. Cadangan kajian akan datang ialah menggunakan sampel sisa pelbagai jenis.

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ASPEK ERGONOMIK DAN REKABENTUK TERHADAP PENGGUNAAN ALAT PERTUKANGAN TANGAN 'THE SMART GRIP'

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Abstrak. Kerja-kerja membuka bolt dan nat pada sesuatu kerja penyambungan di bengkel sukar dilakukan jika tiada peralatan yang betul dan serba boleh. Ini juga melibatkan penggunaan tenaga yang lebih dan masa yang digunakan akan menjadi lebih lama. *The Smart Grip* merupakan alat yang diinovasikan dari spanar konvansional, dimana ia boleh mencengkam bolt dan nat dengan sendiri tanpa perlu pelarasan pencengkam dengan mengambil kira ciri-ciri ergonomik serta mesra pengguna. Dalam kajian ini, penghasilan prototaip *The Smart Grip* dibangunkan melalui proses kajian rekabentuk yang mengambil kira kekuatan dan kelemahan yang sediada pada alat konvansional, aloi keluli dan getah (polimer hidrokarbon kenyal) dipilih sebagai bahan utama penghasilan alat ini. Kajian ini bertujuan untuk mendapatkan maklumbalas berkenaan penggunaan *Smart Grip*, dapatan kajian menunjukkan lebih daripada 80% responden bersetuju penggunaan alat ini mempunyai kelebihan berbanding penggunaan alat konvesional dari aspek kesenangan penyelenggaraan alat (80%), keselesaan penggunaan (96.7%), kecekapan alat (93.3%), keselamatan (100%) dan penyimpanan alat (96.7 %). Selepas ujikaji dan analisis dijalankan, didapati beberapa cadangan dan penambahbaikan boleh dilakukan terhadap alat bagi meningkatkan lagi tahap keberkesanan alat supaya berfungsi dengan lebih baik.

Kata Kunci: Alat perengkuh, Spanar boleh laras, Smart grip,

1. PENGENALAN

The Smart Grip adalah satu alat yang menggantikan alat bolt dan nat iaitu spanar. Spanar ialah alat perengkuh yang mempunyai lubang, unjuran atau cangkuk pada satu atau kedua-dua hujung kepala yang terlibat dengan peranti yang sama objek yang akan dihidupkan [Mohd. Syafaril et al, 2019] . Spanar juga digunakan untuk memutarkan bahagian pengancing yang berbenang. Dibuat sama ada dengan mempunyai rahang atau terbuka bagi disesuaikan pada bolt dan nat yang bersegi empat atau bersegi enam. Spanar diperbuat daripada bahan tengangan tinggi atau keluli pancalogam (*alloy steel*). Antara jenis-jenis spanar ialah Perengkuh Terbuka, Perengkuh Kotak Tiub Atau Tubuler, Kunci Pas Soket dan Sepana Cincin.

Kerja pertukangan harian dan kerja di bengkel sukar dilakukan jika tiada peralatan yang betul dan serba boleh, ini akan menyumbangkan kepada pembaziran masa dan tenaga didalam kerja-kerja pertukangan. Dikebelakangan ini, terdapat kajian inovasi telah dijalankan bagi memudahkan Kerja penyelenggaraan yang melibatkan penggunaan spanar, tetapi masih terdapat penambahbaikan yang diperlukan. Di dalam kajian ini, keadaan fizikal spanar dan kepelbagaian saiz bolt dan nat menjadi faktor utama didalam rekabentuk peralatan, dimana ia akan piawaian kepada kebolehkerjaan spanar yang diubahsuai .

2. SOROTAN KAJIAN

Spanar merupakan salah satu alat yang digunakan dalam kerja-kerja pertukangan samaada pada skala besar atau kecil sesuatu pembinaan. Spanar juga berfungsi untuk mengetatkan dan melonggarkan pengikat seperti bolt, nat dan skru tudung berkepala heksagon. Terdapat

beberapa sepana yang terlibat dalam aktiviti pembinaan. Di antara spanar yang terlibat ialah Spanar Hujung Terbuka, ia mempunyai dua bahagian hujung yang terbuka berbentuk 'U'. Terdapat pula dua jenis spanar hujung terbuka iaitu spanar gelang dan juga spanar gabung. Spanar gelang mempunyai dua hujung yang berbentuk gelang dengan saiz yang berbeza. Saiz spanar gelang ditentukan oleh diameter bahagian dalam gelang. Spanar gabung pula mempunyai satu hujung terbuka dan satu hujung berbentuk gelang dengan saiz yang sama. Selain spanar hujung terbuka, terdapat juga spanar boleh laras. spanar boleh laras mempunyai satu rahang bergerak dan boleh dilaraskan kepada pelbagai saiz bolt dan nat (Mohd. Syafaril et al, 2019).

Bahan yang digunakan untuk membuat *The Smart Grip* ialah aloi keluli. Tujuan mencampurkan unsur - unsur aloi kepada keluli karbon ialah untuk memperbaiki beberapa sifat kimia dan fizikal bahan ini, yang tidak boleh didapati pada bahan asal yang dihasilkan melalui proses atau peraturan biasa. Antara sifat - sifat kejuruteraan yang diperlukan ialah kekuatan tegangan dan kekerasan tinggi tanpa kerapuhan. Selain itu, besi ini juga tahan karat dan mempunyai kekuatan tegangan atau had krip yang tinggi pada suhu tinggi dan di bawah kosong darjah (Sharma, 2007).

Pada bahagian pemegang *The Smart Grip* ini, ia akan mengunakan bahan iaitu getah elastik. Getah merupakan sejenis polimer hidrokarbon kenyal yang terhasil dari koloid dalam sap beberapa jenis pokok, antaranya adalah pokok getah. Terdapat juga getah tirun yang dihasilkan secara sintetik (Nur Aidasyakirah et al, 2017)

Bolt dan nat pula adalah sejenis penyambung yang banyak digunakan. Ia digunakan untuk semua jenis rekabentuk dari yang mudah hinggalah kepada yang tersangat canggih dan mahal yang memerlukan penyambung yang sementara iaitu sambungan yang boleh dibuka apabila perlu dan kemudian disambungkan semula tanpa menjejaskan bahan yang disambung. Walaupun bentuknya nampak mudah tetapi bolt dan nat ini merupakan suatu anggota yang sangat rumit untuk dianalisis kerana ianya mengemukakan banyak masalah, seperti masalah timpuan tegasan dan masalah keratan rentas yang tidak sama tengah (Abdullah et al, 2012).

Bolt digunakan bersama nat untuk mengikat dan mengetatkan dua atau lebih komponen. Terdapat pelbagai jenis saiz dan bentuk. Saiz bolt ditentukan melalui ukuran diameter dan panjang. Nat pula digunakan bersama bolt untuk mengikat dan mengetatkan sesuatu sambungan. Nat mempunyai ulir dalam dan digunakan bersama bolt atau *stad*. Saiz nat ditentukan oleh ukuran diameter lubang berulir. Terdapat pelbagai jenis nat, antaranya ialah nat segiempat, heksagon beralur, nat kota dan nat telinga.

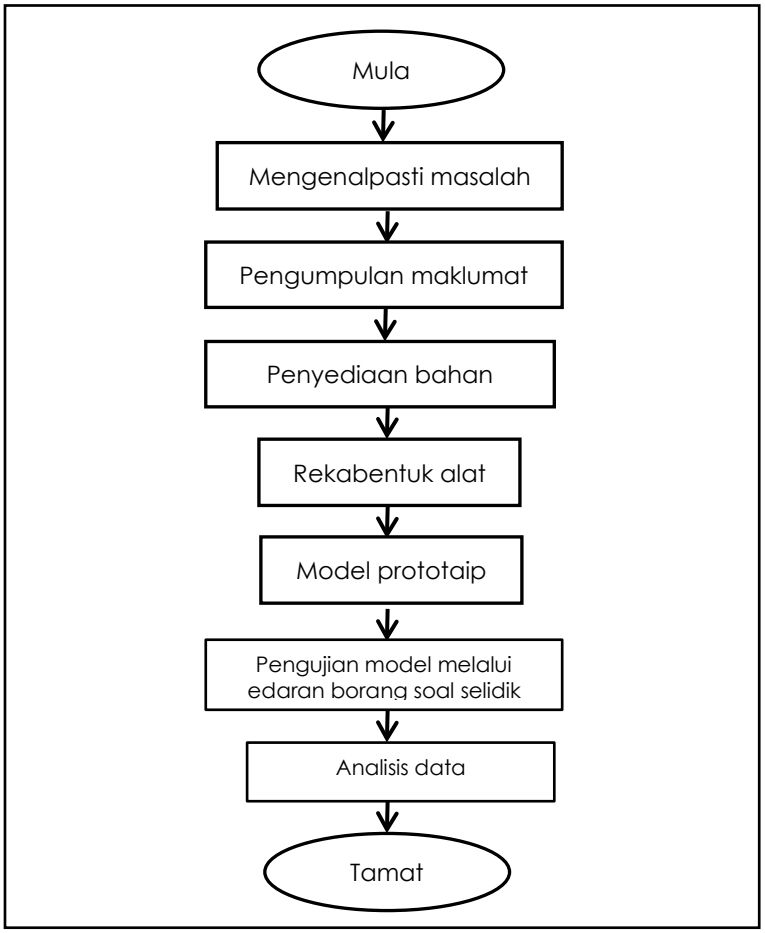
Setiap penyambungan bolt dan nat yang berlainan saiz dan bentuk akan memerlukan spanar yang berlainan saiz dan bentuk. Ini akan menyebabkan pelbagai saiz spanar diperlukan. Tenaga yang lebih juga diperlukan dalam melakukan kerja-kerja pertukangan. Masa yang diambil akan menjadi lebih panjang untuk membuka bolt dan nat pada sesuatu penyambungan. Perkara ini, akan menyukarkan penukang untuk menukar saiz sepana setiap kali nat yang berlainan digunakan. Rahang untuk sepana juga perlu sentiasa dilaras bagi membukanya. Justeru, kajian ini dijalankan bertujuan untuk menambah baik spanar yang sedia ada supaya lebih mesra pengguna dan dapat digunakan dalam kepelbagaian kerja.

3. METODOLOGI KAJIAN

Metodologi kajian adalah satu kaedah untuk mencari jawapan kepada persoalan-persoalan kajian yang dibina dan merupakan pembimbing kepada penyelidik dalam memperolehi maklumat serta data berhubung dengan matlamat kajian yang dirancangkan. Rajah 1 menunjukkan carta alir kerangka operasi kajian yang akan dilaksanakan.

3.1 Penyediaan Bahan

Proses penyediaan bahan dijalankan dengan menjalankan penilaian terhadap bahan-bahan yang sedia ada pada spanar iaitu penggunaan aloi keluli dan getah, Bahan yang digunakan untuk membuat *The Smart Grip* ialah aloi keluli. Tujuan dicampurkan unsur - unsur aloi kepada keluli karbon ialah untuk memperbaiki beberapa sifat kimia dan fizikal bahan ini, yang tidak boleh didapati pada bahan asal yang dihasilkan melalui proses atau peraturan biasa. Antara sifat - sifat kejuruteraan yang diperlukan ialah kekuatan tegangan dan kekerasan tinggi tanpa kerapuhan. Pada bahagian pemegang *The Smart Grip* ini, bahan yang akan digunakan adalah getah.

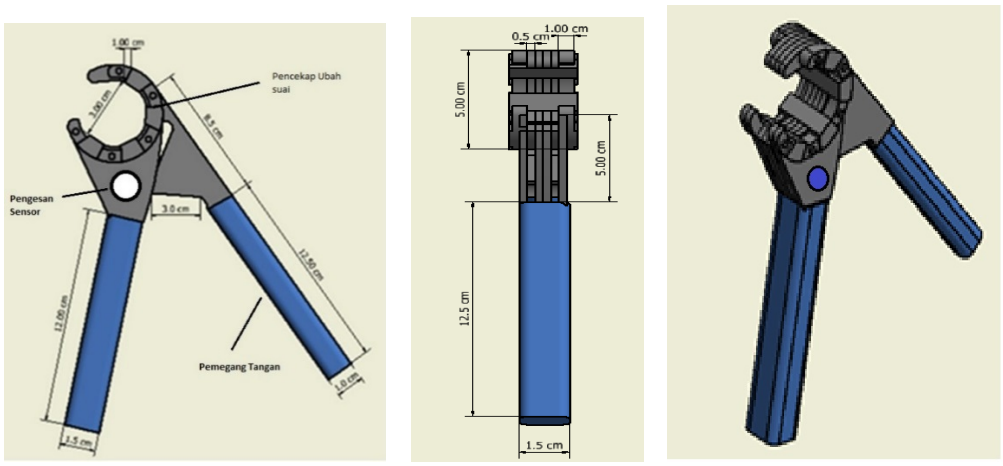


Rajah 1: Carta Alir Kerangka Operasi kajian

3.2 Rekabentuk Alat

Bagi mencapai matlamat dalam melaksanakan projek ini, kaedah pemerhatian telah dijalankan bagi melihat kelemahan yang terdapat pada alat sebelum *The Smart Grip* dihasilkan. Perbandingan di antara spanar dan *The Smart Grip* telah dijalankan bagi mengenal pasti titik kelemahan spanar. Selain itu, alat ini juga direkabentuk supaya mempunyai ciri-ciri mesra pengguna dan tahan lasak kerana ia akan diguna dalam jangka masa yang lama

bergantung kepada cara penggunaannya. Rajah 2 menunjukkan lakaran rekabentuk *The Smart Grip*.



Rajah 2: Lakaran Akhir Rekabentuk *Smart Grip*

3.3 Model Prototaip

Penyambungan aloi keluli dalam pembuatan *The Smart Grip* dilakukan dengan menggunakan proses kimpalan. Aloi keluli dipotong terdahulu mengikut bentuk yang telah dikenalpasti dan aloi keluli yang dibentuk akan disambungkan, getah elastik akan diletakkan ditempat pemegang bagi merealisasikan kaedah yang dicadangkan dalam pembuatan produk. Alat peranti sentuh diletakan pada bahagian cengkaman alat bagi mengesan tahap sentuhan maksimum yang boleh dilakukan oleh cengkapan alat pada bolt dan nat.

3.4 Pengujian Model

Dalam kajian ini, model diuji melalui edaran borang soal selidik. Sebanyak 30 responden telah dipilih untuk menggunakan produk ini. Responden yang dipilih adalah berdasarkan kepada kemahiran dalam menggunakan spanar. Skala Likert digunakan sebagai mengenal pasti aras persetujuan responden bagi setiap pernyataan. Antara maklumat yang terdapat dalam borang soal selidik adalah ciri-ciri alat yang dikaji dari segi fizikal, kekuatan dan mekanikal. Maklumat tersebut akan dianalisis bagi melihat tahap permintaan terhadap penggunaan *The Smart Grip*. Analisis akan dipecahkan kepada beberapa bahagian dan dipersembahkan dalam bentuk carta pai dan graf bar bagi memudahkan perbandingan dilakukan [Sabitha,2005].

4.0 ANALISIS DATA DAN KEPUTUSAN

Kajian ini merupakan satu penyelidikan secara kuantitatif dalam bentuk tinjauan yang menggunakan borang soal selidik, rekabentuk soal selidik adalah melalui kaedah tinjauan semasa atau keratan lintang (cross- sectional survey), dimana data diambil daripada satu sampel dalam satu masa sahaja. Soalan kaji selidik dibangunkan dengan menggunakan empat (4) tahap skala likert yang bermula dari skala 1 'sangat tidak setuju' sehingga skala 4 'sangat setuju'. Hasil dapatan kajian telah dianalisis dengan menggunakan sistem *Statistical Package for Social Science* (SPSS), versi 22.0. Hasil dapatan kajian yang dikemukakan dalam bab ini menghuraikan jawapan kepada persoalan kajian iaitu mengenalpasti keperluan penggunaan *The Smart Grip* yang mesra pengguna dan mengenalpasti keberkesanan penggunaan *The Smart Grip* dalam pelbagai kerja.

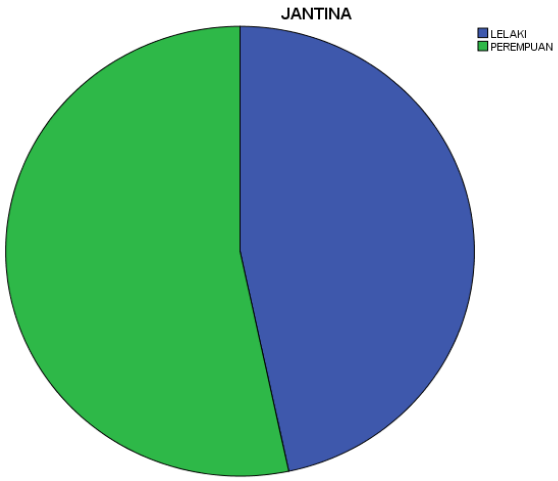
4.1 Maklumat Latar Belakang Responden

Responden terdiri daripada jantina lelaki dan perempuan. Selain itu, responden yang terdiri dari penggunayang kemahiran dalam menggunakan spanar iaitu 3.3% responden mewakili pensyarah, 6.7% pekerja am , 20% mewakili pembantu teknik , 10% mewakili penyelia bengkel

dan 60% yang mewakili pelajar teknikal . Bagi maklumat yang berkaitan dengan jantina, terdapat 46.7% mewakili jantina lelaki dan 53.3% mewakili jantina perempuan seperti ditunjukkan pada Jadual 1 dan Rajah 3.

Jadual 1: Jantina Lelaki dan Perempuan

Jantina	Kekerapan	Peratus (%)	Peratus Kumulatif
Lelaki	14	46.7	46.7
Perempuan	16	53.3	100
Jumlah	30	100	



Rajah 3: Carta Pai Jantina Lelaki dan Perempuan

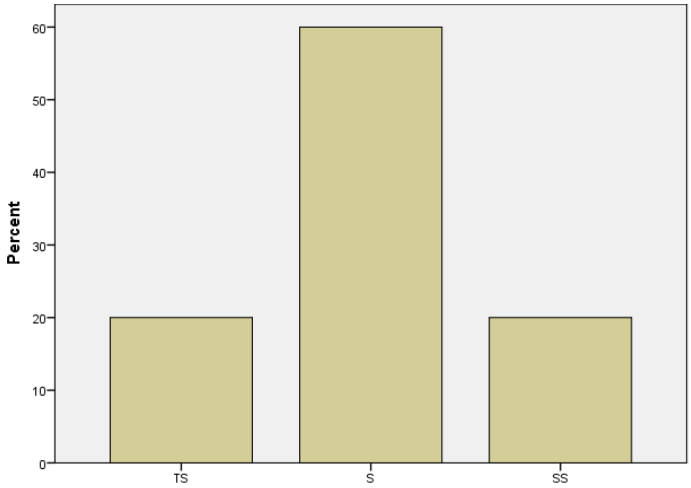
4.2 Analisis Data Kesesuaian Bagi Kerja-Kerja Penyelenggaraan

Pada aspek ciri-ciri alat sesuai untuk penggunaan kerja-kerja penyelenggaraan, sebanyak 60% responden bersetuju bahawa *The Smart Grip* sesuai digunakan untuk kerja-kerja penyelanggaraan bersekala kecil dan 20% daripada responden sangat bersetuju dengan penggunaan *The Smart Grip*. Manakala, sebanyak 20% responden berpendapat bahawa *The Smart Grip* tidak sesuai digunakan untuk kerja penyelenggaraan bersekala kecil seperti ditunjukkan pada Jadual 2 dan Rajah 4.

Jadual 2: Penglibatan Dalam Penyelenggaraan Bersekala Kecil

	Kekerapan	**Peratus (%)**	**Peratus Kumulatif**
Sangat Tidak Setuju (STS)	0	0	0
Tidak Setuju (TS)	6	20	20

Setuju (S)	18	60	80
Sangat Setuju (SS)	6	20	100
Jumlah	30	100	



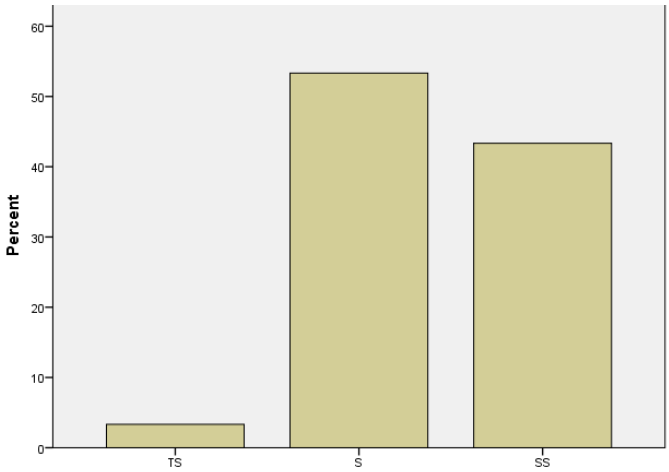
Rajah 4: Penglibatan Dalam Penyelenggaraan Sekala Kecil

4.3 Analisis Data Keselesaan Dalam Menggunakan *The Smart Grip*

Pengunaan alat tangan yang selesa dikategorikan sebagai pengunaan yang tidak mendatangkan kesan kesakitan pada atanomi dan fisiologi manusia (Nasarullah, 2016). Sebanyak 96.7% dari responden telah bersetuju bahawa *The Smart Grip* selesa untuk digunakan hanya 3.3% responden berpendapat bahawa *The Smart Grip* tidak selesa semasa menggunakannya seperti ditunjukkan pada Jadual 3 dan Rajah 5.

Jadual 3: Keselesaan Dalam Menggunakan *'The Smart Grip'*

	Kekerapan	**Peratus (%)**	**Peratus Kumulatif**
Sangat Tidak Setuju (STS)	0	0	0
Tidak Setuju (TS)	1	3.3	3.3
Setuju (S)	16	53.3	56.7
Sangat Setuju (SS)	13	43.3	100
Jumlah	30	100	



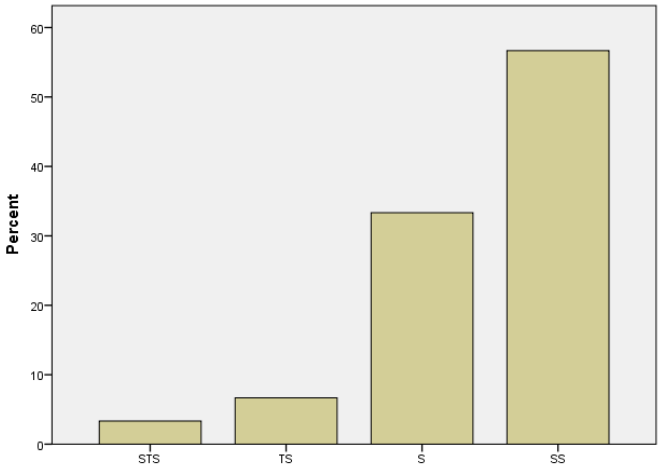
Rajah 5: Keselesaan Dalam Menggunakan '*The Smart Grip*'

4.4 Analisis Data Kecekapan Dalam Menggunakan *The Smart Grip*

Kecekapan penggunaan peralatan boleh ditakrifkan sebagai kadar prestasi alat dalam melakukan sesuatu kerja [Akmal Nor,2018], melalui maklumbalas pengguna sebanyak 90 % responden sangat bersetuju kecekapan dalam menggunakan *The Smart Grip* manakal hanya 6.7% daripada responden tidak brersetuju dan 3.3% sangat tidak bersetuju seperti ditunjukkan pada Jadual 1 dan Rajah 3.

Jadual 4: Kecekapan Dalam Menggunakan *The Smart Grip*

	Kekerapan	Peratus (%)	Peratus Kumulatif
Sangat Tidak Setuju (STS)	1	3.3	3.3
Tidak Setuju (TS)	2	6.7	10
Setuju (S)	10	33.3	43.3
Sangat Setuju (SS)	17	56.7	100
Jumlah	30	100	

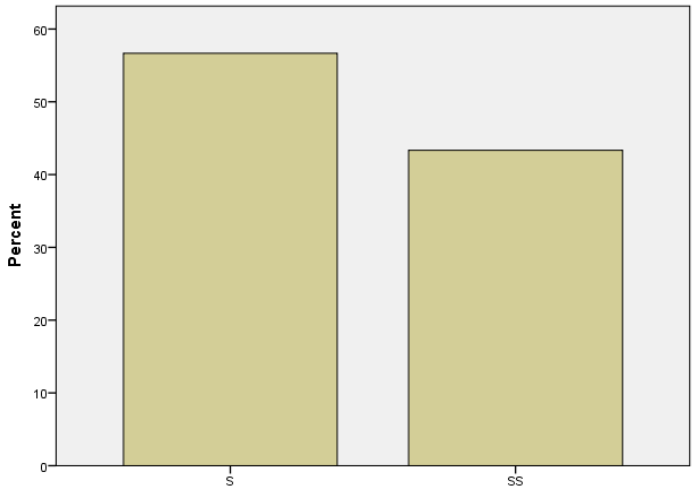


Rajah 6: Kecekapan Dalam Menggunakan *The Smart Grip*

4.5 Analisis Data Dalam Keselamatan Dalam Menggunakan *The Smart Grip*
Pada aspek keselamatan peralatan yang direkabentuk sebanyak 100 % responden bersetuju bahawa *The Smart Grip* ini selamat digunakan ini membuktikan rekaan yang dicadangkan boleh digunakan dengan sempurna seperti ditunjukkan pada Jadual 5 dan Rajah 7.

Jadual 5: Keselamatan Dalam Menggunakan *'The Smart Grip'*

	Kekerapan	Peratus (%)	Peratus Kumulatif
Sangat Tidak Setuju (STS)	0	0	0
Tidak Setuju (TS)	0	0	0
Setuju (S)	17	56.7	56.7
Sangat Setuju (SS)	13	43.3	100
Jumlah	30	100	

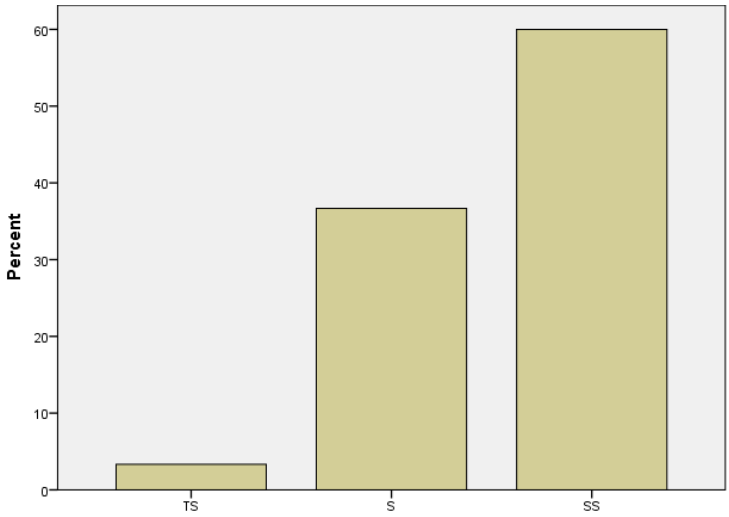


Rajah 7: Keselamatan Dalam Menggunakan *The Smart Grip*

4.6 Analisis Data Dalam Penyimpanan Dalam Menggunakan *The Smart Grip*
Pada aspek kesenangan alat ini disimpan sebanyak 60% sangat bersetuju dan 36.7%% daripada responden bersetuju dalam penyimpanan *The Smart Grip* ini. Manakala, sebanyak 3.3% orang responden juga berpendapat bahawa *The Smart Grip* tidak sukar untuk disimpan seperti ditunjukkan pada Jadual 6 dan Rajah 8.

Jadual 6: Penyimpanan *The Smart Grip*

	Kekerapan	Peratus (%)	Peratus Kumulatif
Sangat Tidak Setuju (STS)	0	0	0
Tidak Setuju (TS)	1	3.3	3.3
Setuju (S)	11	36.7	40
Sangat Setuju (SS)	18	60	100
Jumlah	30	100	



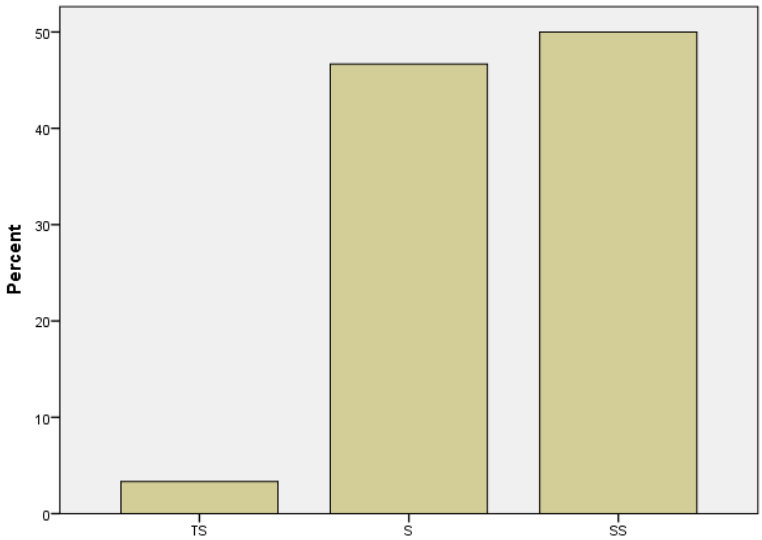
Rajah 8: Penyimpanan *The Smart Grip*

4.7 Analisis Data Kesenangan Dalam Menggunakan *The Smart Grip*

Pada aspek ciri-ciri kesenangan dalam menggunakan alat baru, Sebanyak 96.7 % daripada responden sangat bersetuju dan bersetuju bahawa penggunaan alat tidak terlalu rumit dan memerlukan kepakaran dalam pengendalian alat dan hanya sebanyak 3.3% responden yang tidak bersetuju seperti ditunjukkan pada Jadual 7 dan Rajah 9.

Jadual 7: *The Smart Grip* Senang Digunakan

	Kekerapan	Peratus (%)	Peratus Kumulatif
Sangat Tidak Setuju (STS)	0	0	0
Tidak Setuju (TS)	1	3.3	3.3
Setuju (S)	18	60	80
Sangat Setuju (SS)	11	36.7	100
Jumlah	30	100	



Rajah 9: *The Smart Grip* Senang Digunakan

5.0 PERBINCANGAN DAN KESIMPULAN

Berdasarkan kajian yang telah jalankan terdapat beberapa pernyataan bahawa membuka bolt dan nat dengan menggunakan kaedah konvansional agak sukar kerana spanar atau peralatan yang sedia ada perlu dilaraskan untuk membuka bolt dan nat berbanding *The Smart Grip* ini. Alat ini dapat memudahkan kerja-kerja tersebut kerana pada bahagian cengkaman *The Smart Grip* ini tidak perlu dilaraskan sebaliknya boleh terus mencengkam bolt dan nat mengikut saiz bolt dan nat tersebut.

Dapatan kajian menunjukkan lebih daripada 80% responden bersetuju penggunaan alat ini mempunyai kelebihan berbanding penggunaan alat konvesional dari aspek kesenangan penyelenggaraan alat (80%), keselesaan penggunaan (96.7%), kecekapan alat (93.3%), keselamatan (100%) dan penyimpanan alat (96.7 %). Secara keseluruhanya dapat disimpulkan bahawa produk ini telah mencapai objektif-objektif yang telah ditetapkan iaitu pengenalpastian keperluan penggunaan *'The Smart Grip'* dalam kerja-kerja pembinaan dan pertukangan, penghasilan *The Smart Grip* yang mesra pengguna dan pengenalpastian keberkesanan penggunaan *The Smart Grip* dalam kerja yang pelbagai.

Walaubagaimana pun terdapat beberapa cadangan penambahbaikan yang boleh dilakukan terhadap alat ini bagi meningkatkan tahap keberkesanan alat untuk berfungsi dengan lebih baik. Di antara cadangan penambahbaikan yang boleh dilakukan adalah pengubahsuaian pada bahagian perengkuh yang dibesarkan supaya sesuai dengan skop kerja yang lebih berat, penambahan alat pemotong supaya boleh dipelbagaikan fungsi *The Smart Grip* yang bukan hanya untuk membuka bolt dan nat tetapi boleh untuk memotong dawai dan merekabentuk penatup pada bahagian perengkuh bagi memudahkan ia disimpan.

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PENGGUNAAN GOOGLE SHEET DAN APPSHEET DALAM PROSES MEMBANGUNKAN APP PENGIRAAN MARKAH PENILAIAN KERJA KURSUS

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Abstrak. Pada masa kini telefon pintar memainkan peranan penting dalam kehidupan manusia. Keupayaan telefon pintar berfungsi secara fleksibel dan mudah dikendalikan oleh pengguna di mana sahaja mereka berada menjadi punca kepada perkembangan ini. Dengan perkembangan teknologi yang semakin pesat keupayaan telefon pintar memuatkan pelbagai jenis aplikasi *(Mobile App)* yang diperlukan oleh manusia menjadikannya sebagai satu alat keperluan yang mesti dimiliki. Manfaat yang terhasil daripada telefon bimbit ini boleh dikembangkan lagi dengan menghasilkan *mobile app* yang membantu pengiraan markah penilaian kerja kursus. Menyedari kepentingan ini satu kajian dilakukan bagi memperkenalkan kaedah menghasilkan *mobile app* pengiraan markah penilaian kerja kursus untuk kegunaan pensyarah Jabatan Pengajian Am Politeknik Sultan Mizan Zainal Abidin dengan menggunakan fungsi Google Sheet dan Appsheet. Penulisan kajian ini melibatkan pengenalan kepada Google Sheet dan Appsheet serta kelebihan dan fungsinya secara umum untuk menghasilkan mobile app dengan lebih mudah bagi tujuan pengiraan markah penilaian kerja kursus beserta lampiran contoh bergambar. Kaedah ini amat bersesuaian kepada pensyarah kerana ia dapat membantu mereka menghasilkan sendiri alat pengiraan markah secara mudah alih disamping mengurangkan penggunaan kertas. Ia juga dapat meningkatkan kreativiti pensyarah serta menarik minat mereka dengan teknologi. Perkembangan ini dapat membantu merancakkan lagi proses PdP dengan memperbanyakkan penggunaan produk pendidikan berasaskan teknologi terkini selaras dengan IR 4.0.

Kata kunci : Mobile App, Google Sheet, Appsheet, Teknologi

1. PENGENALAN

Pada masa kini telefon pintar memainkan peranan penting dalam kehidupan manusia. Keupayaan telefon pintar berfungsi secara fleksibel dan mudah dikendalikan oleh pengguna di mana sahaja mereka berada menjadi punca kepada perkembangan ini. Dengan perkembangan teknologi yang semakin pesat, keupayaan telefon pintar memuatkan pelbagai jenis aplikasi mudah alih (Mobile app) yang diperlukan oleh manusia menjadikannya sebagai satu alat keperluan yang mesti dimiliki oleh setiap manusia.

Perkembangan ini juga telah memberi impak yang sangat besar kepada hampir kesemua sistem kerja di seluruh dunia. Proses aliran kerja semakin mudah dan cepat disamping dapat menjamin kualiti dan kuantiti. Penggunaan teknologi ini juga dilihat semakin menarik dan efisen apabila ia disadurkan secara kreatif dan berseni. Kesan daripada perkembangan ini, pelbagai pihak dilihat mula memandang serius terhadap keupayaan teknologi ini dan mula mengembangkan manfaatnya ke semua bidang. Bidang pendidikan dilihat tidak ketinggalan dalam menerima dan mengadaptasi perkembangan ini apabila ramai tenaga pengajar mula menjadikan teknologi ini sebagai sebahagian daripada alat bantuan dalam proses PdP di pelbagai peringkat pengajian.

1.1 Objektif kajian
Kajian ini dijalankan bagi menjelaskan kepentingan penggunaan *mobile app* sebagai alat bantuan pengurusan markah penilaian kerja kursus. Sekali gus untuk memperkenalkan kaedah pembangunan *mobile app* menggunakan Google Sheet dan perisian atas talian Appsheet dalam membangunkan app pengiraan markah kerja kursus. Antara tujuan penyelidikan ini juga adalah untuk meningkatkan minat pensyarah menghasilkan app sendiri sebagai alat bantuan dalam pengurusan markah penilaian kerja kursus.

2. SOROTAN KAJIAN

2.1 Definisi mobile app
Menurut Md. Rashedul, Md. Rofiqul & Tahidul Arafhin (2010) aplikasi mudah alih atau *mobile app* merupakan sebuah program yang dimuatkan ke dalam alat mudah alih dan boleh digunakan pada bila-bila masa dan di mana-mana sahaja. Menurut Mobile app – Wikipedia,(2019) *mobile app* atau aplikasi mudah alih adalah merujuk kepada program komputer atau aplikasi perisian yang direka untuk digunakan pada peranti mudah alih seperti telefon, tablet, atau jam (Mobile app – Wikipedia, 2019) . *Mobile app* juga mempunyai fungsi yang lebih luas seperti membuat panggilan, menghantar mesej, melayari internet, berbual, berkomunikasi melalui rangkaian media sosial, audio, panggilan video, permainan dan lain-lain lagi (Islam & Mazumder, 2010). *Mobile app* boleh dimuat turun dari platform pengendalian mudah alih seperti App Store, Google Play Store dan lain-lain lagi secara percuma atau berbayar. Oleh kerana mendapat permintaan yang tinggi *mobile app* terus berkembang dari hanya untuk membantu produktiviti seperti perkhidmatan e-mel, kalendar dan pangkalan data kenalan kepada permainan mudah alih, automasi kilang, GPS dan perkhidmatan berasaskan lokasi, penjejakan pesanan, pembelian tiket dan lain-lain lagi. *Mobile app* kini dikenali sebagai App. Sehingga kajian ini ditulis terdapat berjuta-juta *mobile app* telah dibangunkan untuk kegunaan manusia.

2.2 Google Sheet
Google Sheet adalah merupakan salah satu produk yang disediakan kepada pemilik akaun google yang ingin menghasilkan dokumen atas talian secara percuma yang ditawarkan menerusi perkhidmatan Google Drive. Google Sheet berfungsi hampir sama dengan *Misrosoft Excel*. Walaubagaimanapun fungsinya lebih terhad berbanding *Microsoft Excel*. Namun begitu Google Sheet tetap membolehkan pengguna menyediakan dokumen berkualiti dengan pelbagai kemudahan *add-ons* yang disediakan. Pengguna perlu lebih kreatif menggunakannya supaya projek yang dihasilkan tetap berkualiti menepati kehendak dan citarasa pengguna. Pelbagai pilihan *Add-ons* boleh didapati bersesuaian dengan projek yang ingin dibangunkan.

2.2.1 Fungsi Dan Kelebihan Google Sheet :
a) Perkongsian Dokumen Secara Atas Talian
Menurut Zapier Team (2016) Google Sheet merupakan aplikasi berasaskan web yang boleh anda gunakan di mana sahaja. Ia berfungsi dari mana-mana peranti, dengan aplikasi mudah alih untuk iOS dan Android bersama dengan aplikasi teras berasaskan webnya. Oleh kerana ia berfungsi secara atas talian, jadi pengguna dapat melakukan perkongsian bahan (*shared*) secara atas talian, menyimpan dokumen dan pengolahan data seperti *Microsoft Excel*. Dokumen tersebut tidak hanya dapat dibaca (*read only*) tapi juga dapat diedit.

b) Menyimpan Fail Secara Automatik
Selain itu semua kemas kini dokumen yang dilakukan akan disimpan secara automatik semasa menaip bagi setiap pengubahsuaian yang dilakukan. Pengguna dapat mengumpulkan data dengan *spreadsheet* secara automatik dan melakukan hampir semua perkara yang dimahukan, walaupun *spreadsheet* tidak dibuka (Zapier Team, 2016).

c) Membuka Dan Kemaskini Fail Bila-Bila Masa
Kelebihan utama yang didapati dari Google Sheet ialah pengguna dapat membuka dan

melakukan pengubahsuaian dokumen bila-bila masa dan di mana sahaja asalkan mempunyai capaian internet tanpa perlu memasang perisian tertentu seperti *Microsoft Excel* pada komputer. Fungsi dan kelebihan Google Sheet terus berkembang apabila ia dapat dibuka menggunakan telefon pintar. Google Sheet juga berupaya mengubah fail dokumen kepada PDF, *Microsoft Excel* dan lain-lain lagi.

2.3 AppSheet

Menurut AppSheet - Wikipedia (2019) AppSheet merupakan sebuah laman web yang menyediakan platform pembangunan tanpa kod untuk perisian aplikasi yang membolehkan pengguna membangunkan aplikasi mudah alih (*Mobile App*), tablet, dan web menggunakan sumber data seperti Google Drive, DropBox, Office 365, dan platform *spreadsheet* dan pangkalan data atas talian yang lain . Laman sesawang ini telah dilancarkan pada tahun 2014 dan terus berkembang pesat. Appsheet memberi perkhidmatan ini secara percuma kecuali sekiranya pengguna ingin menambah fungsi-fungsi tertentu.

2.3.1 Fungsi Dan Kelebihan Appsheet :

a) Membangunkan Mobile app Secara Atas Talian

Appsheet membantu pengguna membangunkan *mobile app* sendiri dengan mudah secara atas talian. Ia dapat diakses menerusi mana-mana enjin carian seperti Google Chrome, Mozilla Firefox, Internet Explorer dan lain-lain lagi selagi pengguna mempunyai capaian internet.

b) Menyediakan Sampel Mobile app Mengikut Kategori

Pengguna tidak perlu memikirkan koding-koding tertentu untuk membangunkan *mobile app* kerana Appsheet telah pun menyediakan beberapa sampel yang biasa digunakan untuk *mobile app* mengikut kategori seperti Inspections & Surveys, Field Service, Property Management, Inventory Management, Sales & CRM dan lain-lain lagi.

c) Membangunkan Mobile app Berdasarkan Sumber Data Sedia Ada

Kelebihan utama Appsheet ialah dapat membantu pengguna membangunkan *mobile app* berdasarkan sumber data sedia ada dari Google Drive, DropBox, Office 365, dan platform *spreadsheet* dan pangkalan data atas talian yang lain.

2.4 Kajian lepas berkaitan dengan kaedah pembangunan mobile app

Terdapat beberapa kajian lepas berkenaan dengan kaedah pembangunan Mobile app. Antaranya ialah Mobile Dua And Zikr For Hajj (MDZ4H). Tesis Sarjana Sains (Teknologi Maklumat) Universiti Utara Malaysia 2012 oleh Ahmed Sheikh Abdullah Al-Aidaroos. Kajian ini adalah berkenaan dengan pembangunan Mobile app yang mengandungi panduan doa dan zikir untuk para jemaah haji. Mobile app ini dibina untuk platform android. yang mana prototaip dibangunkan dengan menggunakan J2ME. Prototaip tersebut terdiri daripada audio doa dan zikir yang dibaca dalam bahasa arab dan terjemahannya dalam bahasa Melayu. Mobile app ini memudahkan pengguna membaca zikir dan doa semasa melaksanakan haji terus dari telefon bimbit (Al-Aidaroos, 2012). Namun begitu kaedah membangunkannya hanya mampu dilakukan oleh mereka yang pakar dalam bidang ini.

Kebolehgunaan Aplikasi Mudah Alih (Mobile apps) Bagi Kursus Sains, Teknologi Dan Kejuruteraan Dalam Islam (M-istech) Di Politeknik Malaysia. Kajian ini ditulis dalam Attarbawiy: Malaysian Online Journal of Education, Vol 2 (1) oleh Ahmad Fkrudin Mohamed Yusoff & Ammar Badruddin Romli (2018). Kajian dilakukan dengan tujuan menilai kebolehgunaan aplikasi mudah alih dalam kursus Sains, Teknologidan Kejuruteraan Dalam Islam. Aplikasi mudah alih ini dibangunkan menggunakan alat pengarangan Adobe Flash CS6 Platform Android berasaskan model reka bentuk pengajaran ADDIE yang mempunyai lima fasa iaitu fasa analisis, fasa reka bentuk, fasa pembangunan, fasa pelaksanaan dan fasa penilaian. Hasil dapatan kajian ini mendapati bahawa pensyarah dan pelajar sangat berpuas hati terhadap aplikasi yang dibangunkan ini (Fkrudin & Badruddin 2018). Kaedah ini juga dilihat

agak sukar dan memerlukan kepada kepakaran dalam bidang pembangunan aplikasi mudah alih.

Kebolehgunaan dan Kesan Aplikasi Mudah Alih (Mobile apps) dalam Minggu Mesra Mahasiswa yang ditulis dalam Jurnal Personalia Pelajar 22(1): 93-101 oleh Mohd Suzeren Md Jamil, Roslee Rajikan, Noor Alaudin Abdul Wahab, Shahrul Nazmi Sannusi & Muhammad Hamiduddin Saat (2019). Kajian ini ditulis untuk menilai kebolehgunaan dan kesan aplikasi mudah alih 'MESRA@UKM' dalam Minggu Mesra Mahasiswa (MMM) 2018 yang dibangunkan oleh pelajar Fakulti Teknologi Sains Maklumat UKM. Hasil dapatan kajian ini mendapati bahawa pelajar sangat berpuas hati terhadap aplikasi yang dibangunkan ini dan berpotensi dilaksanakan sebagai medium utama penyampaian maklumat, tunjuk arah, jadual program dan pergerakan bas serta bantuan menjawab pelbagai persoalan pelajar (Suzeren et. al., 2019). Kaedah membangunkannya juga sudah tentu sukar dan hanya mampu dilaksanakan oleh mereka yang pakar dalam bidang pembangunan aplikasi mudah alih.

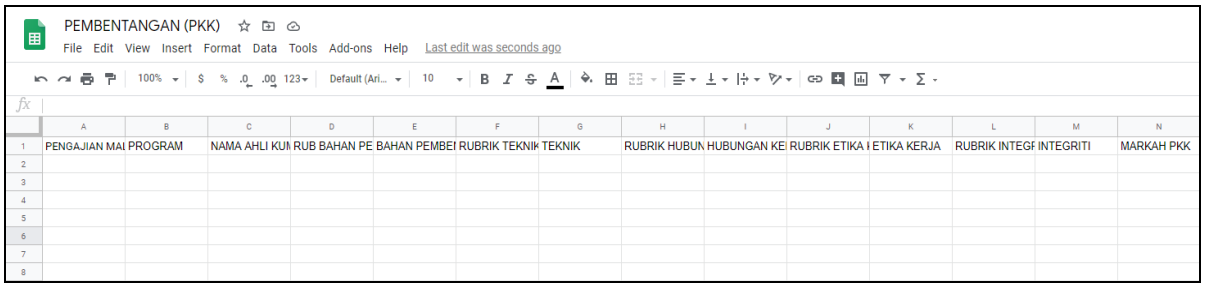
Melalui tinjauan kepada kajian-kajian di atas, didapati bahawa penggunaan *mobile app* amat diperlukan sebagai alat bantuan sama ada dari sudut pengurusan atau pelaksanaan PdP disamping menjaga kualiti PdP yang dilaksanakan. Namun begitu kaedah membangunkan *mobile app* dilihat agak sukar kerana hanya mampu dilakukan oleh mereka yang pakar dalam bidang tersebut. Oleh kerana itu setiap pensyarah tidak harus ketinggalan dalam menguasai kemahiran membangunkan *mobile app* menggunakan Google Sheet dan Apsheet untuk digunakan sebagai alat bantuan dalam pengurusan PdP. Menurut Parker (2008) dalam kajiannya mendapati penggunaan bahan ICT dalam proses PdP dapat meningkatkan minat dan perhatian murid, menggalakkan maklum balas, menawarkan pengalaman pembelajaran intelektual, membantu perkembangan literasi serta kemahiran pemikiran tahap tinggi dalam kalangan murid dan guru.

3. METODOLOGI KAJIAN

Dalam penyelidikan ini, kajian perpustakaan telah digunakan bagi mendapatkan maklumat berkenaan topik kajian. Menerusi kajian perpustakaan sumber-sumber data dapat dikumpulkan seperti definisi, fungsi dan kepentingan topik kajian secara umum. Fungsi Google Sheet sebagai pangkalan data dan AppSheet sebagai platform yang menghubungkan data-data kepada pengguna kemudiannya digabungkan bagi melihat keupayaannya menjana app borang markah penilaian. Kaedah ini kemudiannya diuji oleh penyelidik dengan membangunkan app borang markah PKK Pembentangan bagi kursus MPU 21012 Pengajian Malaysia dalam masa kurang 30 minit bagi membuktikan kaedah ini mampu menghasilkan *Mobile App* dengan pantas dan berkualiti setaraf dengan Mobile app lain di internet.

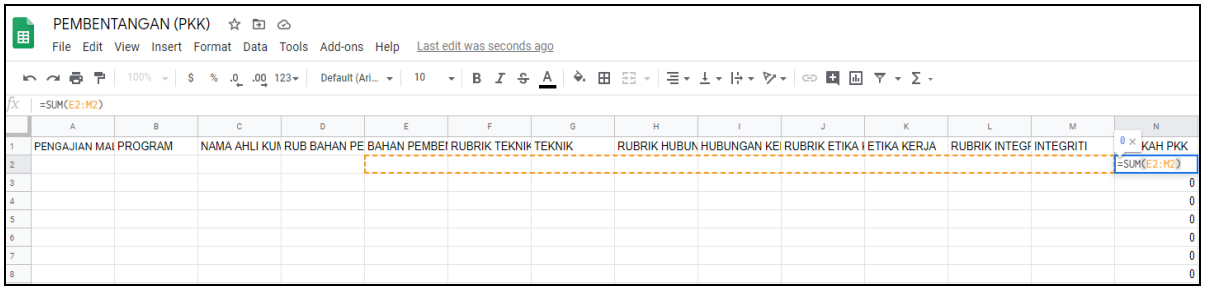
3.1 Membangunkan *Mobile App* Menggunakan Google Sheet Dan Appsheet
Berikut adalah langkah-langkah yang perlu dilakukan bagi membangunkan *mobile app* dengan menggabungkan Google Sheet dan Appsheet.

3.1.1 Hasilkan Dokumen Menggunakan Google Sheet
Perkara pertama yang perlu dilakukan ialah menghasilkan satu *spreadsheet* menggunakan Google Sheet yang terdapat dalam Google Drive. Sebagai contoh *spreadsheet* yang akan dilampirkan dalam penulisan ini ialah markah PKK Pembentangan bagi kursus MPU 21012 Pengajian Malaysia yang dilaksanakan di Politeknik Sultan Mizan Zainal Abidin. Bagi kursus ini penilaian PKK Pembentangan mengikut rubrik melibatkan markah Bahan Pembentangan, Teknik Pembentangan, Hubungan Kerja, Etika Kerja dan Integriti. Oleh kerana itu *spreadsheet* yang dihasilkan adalah sebagaimana berikut :

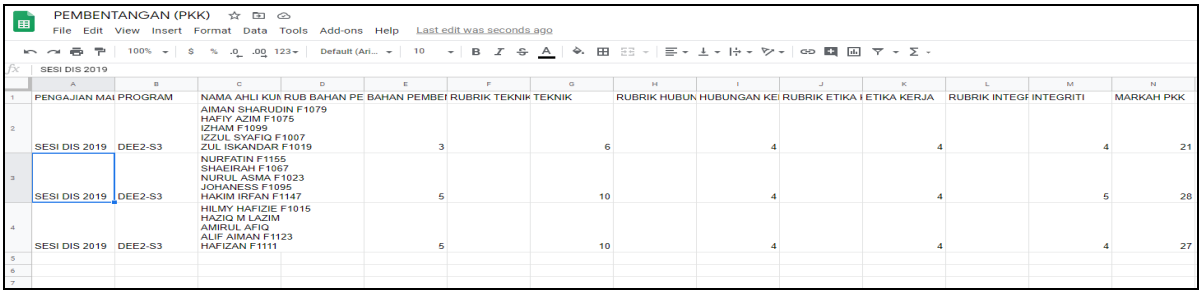


Rajah 1 : Spreadsheet Pembentangan PKK

Kemudian setkan formula pengiraan markah PKK pada ruangan yang sepatutnya. Pengguna juga hendaklah mengisi maklumat markah pelajar sekurang-kurangnya untuk tiga baris pertama kerana apabila ia dihubungkan dengan Appsheet, sistem dalam Appsheet akan membaca secara automatik bagi pengiraan markah untuk baris yang seterusnya. Contoh adalah sebagaimana berikut :



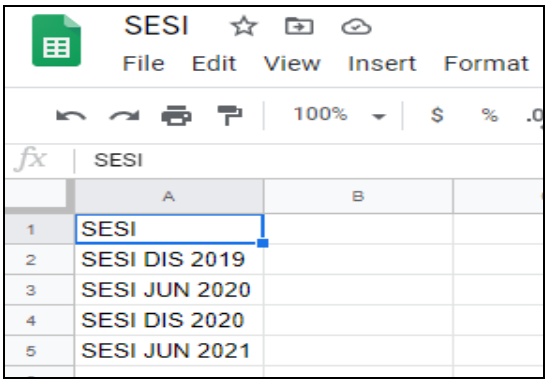
Rajah 2 : Masukkan Formula Kiraan Markah



Rajah 3 : Mengisi Tiga Baris Pertama

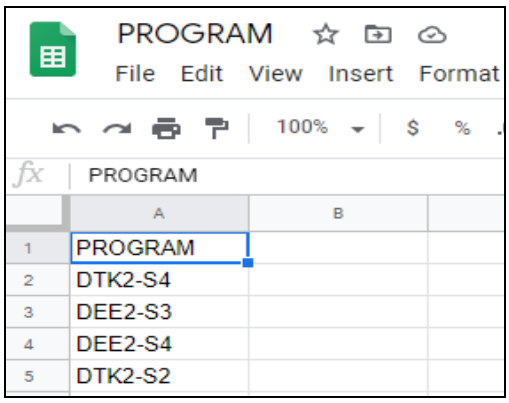
Sebelum data ini di tukar menjadi *mobile app* menggunakan Appsheet pengguna boleh menambah beberapa data *spreadsheet* sebagai data sokongan untuk di hubungkan dengan Appsheet supaya *mobile app* yang terhasil lebih menarik. Contoh adalah sebagaimana berikut :

a) Hasilkan *Spreadsheet* Sesi untuk Memaparkan pilihan sesi pada ruangan Sesi.



Rajah 4 : *Spreadsheet* Sesi

b) Hasilkan *Spreadsheet* Program untuk memaparkan pilihan program pada ruangan Program.



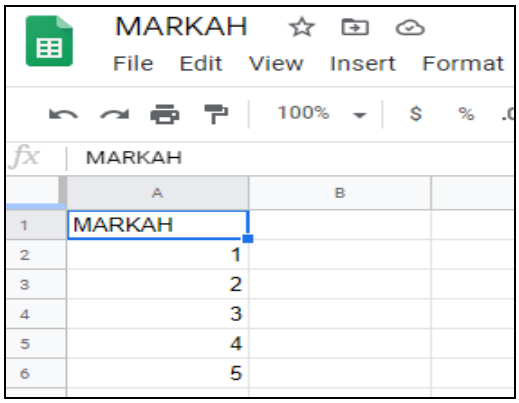
Rajah 5 : *Spreadsheet* Program

c) Hasilkan *Image* Rubrik Bahan dan sebagainya untuk memaparkan gambar pada ruangan Rubrik Bahan, Rubrik Teknik, Rubrik Hubungan Kerja, Rubrik Etika Kerja dan Rubrik Integriti.



Rajah 6 : *Image* Rubrik Bahan

d) Hasilkan *Spreadsheet* Markah untuk memaparkan pilihan markah pada ruangan Bahan Pembentangan, Teknik, Hubungan Kerja, Etika kerja dan Integriti.



Rajah 7 : *Spreadsheet* Markah

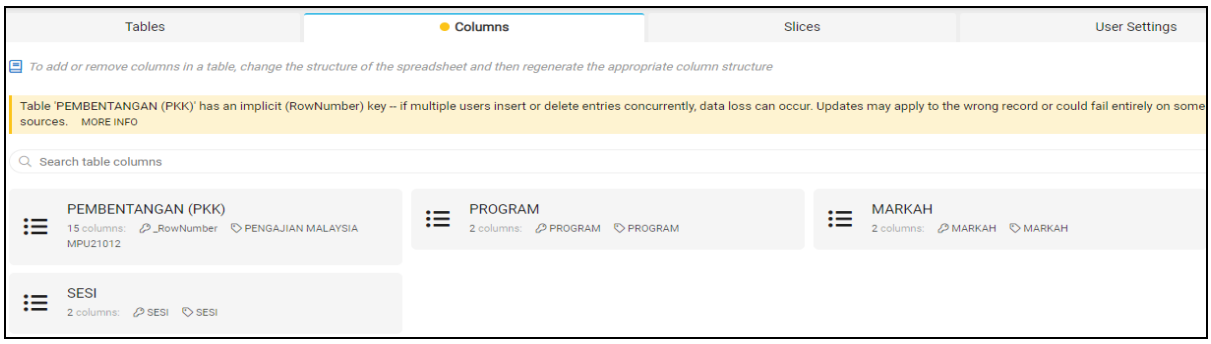
Kesemuanya hendaklah berada dalam satu *folder* yang sama supaya Appsheet dapat mencapai dan memaparkan arahan-arahan tersebut dalam *mobile app* yang akan dibangunkan nanti.



Rajah 8 : Dokumen Dalam Folder Pembentangan PKK

3.2 Jadikan Dokumen Sebagai Mobile app Menggunakan Appsheet

Apabila kesemua dokumen yang diperlukan telah siap dihasilkan menggunakan Google Sheet pengguna boleh terus ke Appsheet.com untuk *sign up* akaun. Untuk memudahkan proses, pengguna hendaklah terus *sign in* menggunakan akaun Google yang menyimpan *spreadsheet* yang telah dihasilkan sebagaimana penerangan yang lepas. Seterusnya pengguna boleh terus klik *Start with your own data* untuk memulakan projek. Data-data yang dihasilkan menggunakan Google Sheet akan disambungkan kepada Appsheet apabila ianya dimuat naik ke dalam sistem data Appsheet. Data-data sokongan pula akan disambungkan kepada data utama apabila formula tertentu disetkan pada data utama menggunakan fungsi yang terdapat pada ruangan Colums Data Appsheet.



Rajah 9 : Data Spreadsheet Yang Dimuat Naik Ke Dalam Appsheet



Rajah 10 : Contoh Formula Bagi Menghubungkan Data Sokongan Kepada Data Utama

Apabila kesemua tetapan berfungsi dengan baik pengguna hanya perlu memasukkan angka markah dari data sokongan yang disambungkan kepada data utama dan kemudiannya Appsheet akan membuat kiraan secara automatik untuk menghasilkan markah penilaian PKK.

4. DAPATAN KAJIAN

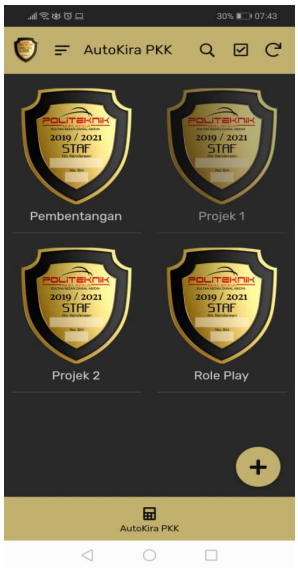
Keberkesanan penggunaan Google Sheet Dan Appsheet dalam proses membangunkan app pengiraan markah penilaian kerja kursus telah diuji oleh penyelidik sendiri. Sebagai seorang yang berlatar belakang Pengajian Islam dan tidak mempunyai kepakaran dalam bidang pembangunan app, penyelidik mendapati kaedah ini sangat mudah dan ringkas dalam membantu sesiapa sahaja untuk membangunkan *mobile app* walaupun tidak mempunyai kepakaran dalam bidang IT. Hasil kajian juga mendapati setiap arahan yang diberikan oleh penyedia perkhidmatan mudah difahami dan formula yang perlu ditetapkan bagi menghasilkan input dan output adalah sangat senang dan ringkas. Penulis juga sangat bersetuju bahawa dengan kaedah ini, app yang dibangunkan senang untuk dikawal dan dikemaskini sekiranya terdapat perubahan dan kesilapan. Selain itu, kaedah ini juga membantu pengguna membangunkan *mobile app* dengan lebih cepat dan pantas. Hasil penelitian juga mendapati app yang dibangunkan dengan kaedah ini berjaya disiapkan dalam masa kurang 30 minit.

4.1 Mobile App Yang Dibangunkan Menggunakan Google Sheet Dan Appsheet

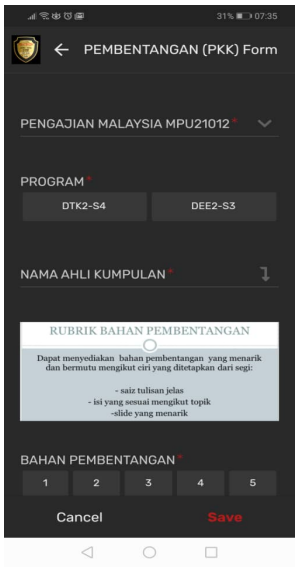
Topik ini akan membentangkan *mobile app* yang terhasil dengan menggunakan kaedah ini. Antara *mobile app* yang dibangunkan ialah AutoKira PKK untuk kegunaan pensyarah kursus MPU 21012 Pengajian Malaysia di Politeknik Sultan Mizan Zainal Abidin. Selain itu *mobile app* pengiraan markah amali bacaan solat & surah hafazan untuk kegunaan pensyarah kursus DUA2012 Sains Teknologi & Kejuruteraan Dalam Islam juga turut dibangunkan menggunakan kaedah ini.

4.1.1 AutoKira PKK

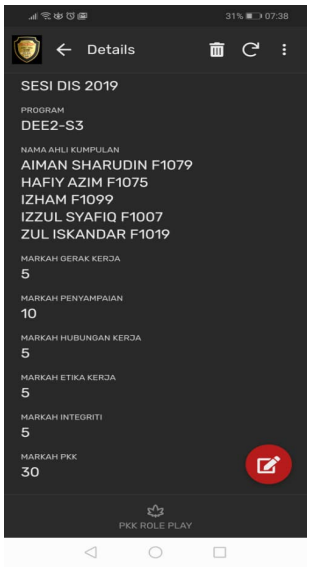
AutoKira PKK merupakan sebuah *mobile app* pengiraan markah yang dibangunkan untuk kegunaan pensyarah kursus MPU 21012 Pengajian Malaysia di Politeknik Sultan Mizan Zainal Abidin. AutoKira PKK mengandungi borang markah penilaian kerja kursus yang melibatkan penilaian Projek 1 dan Projek 2, penilaian Role Play dan penilaian Pembentangan. AutoKira PKK juga akan memaparkan setiap markah yang dimasukkan mengikut tetapan yang dilakukan oleh pengguna. Contoh paparan AutoKira PKK adalah sebagaimana berikut :



Rajah 11 : Paparan Muka Depan AutoKira PKK



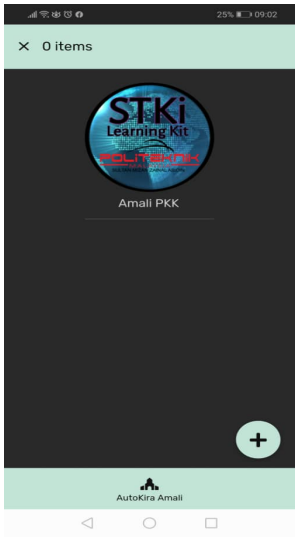
Rajah 12 : Paparan Borang Markah AutoKira PKK



Rajah 13 : Paparan Markah

4.1.2 AutoKira Amali

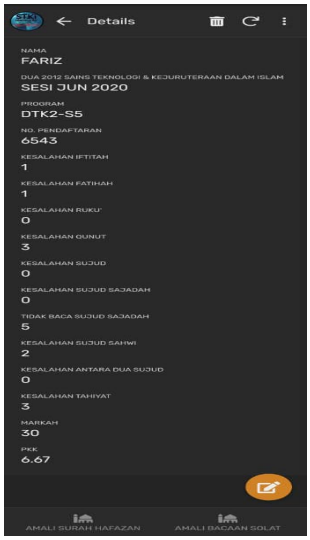
AutoKira PKK merupakan sebuah *mobile app* pengiraan markah yang dibangunkan untuk kegunaan pensyarah kursus DUA 2012 Sains teknologi & Kejuruteraan Dalam Islam di Politeknik Sultan Mizan Zainal Abidin. AutoKira Amali mengandungi borang markah penilaian kerja kursus yang melibatkan penilaian Amali Solat dan Surah Hafazan. AutoKira Amali juga akan memaparkan setiap markah yang dimasukkan mengikut tetapan yang dilakukan oleh pengguna. Contoh paparan AutoKira PKK adalah sebagaimana berikut :



Rajah 14 : Paparan Muka Depan AutoKira Amali



Rajah 15 : Paparan Borang Markah AutoKira Amali



Rajah 16 : Paparan Markah

5. KESIMPULAN

Berdasarkan penerangan, pelaksanaan dan hasil yang diperolehi dalam membangunkan *mobile app* menggunakan Google Sheet dan perisian atas talian Appsheet yang dibentangkan dalam penulisan ini jelas menunjukkan bahawa Kaedah ini amat bersesuaian kepada pensyarah terutamanya bagi mereka yang tidak mempunyai kepakaran dalam

bidang pembangunan aplikasi mudah alih kerana ia dapat membantu mereka menghasilkan *mobile app* pengiraan markah sendiri walaupun mereka bukan pakar dalam bidang pembangunan app. Ia juga dapat menarik minat pensyarah dengan teknologi dalam pendidikan kerana fungsinya yang menggabungkan pendekatan proses PdP dan teknologi terkini. Ia juga dapat memberi pengalaman yang baru dan menarik minat pensyarah dalam melaksanakan PdP bersesuaian dengan situasi semasa negara yang berhadapan dengan COVID-19. Perkembangan ini dapat membantu merancakkan lagi proses PdP kerana mampu menghasilkan produk pendidikan berasaskan teknologi yang ringkas, mengelakkan penggunaan kertas, mudah dibangunkan dan menjimatkan kos selaras dengan IR 4.0.

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DESIGN AND FABRICATION OF SEA TRASH BIN

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Abstract. Water pollution is the presence in or introduction to the contamination of water boundaries, including oceans, rivers, lakes, aquifers, and groundwater. This condition usually occurs as a result of human activities. Water pollution occurred when contaminants introduced into the natural environment, and this may become a threat to marine or aquatic life. This project was intended to solve the problem of collecting the floating debris on the water surface. The objectives of the project are to design and fabricate the floating trash bin with functional analysis regarding the amount of collected debris and its efficiency. The floating trash bin is built on the platform with the diameter 34.5 cm of the container body, and the height is 44 cm while the capacity of the submersible pump is 5000 LPH which is supplied from the electricity of 220-240V/50 Hz. The work fabrication applied a metal cutting process to cut the steel structures, with MIG and TIG welding processes to join the steel structures permanently and fastened the steel platform with the container body using bolts and nuts. Water then flows into the container body along with the floating debris and the debris will be trapped into the net during operation. Then, the debris is disposed into the dry trash bin. Based on the experimental results, it is known that the pump can suck water along with all the floating trash debris within 1.3 minutes on its first try, 1.42 minutes on the second try while 1.58 minutes on the third try. This is consistent with the hypothesis proposed. It could be concluded that the stronger the suction capacity of the pump, the stronger the water is sucked into the flask container body along with the debris.

KeywordS: Water pollution, floating debris, submersible pump, sea trash bin

1. INTRODUCTION

Plastic is the most common material that can be found in the ocean. There is a lot of plastic present in the ocean as it is, and more and more are being dumped there every day (Emaze, 2016). Plastic waste can be found everywhere, including landfills, the streets, and in the ocean. However, only 1 to 3% of plastic waste is recycled (Wehrli, 2016). Plastic bags, which are made of polythene, causes pollution all its life – from manufacturing to disposal. Its production uses up 8% of the oil resource. Its manufacturing process is harmful to the environment, and it remains toxic to the environment after been threw it away (Wehrli, 2016). Plastic bags are one of the leading causes that contribute to marine pollution, and the focus to reduce plastic bag consumption is ongoing day by day. In the present day, supermarkets and shopping stores have reduced issuing plastic bags to customers but at the same time, encourage them to bring their own bags. The main reason why most countries have banned plastic consumption due to the plastic does not biodegrade and remains forever. It breaks down in the ocean and photo-degrades into little pieces of itself. The number of plastic sized particles produced compared with plankton is 6 to 1. The plastic particles are mistaken as food by marine animals and kill them (Wehrli, 2016).

Another plastic product that contributes to water pollution is small plastic straws that come with most beverages from soft drinks to even a glass of water. At first, this small straw may not

seem like a lot, but when the amount is added up, plastic straws cause a big problem for the environment. During the ocean coastline cleanups, plastic straws make into the list of one of the most found ocean trash including plastic bags. In early 2018, Ocean Conservancy's TIDES system shows that straws/stirrers are the 11th most found ocean trash in ocean coastline clean-ups, contribute about 3% of recovered trash (Anapol, 2018). Most cases involving these straws and plastic polluting the oceans are hurting and taking the marine lives. For example, one incident, where researchers off the coast of Costa Rica have found a plastic straw that had been embedded in the nostril of an Olive ride sea turtle. They successfully removed the straw from its nostril. It seems that the sea turtle has accidentally swallowed the straw, and then had it stuck up its nostril while trying to cough the straw out (The Washington DC, 2012). Plastic straws are also a threat to seabirds, as they can be quickly picked up and swallowed, suffocating, and choking the bird. Each year, the study shows that over one million seabirds die from ingesting plastic (The Washington DC, 2012).

Another ocean pollution cause is cigarette butts. Most studies have shown that cigarette butts contain many toxic chemicals, including arsenic, nicotine, various heavy metals, and a class of compounds called polycyclic aromatic hydrocarbons from discarded cigarette butts which resulted in serious threats on the oceans (Dangerfield, 2018). In addition, even small quantities of cigarette butts in ocean water can be fatal to fish and marine organisms. This is proven by a previous study tested two different cigarette butts – one smoked right down to the filter and another with a small amount of tobacco remaining – and one un-smoked cigarette, by putting a single butt in a liter of water with fish (Dangerfield 2018). Another plastic product is polystyrene which is inexpensive with hard plastic features, which is the only polyethylene product with the most common usage in everyday life. Polystyrene contains the toxic substances Styrene and Benzene, causes carcinogens and neurotoxins that are hazardous to humans (Nyberg, 2018). Hot foods and liquids start a partial breakdown of the Styrofoam, causing some toxins to be absorbed into the bloodstream and tissue. Polystyrene food containers produce the toxin Styrene when contact with warm food or drink, alcohol, oils, and acidic foods causing human contamination and pose a health risk to people (Nyberg, 2018).

Nowadays, the problem of waste disposable becomes a severe problem as there was massive floating trash at water surfaces such as at sea, lakes, and rivers. Moreover, there will need more resources such as workers, and costs are required to collect the floating trash at the water though it is so difficult. Furthermore, there will a need for more specific, and high technology to collect the floating trash in the water. To conclude, there will be a hard challenge to collect all floating trashes at the water surface in the future as more floating trashes are available at the water surfaces of lakes, rivers, and sea. Since the area of the sea is larger which requires a great deal of time to collect all the rubbish of the entire ocean. There are several types of methods that can prevent trash polluting the sea and lake, which give an outstanding impact to collect all the trash in the sea, and with this solution, it will reduce the trash that is floating in every place on the seaside. Some of them are including Ocean Clean Up, Trash Wheel, and Seavax. The Ocean Clean-up was launched by Boyan Slat at the center of the sea. The Ocean Clean-up Foundation develops technologies to elude plastic pollution from the oceans and prevent more plastic debris from inflowing ocean water (Strege, 2014). Their predictions indicate that a full-scale ready system is reliable to clean up 50% of the Great Pacific Garbage Patch in 5 years. According to the researchers, the majority of plastic by mass is currently in the larger debris at the ocean (Strege, 2014).

Another project was The Inner Harbour Water Wheel, or popularly known as "Mr. Trash Wheel" which combines old and new technologies to harness the solar and power of water to collect floating trash and debris flowing down the Jones Falls River (Partnership, 2016). The rivers current provides power to turn the water wheel, which lifts floating trash and debris from the water and deposits them into a dumpster barge. When the water current is not enough to provide the power, a solar panel array provides additional power to keep the machine running. When the dumpster is full, it was towed away by boat, and replaced with a new dumpster. Since May 2014, the Trash Wheels have successfully collected over 1.7 million lbs

of trash and debris including 684,000 plastic bottles, 796,000 polystyrene containers, and 10 million cigarette butts (Partnership, 2016). Another sea trash collector is Seavax, when built, it will be 44 meters (144 feet) long, have a suction head some 13.5 meters (44 foot) wide, and will be fully autonomous (Frost, 2016). This machine is roaming, a satellite-controlled aluminum platform powered by sun and wind operates like a giant vacuum cleaner, chewing up and compressing the toxic garbage. The system in all sizes of trash, from huge fishing nets to deadly microparticles, can be swept or sucked up, ground down, and stored in SeaVax's tanks (Frost, 2016). Sensors help detect the trash, and sonar technology keeps marine and birdlife from getting caught in the 160 ft long vessel. The compacted cargo is then either collected at sea or returned to the port for recycling. Deck-mounted solar panels and two wind turbines provide electricity to electric pumps and filters that suck up plastic solids and microplastics. The objectives of this project are to design the sea trash bin, fabricate the structure of the sea trash bin and to analyze the sea trash bin with regards to its design capability, pump efficiency, and the amount of sea trash bin collected.

1. METHODOLOGY

The scopes of this project are:

a. Design the main body using Autodesk Inventor for the detailed and assembly drawings.
b. Sketch the main body using Microsoft Visio for the schematic diagram.
c. Assemble the main body part by part with permanent and nonpermanent joinings
d. Use a submerged water dry pump for the suction.
e. The flow rate of the pump is 5000 LPH.
f. The diameter of the collector is 34.5 cm, and the length is 44 cm.
g. The material for the filter is a polymer bag.
h. The material for the collector's main body is hard plastic with Styrofoam.
i. Steel is used as material for the bracket.
j. Assemble the pump and electrical wiring with the electricity of 220-240V/50 Hz
k. Calculate the flow rate of the pump, dimension of the main body, size of the main body, length of the C channel, and the dimension of the plastic filter bag.
l. Analyses all the calculations using Microsoft Excel and form the graphs for further analysis.

Figure 1 shows the floating trash bin flow chart. The flow charts start with the literature related to the current project. The literature review is the first step for an overview of the context of the current project. There is a need to understand the project overview to parallel with the problem statement and the purposes of the project and finding previous or similar methods to facilitate people to collect the trash in the sea. Before starting the fabrication and assembling processes, process planning is required to be charted out. These process planning are used as guidelines to be followed so that the final product meets the requirement, and time could be managed precisely. This process will determine the efficiency of the project to be completed. Regulating and analyzing these steps is very important as each of them has its criteria to be followed.

Idea generation is the overall process including idea creation development and communication which are abstract, concrete, or visual. The processes include the process of constructing through the idea, innovating the concept, developing the involved processes, and bringing the conceptual designs to reality. It is part of the idea management flow that focuses on the possible solutions to perceived or actual problems and opportunities. This project applies the functional decomposition chart which is a method of analysis that separates a complex process to show its detailed elements as shown in Figure 2. This chart facilitates the understanding and management of large and complex processes and can be used to help solve problems and aid in the development of business operations, computer programming, machine learning, and a variety of other fields. Functional decomposition has its origin in mathematics, where it refers to the process of analyzing the links and relationships

between all the components that create a functional relationship so that the original function may be recomposed.

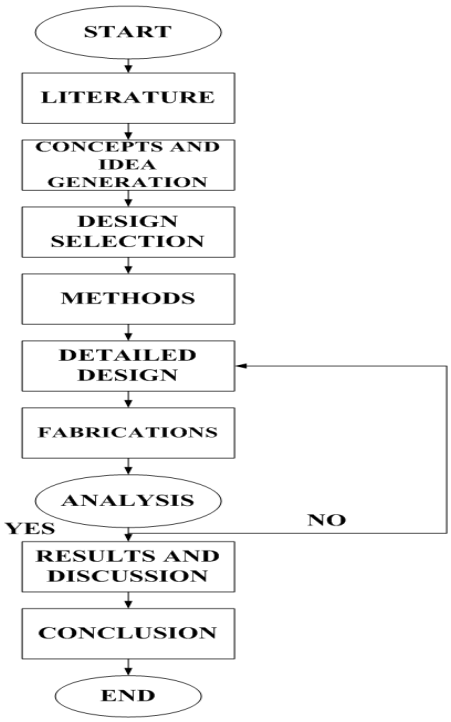


Figure 1: The Floating Trash Bin Flow Chart

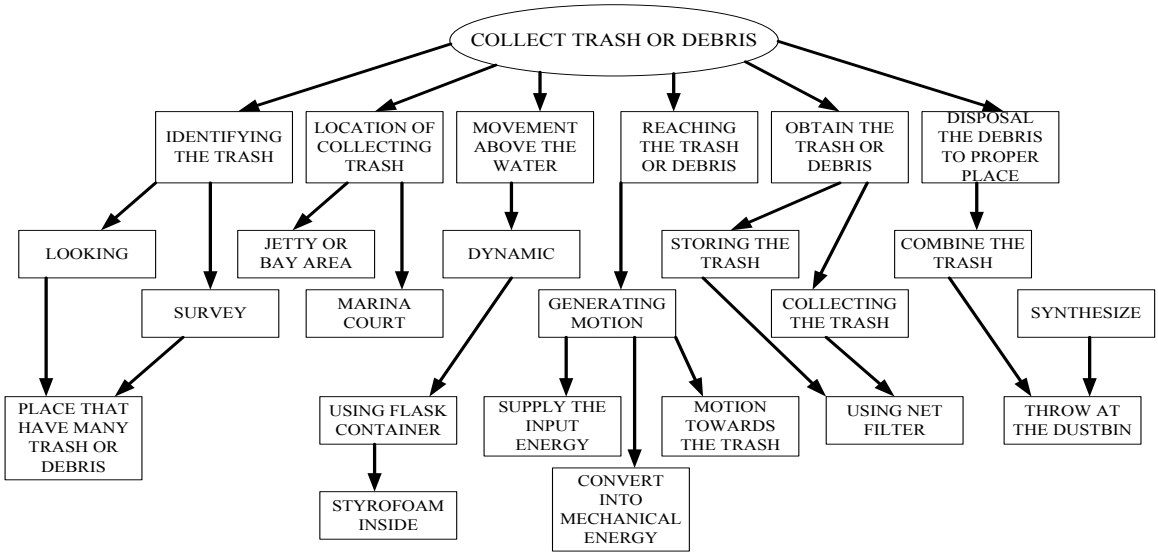
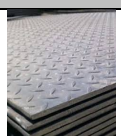
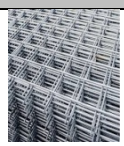


Figure 2: Function Decomposition Chart

This project also applies the morphological chart to generate ideas in terms of analytical and systematic manners which provides possible solutions or components. Usually, the functions of the product are representing as the starting points to generate the possible ideas that appeared in the morphological chart. The various functions and subfunctions of a product can be established through a function analysis. However, function analysis does not guarantee that all the relevant (sub) functions are identified. Table1 shows the morphological chart for a floating trash bin that including possible solutions for each detailed function.

Table 1: Morphological Chart

Function	Important	Possible solutions					
Type of pump	9						
		Centrifugal pumps	Submersible pump	Vacuum pump	Iron pump	Well and sump	Pump General use
Main body	7						
		Biogas anaerobic	Stainless steel litter bin	Tong Drum BBQ	Tong Drum Plastic	Rice Flask	
Filter Net	5						
		Net fish TL	Fish net	Poly net			
Steel	8						
		Pipe	C channel	Beton	Plat	Elbow	Wire mesh
Bracket	7						
		Scl-101-3	Cp-sg slotted	z-202	L-202	Sl-102	c-102-6
Bolt nut	6						
		Elevator bolts	Hex blots	Carriage bolt	Lag bolts	Set crew	Socket screw

A selection of designs process is the analytical process to determine t the variations of design and will choose the finalized design that is good to be constructing. The idea of choosing the finalized design is shown in the drawings. This will conclude the research information and decomposition characteristics that need to exist in the design. Table 2 shows different designs for the floating trash bin which comprises different components.

Table 2: Different Floating Trash Bin Designs

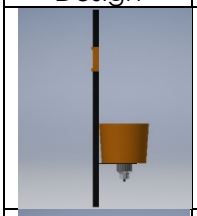
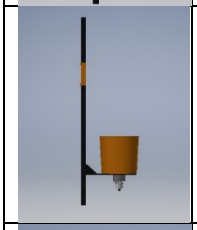
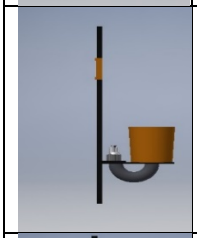
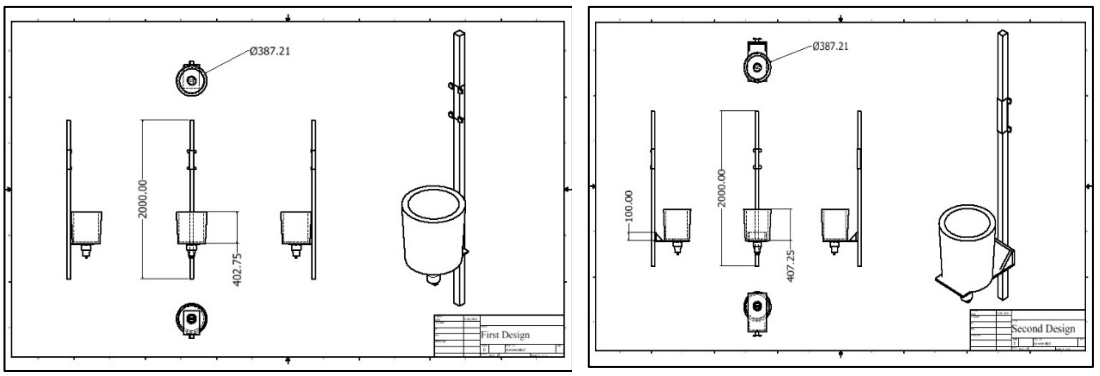
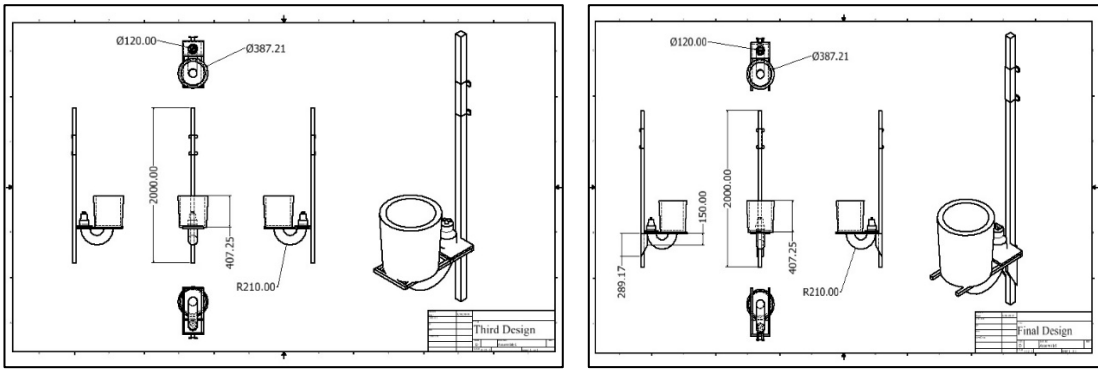
Design	Details
	a) Use mild steel to fabricate the body. b) There is no joint between the main body and the steel. c) Unstable because of no steel plate or barrier between the mild steel square and the main body.
	a) Use mild steel to fabricate the body. b) There is a joint between the main body and the mild steel, but the submersible pump is placed upside down. c) When the pump upside down so it makes the pump unusable.
	a) Use mild steel to fabricate the body. b) The pump had placed the correct way to suck in the water through the PVC pipe, but there is no joint or barrier between the main body and the mild steel square. c) Unstable due to the overweight from the mass of the pump and the main body.
	a) Use mild steel to fabricate the body. b) There is a joint metal below the steel plate, and the pump was placed correctly. c) Stable and the water suction from the pump are normal.

Figure 3 shows the different assembly drawings for the designs. There were three designs were selected (Figure 3 (a), (b) and (c)) for the selection for the final design (Figure 3 (d)). The second design for the floating trash bin does not have the PVC pipe but requires mild steel barrier plate joints. As for the third design for the floating trash bin, the design requires a PVC pipe that connected to the submersible pump without attached the mild steel barrier plate joint. While for the final design, the floating trash bin requires the joining of the mild steel barrier plate is attached between the PVC pipe and the submersible pump. Figure 4 shows the schematic diagram of floating trash bin and Figure 5 shows the full assembly of the project.



a) First Design Assembly Drawing

b) Second Design Assembly Drawing



c) Third Design Assembly Drawing

d) Final Design Assembly Drawing

Figure 3: Variations of Assembly Drawing for Designs

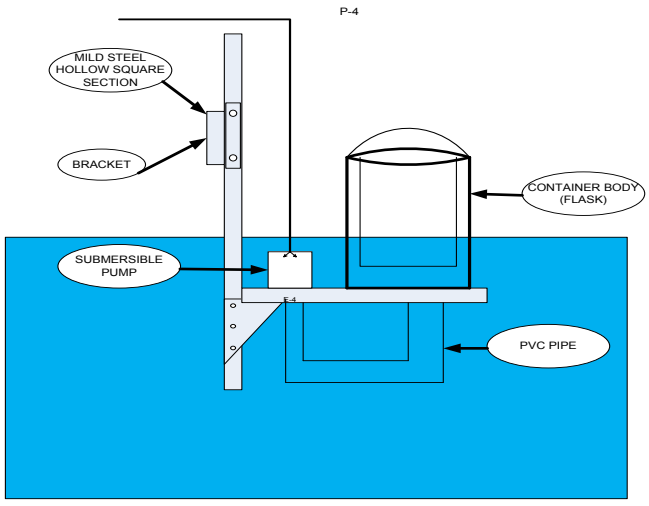


Figure 4: Schematic Diagram of Floating Trash Bin



Figure 5: Full Assembly

3. ANALYSIS AND DISCUSSION

In this section, the details and study of the sea trash bin project are presented. Further discussions of the specific project are obtained based on the result of this research and experimentation on the types of materials used in the project, things will be described the prototype, software analysis, testing, and prototype specification. A procedure that will be taken to construct this prototype is followed by engineering-type also will fulfill the specification. After this project has been successfully fabricated, it will be analyzed and tested. Theoretically, the floating trash bin prototype is collecting the trash by the shore of the sea, easy to assemble it on the deck work fine when using at any deck especially on the seaside and safe to be used in which does not hurt the aquamarine. Also, this prototype can ensure to have a high safety characteristic and allows users to apply usability in a real situation most of all the worst area of the seashore. Engineering analysis is the most important to identify and determine the flow rate of the water suck thought the pump and the assumption of the flow rate. In this engineering analysis such as the water flow rate will be used. This project aims to test the flow rate and the power of the pump on the prototype that has been developed. This project was being tested at the lake and it has tested with three tests which take the first test, second test and third test. The test was being experimented due to find out how much debris can be collected with different types of the debris of plastics and it measuring the time taken by stopwatch.

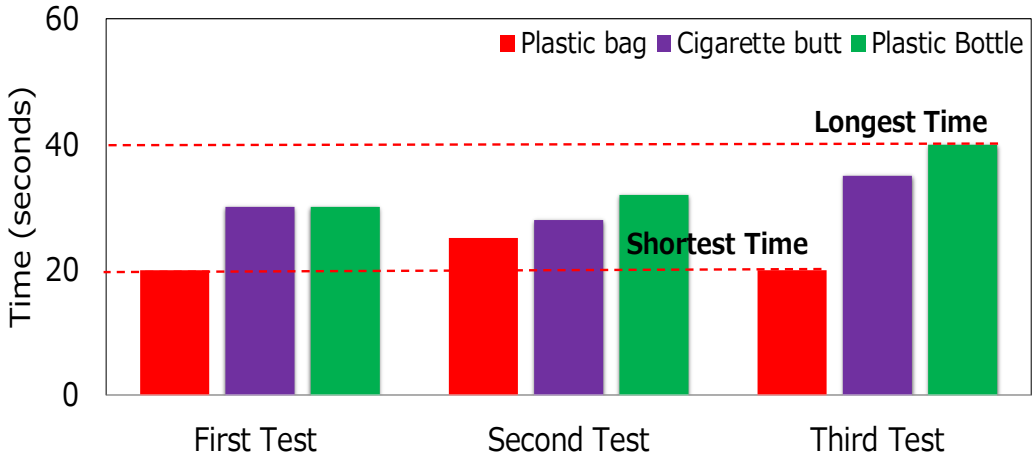


Figure 6: Graph Analysis of Different Debris collecting per seconds

Figure 6 shows the suction water pump of collecting debris per second with different types of plastics. Based on the experimental results, it is known that the pump can suck water along with all the floating trash debris within 1.3 minutes on its first trial and this is because of the pump function so well when sucking the water into the pipe and the debris is still fully light and have less weight. Also, it takes 1.42 minutes on the second trial of collecting debris, and the time increase because the weight of the plastic debris also increases due to water that flow through inside the following plastic. Moreover, the submersible pump also has low power to suck in the water due to the weight of the debris. Next, it takes 1.58 minutes on the third trial of collecting the debris and the time also increases due to the increased weight of the debris with the increasing time. This is consistent with the hypothesis proposed. It could be concluded that the stronger the suction capacity of the pump, the stronger the water is sucked into the flask container body along with the debris.

4. CONCLUSION

As a conclusion, this project is successfully developed and tested the floating trash bin which lead to reducing the population of debris or floating trash at the sea, lakes, or rivers using a submersible pump with a capacity of 5000 LPH which is supplied from the electricity of 220-240V/50 Hz. Overall, the objectives of the project are designing the floating trash bin that could function properly, fabricate the structure of the floating trash bin, and analyzing the floating trash bin with regards to its design capability, pump efficiency, and the amount of sea trash bin or debris collected. The first objective for the design of a floating trash bin that could functional is been achieved. Next, the actual design of the floating trash bin is made by using Autodesk Inventor Professional 2019. The second objective is to fabricate the structure of the floating trash. All the components for the floating trash bin such as mild steel hollow square section, aluminum plate, submersible pump, container body (flask), bracket, PVC pipe, and its connector and the filter net are assembled with cutting, welding, and drilling process. This makes the second objective of this project also has achieved. The third objective of this project is to analyse the floating trash bin with regards to its design capability, pump efficiency, and the amount of sea trash bin or debris collected. At first, the floating trash bin was being tested at the lake for analyzing it, and while being tested, it is known that the pump can suck water along with all the floating trash debris within 1.3 minutes on its first trial, 1.42 minutes on the second trial while 1.58 minutes on the third trial. It could be concluded that the stronger the suction capacity of the pump, the stronger the water is sucked into the flask container body along with the debris.

For recommendation or improvement, larger capacity power of the submersible pump is required to generate higher suction capacity to siphon more water with debris into the main container body for the filtration. Next, increase the water flow rate that flows through the main body to produce higher flow using the smaller diameter of PVC pipe to the main container body.

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DESIGN AND FABRICATION OF MULTIPURPOSE CHOPPER

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Abstract. In this time of era, machines have become an indispensably portion of human life because there are very limited research done on a chopping machine. People are being competitive and trying to save time, use minimal floor space, portable, prefers greater machines that gives better efficiency and quality with a cheaper price.This contribution aims to report on the development, includes design and fabrication of a multipurpose chopper for the use of smaller or medium enterprise. This research includes the consideration of design, working mechanisms assisted by design tool (AutoCAD). A set of questionnaires is done in obtaining the information regarding their goals in meeting the requirements. The result of this study is a multipurpose chopper machine that is able to chop corn stalk, banana stems and sugarcane stalk into smaller sizes, easily operated by the user and cheaper compared to market prices. Finally, this paper also suggests various techniques and opportunities of product planning in manufacturing industries as future recommendations.

Keywords: Multipurpose chopper, design, fabrication, product development.

1. INTRODUCTION

Manufacturing technology provides the productive tools that aids in the rising standard of living as well as ease the users in everyday life. Although traditional method is also favorable, it is weaker because of the longer time and many labor that it needs. Minimum two people are required to utilize any chopper machine not because it is intolerable but to avoid injuries. (Jamshidpouya & Hashjin, 2018) this type of devices will probably use in urban or semi urban areas since the main consumers of traditional foods are from that areas. (S.N, Raskar, Tate, Rajguru, & Shinde, 2017). This paperwork aims in the development and fabrication of the design that eases the users and in affordable price range. Multipurpose chopper serves the purpose of chopping the corn stalks using electrical system that can be used in small to medium sized enterprises (SME's). Corn has become a staple food with the total production surpassing wheat and rice. Once the corn grain harvested, the corn stover is the residue that is left over which needs to be organized in maintaining the cleanliness of the farm. The stover includes stalks, cobs, husks, leaves and non-grain portions of the plant. (Schlesser, 2007). In 1999, more than 90% of corn stover was left in the field with less than 1% of the stover being collected for industrial processing and about 5% being baled for animal feed and bedding. (Glassner, Hettenhaus, & Schechinger, 1999) The rest of corn stover is harvested and widely used as animal feeds for ruminants and livestock bedding. Figure 1 shows the parts of a corn plant.

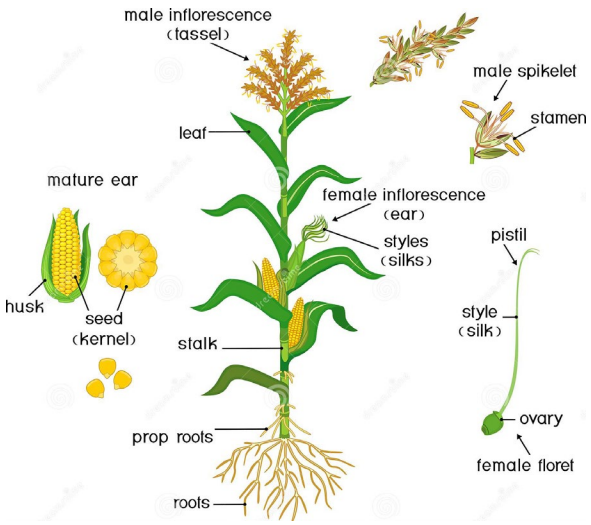


Figure 1: Parts of a Corn Plant

2. LITERATURE REVIEW

Design is a crucial thing to have in developing a product for the visual view of the customer. From the design, the development problem can be tackled in forming a new and improvised device. According to (Pahl & Beitz, 2013), there are four different phases in design process which are product planning, conceptual design, embodiment design and detail design. The third phase suggest that the output is done in the form of technical drawing which are often in scale drawing as this research used AutoCAD in drawing the chopper. Fabrication is a process of building a product from a scratch either from raw semi-finished or raw materials. This process includes all the manufacturing process which are welding, bending, forming, cutting, drilling and others in obtaining the finished goods. It is also known as the action or process of manufacturing in inventing a product. Product development means the steps taken in understanding the consumers, markets, and competitors so that the products can be developed accordingly that suits the customer's needs. According to (Claessens, 2015), there are eight major steps in the new product development process as visualised below.



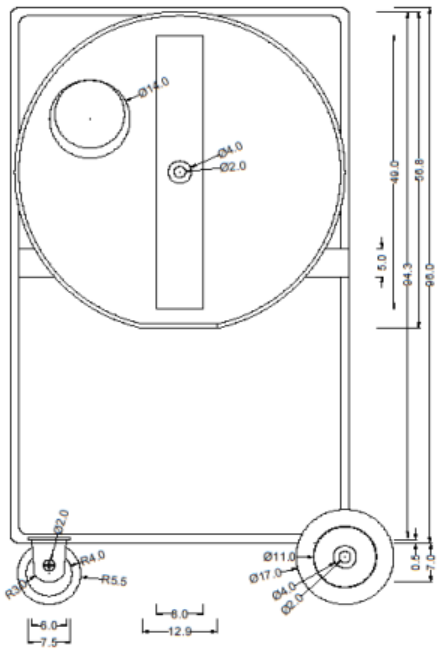
Figure 2: Product development process

3. METHODOLOGY

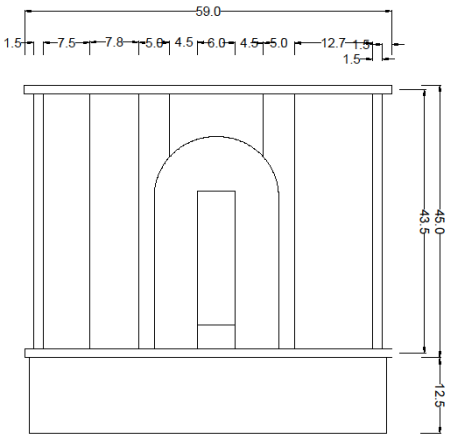
Reducing size of the materials seems to be the crucial part in chopping corns and others. Although there are many types of size reduction method such as cutting, shearing and crushing, shearing method selected due to its simplicity of operation. (Ziauddin, Huq, & Roy, 1995) The design of the multipurpose chopper consists of flywheel with cutting blade, where the sharp knives fixed in order to chop the stalks. The design illustrated using AutoCAD orthographic views as in Figure 3 below.



3D View



Front view



Top view

Figure 3: Orthographic view of multipurpose chopper

Materials used in developing the chopper are aluminium and stainless steel. The advantages of using both materials are as listed in Table below.

Table 1: Advantages of aluminum and stainless steel

	Aluminium	Stainless steel
Weight	Light and stable	Heavier
Corrosion resistance	Prevents corrosion by forming layer of oxide	High corrosion resistance
Strength	Less tensile strength but easily alloyed	Good strength in cold work or heat
Conductivity	High thermal conductivity	Less thermal and electric conductivity
Processing	Almost all methods Machining, welding, forming, extruding)	Ease of fabrication
Environment	Low melting point, easily reused	Not coated with toxic material and is recyclable

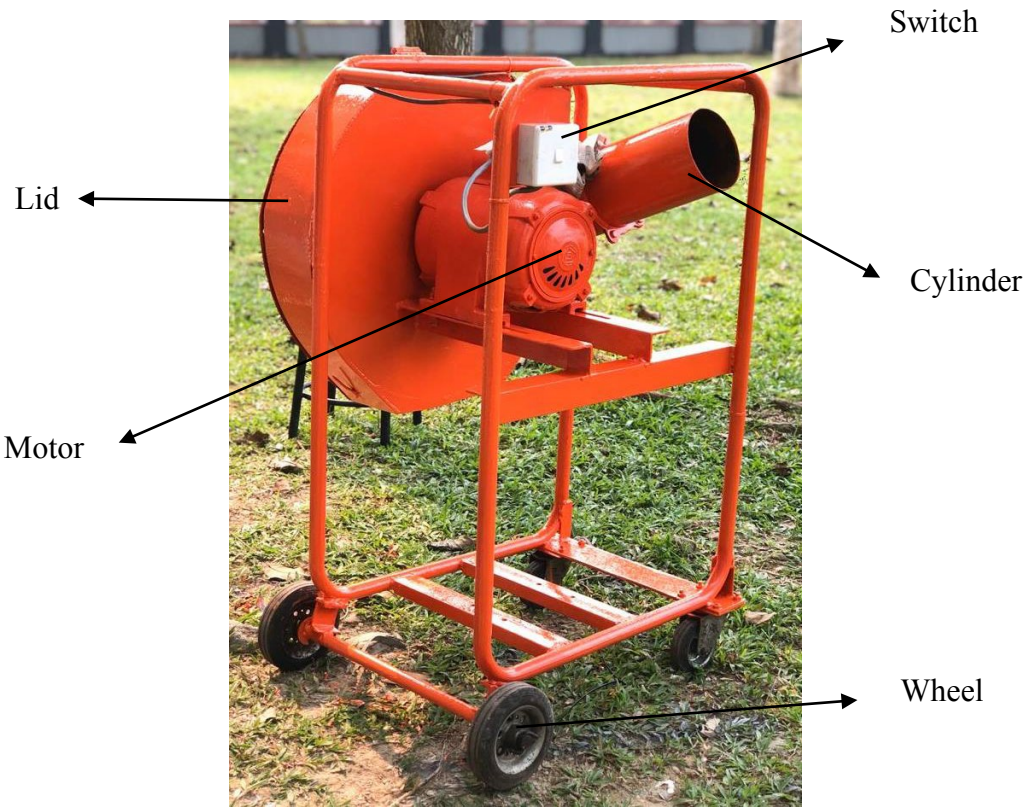


Figure 4: Multipurpose chopper

Figure 4 shows multipurpose chopper labelled with its parts. The parts included in the multipurpose chopper are the switch, cylinder, lid, wheel and motor. The switch installed on the back of the machine and used for switching ON and OFF this multipurpose chopper machine. The cylinder is quite big, and it used for inserting the corn stalks, banana stems and sugarcane. The most important parts are the motor that only uses one horsepower. On the other hand, the wheels used to lift or move objects and making it easy to move the machine anywhere. Finally, yet importantly are the lid to cover the blade inside and as a safety for the users. Lid have to be closed when the machine is still running to avoid injuries for the users.

4. DISCUSSION AND ANALYSIS

The design and development stage of the product are done after gathering information from questionnaire. It relies on the customer's focus which are the changing needs and preferences. The features of customer interest are implemented in the product that are rapid, easy cutting and greater safety yet reasonable price. The philosophy behind the method of identifying customer needs is to create a high-quality information channel that runs directly between customers in the target market and the developers of the product. This philosophy are built on the premise that those who directly control the details of the product including engineers and industrial designers must interact with customers and experience the using environment of the product. (Talapatra, Shakil, Mondal, & Islam, 2014)

In order to get the information, questionnaire are given to small to medium sized enterprises since they are the targeted group in using such a device. Results obtained to analyse project goals to meet the requirements. Survey was conducted to 15 people through a questionnaire. The results are as below. Figure 5 explained about the first question which is whether the existence of the product is known to the customers. From the pie chart, 86.7% respondents answered yes whereas 13.3 % did not know the existence of it.

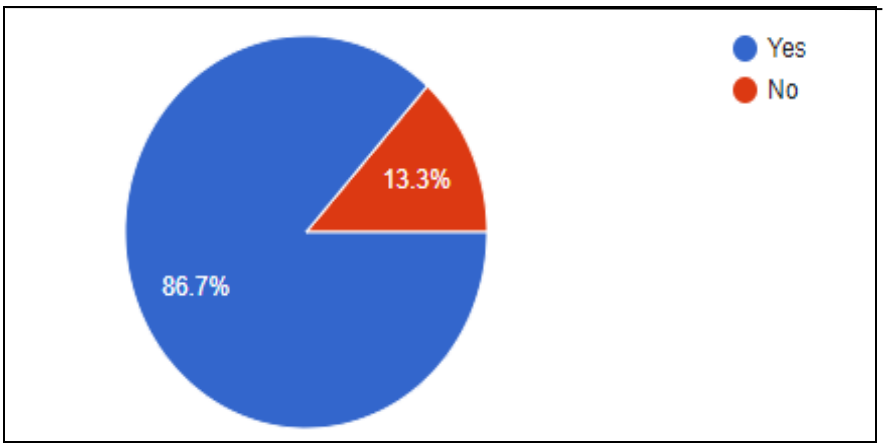


Figure 5: Multipurpose chopper

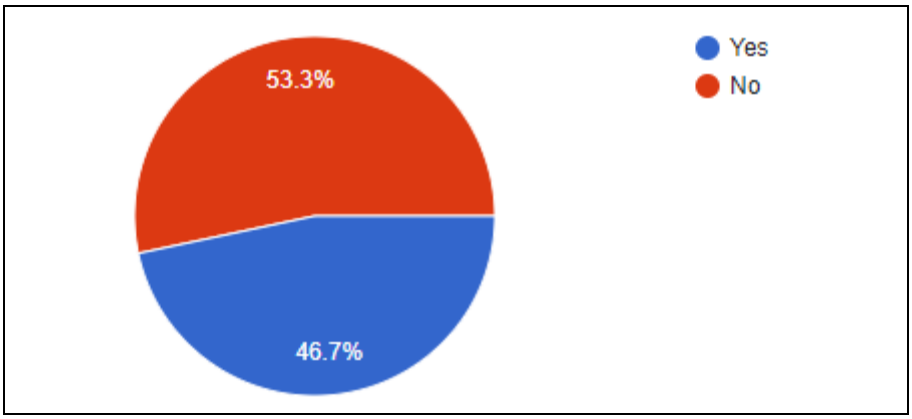


Figure 6: Percentage of corn stalk, banana stems and sugarcane in their area

Figure 6 shows the percentage of people who stated the plants either corn, banana or sugarcane are planted in the area. There are 46.7% people said the area is occupied with the plants while 53.3% said there is no that kind of plants planted there.

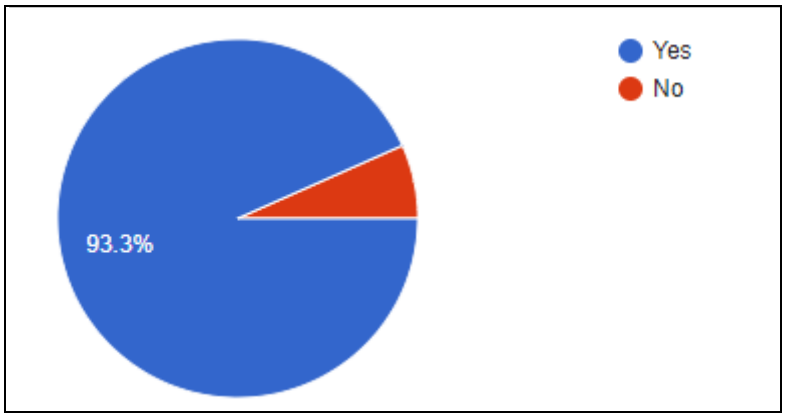


Figure 7: Reduce time and energy

Figure 7 shows that almost 95% respondents agreed to that statement which the multipurpose chopper reduce their time and energy while chopping the stalks.

Figure 8 shows the percentage of importance of this machine to their life which says 90% people agree with the statement and only one people disagree. Besides, there is a few people which is 33.3% say this machine is not really important for their life.

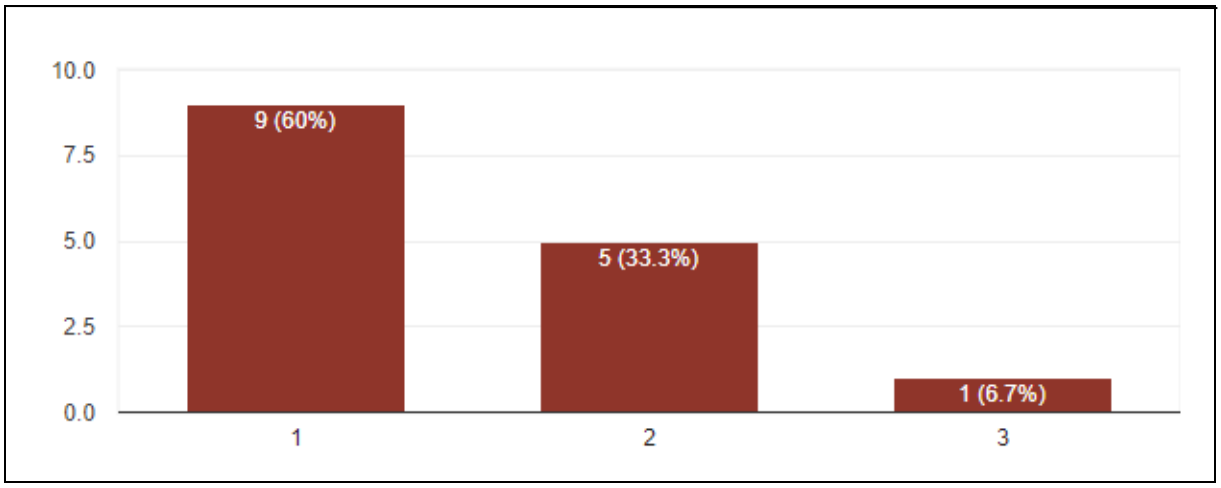


Figure 8: Importance of multipurpose chopper

5. CONCLUSION

A multipurpose chopper has been produced by utilizing local materials that are freely available on the market and cost very less compared to trending items in market. The multipurpose chopper is friendly user since a single person could operate it without a proper manual. The purpose is chopping corn stalk, banana stems and sugarcane stalk into smaller sizes. However, some minor modification can be done to improve the performance and quality for better purpose in future that are latest technology such as sensors, software programming where it can be automated remotely and able to produce real-time output. Besides that, type of material and the structure should be considered as the chopper needs lightweight criteria but high strength properties. The suggestion for future development that the respondents suggested in their questionnaire are add more blades to ease the chopping process, improve the materials used in getting better quality but with a cheaper price, use sensor to upgrade the device. Besides that, adding few upgrades to enhance the safety of the machine for the user such as installing the hold brake for blades to avoid users injuries, and make it portable for ease of carrying. The main constraint of this machine is the low initial cost and has low operating costs. (S.N, Raskar, Tate, Rajguru, & Shinde, 2017)

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KESAN PENAMBAHAN ABU TERBANG KELAPA SAWIT TERHADAP HASIL TUANGAN ALUMINIUM TULEN

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Abstrak. Aluminium merupakan logam yang digunakan secara meluas dalam industri automotif dan aeroangkasa kerana sifatnya yang ringan dan berketumpatan rendah. Aluminium perlu dialoikan bagi meningkatkan kekuatan dan kekerasannya supaya bersesuaian dengan aplikasi industri berkenaan. Walaubagaimanapun, dengan kos proses pengaloian adalah agak tinggi bergantung kepada bahan pengaloian yang digunakan. Abu terbang kelapa sawit yang merupakan salah satu hasil buangan pertanian dilihat sebagai bahan yang berpotensi untuk menggantikan bahan pengaloian yang sedia ada. Oleh itu, kajian ini dilaksanakan bagi mengkaji potensi abu terbang kelapa sawit sebagai bahan tambah kepada aluminium tulen. Objektif kajian ini adalah untuk mengkaji kesan penambahan abu terbang kelapa sawit ke atas sifat mekanikal dan fizikal tuangan aluminium tulen. Nisbah komposisi abu terbang yang dicampurkan ialah 3, 6, 9, 12 dan 15% relatif kepada berat aluminium. Sampel disediakan melalui tuangan pasir dan diuji dengan ujian tegangan, ujian hentaman Charpy dan ujian kekerasan mengikut piawaian ASTM. Hasil ujikaji menunjukkan nilai kekerasan dan kekuatan hentaman berkurang dengan pertambahan komposisi abu terbang, namun nilai kekuatan tidak menunjukkan perubahan yang signifikan. Selain itu, analisis mikrostruktur menunjukkan wujudnya porositi apabila komposisi abu terbang meningkat. Dapat diperhatikan juga permukaan patahnya adalah dalam keadaan rapuh. Secara keseluruhannya, kesan penambahan abu terbang ke atas aluminium tulen adalah yang paling baik pada komposisi 3%.

Kata Kunci: *aluminium, abu terbang, bahan tambah*

1. PENGENALAN

Pengaloian merupakan proses pencampuran dua atau lebih unsur sama ada logam atau bukan logam ke atas suatu logam tulen. Tujuan pengaloian adalah untuk memperbaiki sifat-sifat suatu logam tulen seperti rupabentuk, kekuatan, kekerasan, rintangan hakisan dan sebagainya supaya ia bersesuaian dengan aplikasi kejuruteraan tertentu. Namun, pengaloian merupakan proses yang agak sukar untuk dilakukan dan kosnya juga adalah tinggi, bergantung kepada jenis bahan yang digunakan. Walau bagaimanapun, teknologi semasa sering mempunyai keperluan yang tidak dapat dipenuhi oleh aloi tradisional. Industri hari ini memerlukan bahan-bahan dengan sifat mekanik yang baik seperti kepadatan rendah, kekuatan tinggi, lelasan dan rintangan kakisan (Vivekananthan et al, 2019). Gabungan ciri-ciri ini boleh dicapai dengan menggunakan bahan komposit .

Komposit yang diperkuat dengan sisa buangan daripada industri merupakan salah satu inisiatif bagi mengurangkan kos penghasilan sesuatu bahan dan dalam masa yang sama mengurangkan kesan sisa buangan tersebut terhadap alam sekitar. Antara sisa buangan industri yang sering dikaji sebagai bahan bahan penguat dalam matriks aluminium ialah sekam padi, serat kelapa sawit dan abu terbang kelapa sawit kerana ia lebih murah dan mudah didapati (Udoye et.al, 2019). Dengan itu, kajian ini dilakukan bertujuan untuk

mengkaji penggunaan bahan terbuang iaitu abu terbang kelapa sawit sebagai bahan tambah ke dalam aluminium tulen. Ia bertujuan untuk mengkaji sifat-sifat mekanikal kesan campuran abu terbang ke atas aluminium tulen melalui ujian tegangan, ujian hentaman dan ujian kekerasan. Pemantauan mikrostruktur dengan menggunakan mikroskop imbasan electron (SEM) turut dilakukan.

2. SOROTAN KAJIAN

Aluminium telah digunakan secara komersial sejak 100 tahun yang lalu. Ia merupakan antara logam yang ringan yang ada di pasaran. Penggunaan aluminium amat meluas dan menduduki tempat kedua selepas keluli (Zainal Abidin, 1999) dan menjadi logam bukan ferus yang penting dalam pelbagai industri seperti automotif, aeroangkasa, pembinaan, alatan eletrik dan barangan pengguna.

Aluminium mempunyai sejumlah sifat yang unik serta menarik menyebabkan ia digunakan dengan begitu meluas (Kenneth et al, 2010). Walaupun terdapat sejumlah sifat yang baik, aluminium juga mempunyai satu kekurangan yang dikatakan agak serius dari aspek kejuruteraan iaitu modulus keanjalan yang rendah. Modulus keanjalan aluminium adalah lebih kurang satu pertiga keluli. Dengan itu, jika dikenakan beban yang serupa, komponen aluminium akan terpesong tiga kali lebih besar daripada keluli (Zainal Abidin 1999). Selain itu, aluminium juga sangat mudah untuk calar dan berlekuk (Vipin et al,2017). Oleh itu, aluminium perlu ditambah dengan bahan tambah yang lain bagi memperbaiki sifat-sifat ini. Pelbagai kajian telah dibuat dengan menggunakan bahan tambah yang berbeza ke dalam matriks aluminium bagi tujuan meningkatkan dan memperbaiki sifat-sifatnya.

2.2 Bahan Tambah

Bahan tambah merupakan bahan yang disebatikan dengan suatu bahan lain seperti logam dan polimer untuk mendapatkan atau memperbaiki sifat fizikal, kimia, pembuatan atau mekanikal bahan tersebut (George Wypych, 2016). Antara bahan tambah yang sering dicampurkan dalam aluminium adalah silikon nitrida, grafit, silikon karbida, alumina dan sebagainya. Komposit aluminium diperkuat dengan partikel silikon karbida dan alumina telah mendapat perhatian sejak beberapa dekad yang lalu kerana memiliki modulus elastik, kekuatan tegangan dan rintangan hakisan yang tinggi berbanding aluminium yang tidak diperkuat. Namun, komposit ini adalah terhad kerana kos untuk menghasilkannya tinggi (Russel et al, 2017). Oleh itu, bahan tambah yang murah perlu digunakan untuk mengurangkan kos keseluruhan penghasilan sesuatu bahan. Bagi mencapai tujuan ini, bahan tambah daripada sisa buangan industri khususnya industri pertanian digunakan.

Di Malaysia, pada tahun 2010 sisa buangan daripada industri kelapa sawit adalah sebanyak 4.5 juta tan (Zarina et al, 2013). Dalam penghasilan abu terbang, pada umumnya hampas yang terhasil akan dikisar dan dihancurkan melalui kebuk pembakaran di mana ia dijadikan bahan bakar dalam pembakaran di tiub dandang. Partikel abu terbang yang lebih berat (peringkat yang paling kasar) akan jatuh ke bawah dalam kebuk pembakaran manakala partikel yang ringan atau baki terakhir akan terampai di dalam aliran udara. Hal ini akan memberi kesan pencemaran terhadap alam sekitar. Kajian yang telah dijalankan beberapa tahun kebelakangan ini menemui sisa buangan seperti sekam padi (M H Ahmad et al, 2019), tempurung kelapa (A S Budi et al, 2019), serat kelapa sawit dan juga abu terbang kelapa sawit berpotensi sebagai bahan tambah.

2.1.1 Abu terbang kelapa sawit

Abu terbang kelapa sawit terhasil daripada pembakaran hampas kelapa sawit. Komposisi utama yang terdapat dalam abu terbang ialah silika. Jadual 1 menunjukkan peratusan komposisi bahan yang terkandung dalam abu terbang secara keseluruhannya.

Jadual 1 : Peratusan komposisi abu terbang

Komposisi kimia	SiO_2(%)	Al_2O_3(%)	MgO(%)	Na_2O(%)	CaO(%)	Fe_2O_3(%)	Cl(%)	P_2O_5(%)	K_2O(%)	LOI (%)
Abu terbang	66.66	5.13	4.17	0.49	9.86	5.29	0.162	3.71	8.42	1.07

Sumber: Raut et al (2016)

Abu terbang yang berketumpatan rendah ini apabila ditambah ke dalam logam akan menghasilkan komposit yang ringan dan berketumpatan rendah. Partikel abu terbang sentiasa menjadi pilihan utama kerana ia mempunyai sifat-sifat mekanikal yang baik dan harganya yang murah (Shankar et al 2019). Ini seterusnya mengurangkan kos penghasilan komposit berkenaan. Menurut Vipin et.al (2017) dalam kajiannya berkenaan kesan partikel abu terbang dan leburan aluminium terhadap rintangan hakisan komposit aluminium prestasi suatu komposit aluminium bergantung kepada keseragaman taburan partikel penguat dalam matriks.

Saiz partikel dan peratusan berat abu terbang mempengaruhi sifat-sifat komposit aluminium (Shankar et al 2019). Dalam penghasilan abu terbang, terdapat tiga peringkat yang berbeza saiz dan kandungan campurannya. Dalam kajian ini, abu terbang yang paling halus digunakan iaitu pada peringkat ketiga dengan saiz di bawah 250µm. Kekerasan dan kekuatan tegangan meningkat manakala pemanjangan berkurang dengan pertambahan kandungan abu terbang (Russel et al, 2017). Menurut Razzaq et.al (2017) dalam kajiannya didapati pembentukan porositi dalam komposit adalah disebabkan oleh pertambahan kandungan partikel abu terbang, iaitu semakin tinggi kandungan abu terbang, semakin tinggi jumlah porositi yang wujud.

3. METODOLOGI KAJIAN

3.1 Bahan

Bahan yang digunakan dalam kajian ini ialah aluminium tulen dan abu terbang kelapa sawit. Abu terbang yang digunakan adalah di peringkat ketiga dan paling halus iaitu bersaiz antara 63 µ hingga 250 µ. Semakin halus partikel yang digunakan maka semakin baiklah kesannya ke atas hasil yang diperolehi (George Wypych 2016). Abu terbang yang diperolehi daripada kilang kelapa sawit ini ditapis dengan menggunakan pengayak (*sieve shaker*) bagi mendapatkan julat saiz abu terbang yang dikehendaki. Abu terbang ini kemudiannya dibentuk menjadi kapsul.

3.2 Kaedah

3.2.1 Proses Tuangan (ASTM B26)

Proses tuangan pasir dilakukan bagi mencampurkan aluminium tulen dan abu terbang kelapa sawit. Campuran adalah mengikut peratusan jisim yang telah ditetapkan seperti dalam Jadual 2. Relau yang digunakan untuk meleburkan campuran ini ialah relau mangkuk pijar dengan menggunakan minyak diesel sebagai bahan bakar. Aluminium dileburkan terlebih dahulu. Setelah aluminium lebur iaitu pada suhu kira-kira 632°C, kapsul abu terbang dimasukkan ke dalam relau mengikut komposisi yang telah ditetapkan. Campuran ini dipanaskan sehingga mencapai suhu takat lebur aluminium iaitu 660°C sebelum dituang ke dalam acuan yang bersaiz 15mm. kemudian ia dibiarkan beberapa ketika untuk memejal sebelum spesimen dikeluarkan.

Jadual 2 : Peratusan campuran aluminium – abu terbang

Campuran	% aluminium	% abu terbang
A	97	3
B	94	6
C	91	9
D	88	12
E	85	15

3.2.2 Penghasilan Sampel
Spesimen yang dihasilkan silinder bergaris pusat 15mm akan dimesin menggunakan mesin larik untuk menghasilkan sampel bagi ujian tegangan mengikut piawaian yang ditetapkan. Bagi ujian hentaman pula, takuk dibentuk pada sampel dengan menggunakan notch cutter seperti dalam piawaian.

3.3 Ujian Mekanikal
3.3.1 Ujian Tegangan
Ujian tegangan dijalankan mengikut piawaian ASTM E8 pada suhu bilik. Ujian dijalankan terhadap 4 sample bagi setiap komposisi dengan menggunakan mesin ujian tegangan Universal Testing Machine dari *Gotech Testing Machinesn Inc*. Sampel ini berbentuk *dumbbell*. Nilai purata daripada 4 sampel ujian tegangan diambil.

3.3.2 Ujian hentaman
Ujian hentaman Charpy dijalankan mengikut piawaian ASTM E23. Ujian ini dijalankan terhadap 4 replika sampel bagi setiap komposisi dengan menggunakan mesin ujian hentaman Charpy. Nilai purata daripada 4 sampel ujian hentaman diambil.

3.3.3 Ujian kekerasan
Ujian kekerasan yang digunakan dalam kajian ini ialah ujian kekerasan Vickers berdasarkan piawaian ASTM E92 dengan menggunakan mesin ujian model BUEHLER 1900-2005-250. Sampel yang digunakan adalah sampel yang sama dengan ujian hentaman. Beban disetkan sebanyak 30kg dibawah tindakan beban statik selama 10 hingga 15 saat.

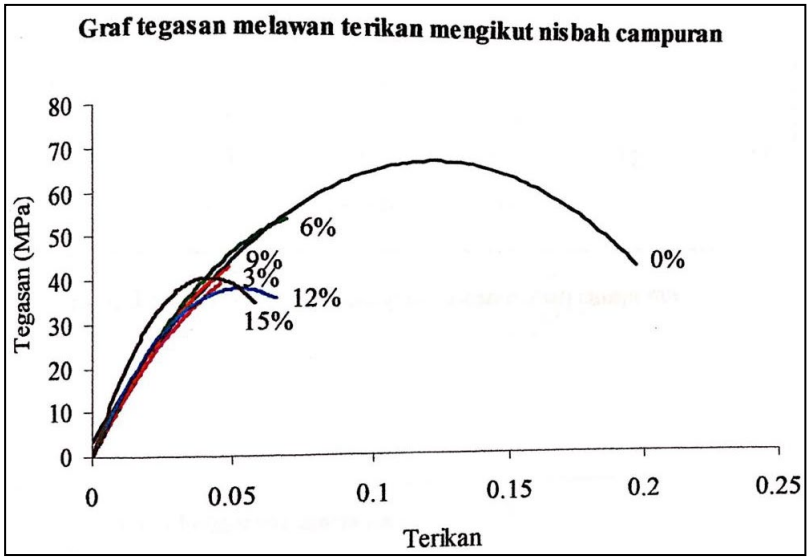
3.3.4 Analisis mikrostruktur
Mikroskop imbasan elektron (SEM) digunakan untuk menganalisis bahan bagi melihat mikrostruktur dan permukaan patah bagi logam. Mesin jenis Leica Streoscan 420 (S420) digunakan dalam ujikaji ini. Fraktograf SEM akan menentukan sama ada permukaan patah adalah transgranular, intergranular atau gabungan kedua-duanya.

4. ANALISIS DAN KEPUTUSAN

4.1 Ujian tegangan
Rajah 1 menunjukkan graf tegasan-terikan bagi keseluruhan sampel mengikut nisbah campuran abu terbang. Didapati bahawa sampel aluminium tulen iaitu tanpa penambahan abu terbang menunjukkan sifat kemuluran yang tinggi. Berdasarkan rajah tersebut juga jelas bahawa campuran aluminium dan abu terbang pada 3%, 6% dan 9% menghasilkan sampel yang bersifat rapuh. Hasil dapatan dari kajian menunjukkan faktor yang mempengaruhi penurunan nilai kekuatan tegangan adalah lekatan di antara partikel/matriks dan penyebaran partikel yang tidak homogen dan ini dapat dilihat melalui SEM.

Bagi komposit yang bahan peguatnya berbentuk partikel, mekanisma peguatan berlaku dengan cara partikel bersama-sama menanggung beban dengan matriks dan satu lagi mekanisma penguatan adalah dengan cara pembentukan ikatan antaramuka diantara partikel dan matriks. Oleh itu, faktor yang mempengaruhi kekuatan sesuatu komposit adalah bergantung kepada jumlah partikel, serakan partikel, saiz dan bentuk partikel.

Kajian oleh Niranjan et al. (2016) mendapati bahawa nilai kekuatan tegangan berkurang bagi komposisi abu terbang 10% dan 15% yang mungkin disebabkan oleh lekatan yang lemah antara partikel abu terbang dengan matriks. Faktor saiz partikel juga boleh dipertimbangkan sebagai faktor pengurangan nilai kekuatan. Dalam kajian ini, saiz partikel yang digunakan antara 63 µ hingga 250 µ. Saiz abu terbang di antara 1 µ hingga 100 µ memberikan sifat mekanikal yang lebih baik jika dibandingkan dengan aloi tanpa penguat (Shankar et al, 2019). Partikel yang bersaiz halus mempunyai ikatan dengan matriks yang lebih baik berbanding partikel yang bersaiz besar. Nilai kekuatan berkurang dengan pertambahan saiz partikel abu terbang daripada 20 µ ke 60 µ bagi semua komposisi abu terbang yang dikaji (Niranjan et al, 2016).

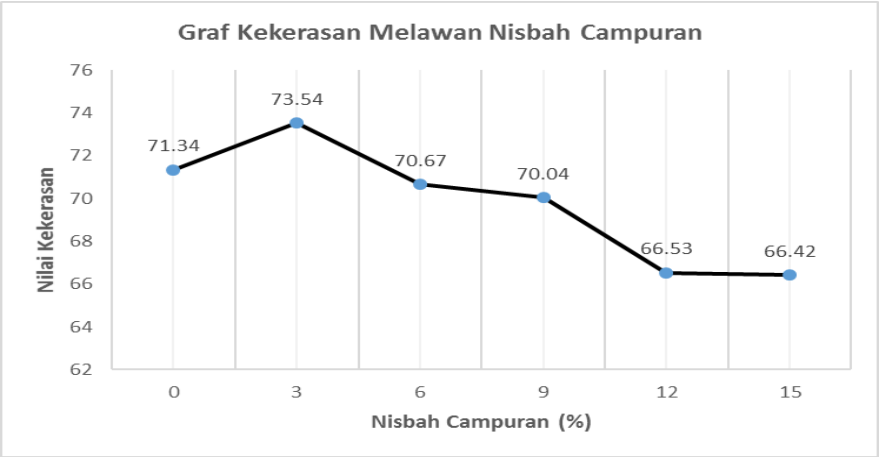


Rajah 1 : Graf tegasan melawan terikan mengikut nisbah campuran

4.2 Ujian kekerasan.

Ujian kekerasan adalah bertujuan untuk menguji kebolehan sesuatu bahan bagi menahan lekukan atau rintangan bahan terhadap haus. Hasil dari keputusan ujian kekerasan bagi nisbah pencampuran abu terbang ke dalam aluminium tulen adalah seperti di dalam Rajah 2.

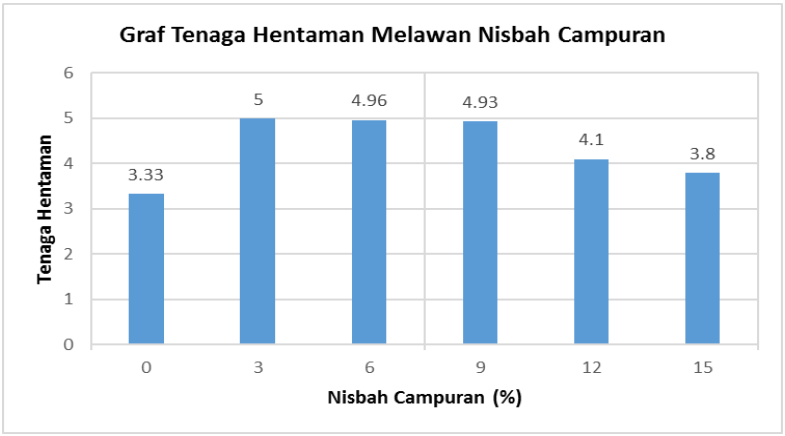
Nilai kekerasan untuk aluminium tulen adalah sebanyak 71.34. Kekerasan maksima yang dapat dicapai daripada ujian ini ialah pada campuran 3% berat abu terbang berbanding aluminium tulen iaitu 73.54 HV. Manakala nilai kekerasan bagi nisbah campuran 6, 9, 12 dan 15% adalah 70.67, 70.04, 66.53 dan 66.42 HV. Nilai kekerasan yang diperolehi didapati semakin berkurang dengan pertambahan komposisi abu terbang. Hasil dapatan daripada ujian kekerasan ini adalah bertentangan dengan kajian-kajian terdahulu yang menunjukkan bahawa nilai kekerasan komposit bertambah dengan pertambahan peratusan berat abu terbang (Russel et al, 2017).



Rajah 2 : Graf kekerasan melawan nisbah campuran

4.3 Ujian hentaman

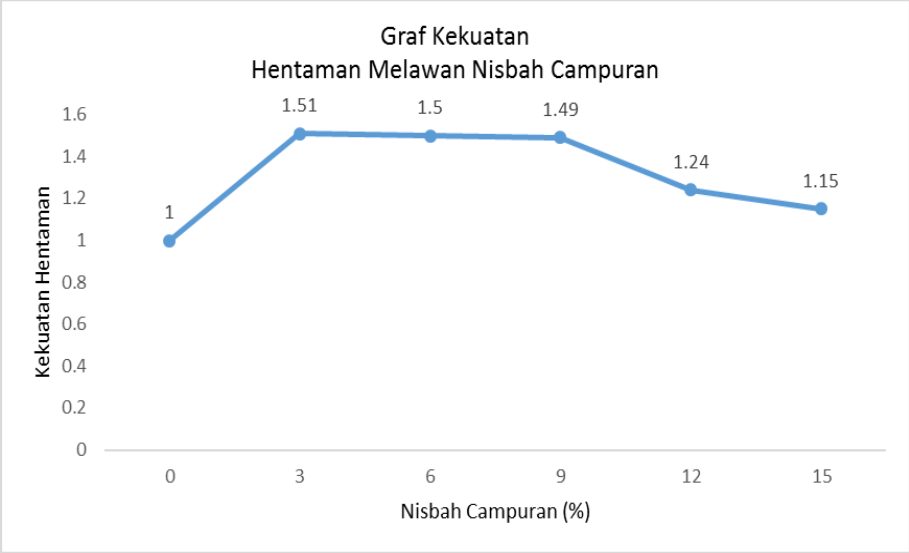
Ujian hentaman dilakukan untuk mengetahui jumlah tenaga diserap untuk mematahkan sampel. Dalam ujian ini. Takuk di buat di tengah-tengah sampel berperanan sebagai titik tumpuan tegasan dan tempat permulaan retakan.



Rajah 3 : Carta bar tenaga hentaman melawan nisbah campuran

Tenaga hentaman melawan nisbah campuran abu terbang ditunjukkan dalam Rajah 3. Tenaga hentaman yang paling tinggi diserap oleh sampel adalah sebanyak 5 J pada nisbah campuran sebanyak 3%. Tenaga hentaman pada nisbah campuran 6, 9, 12 dan 15% adalah 4.96, 4.93, 4.10 dan 3.80 J. Manakala aluminium tulen pula menunjukkan bacaan 3.33 J. Walaupun nilai tenaga hentaman bagi semua komposisi abu terbang adalah tinggi jika dibandingkan dengan aluminium tulen, tetapi ia menunjukkan penurunan dengan peningkatan komposisi abu terbang.

Nilai maksimum untuk tenaga hentaman bergantung kepada saiz partikel dan kekuatan yang terdapat pada ikatan antaramuka di antara aluminium dan abu terbang. Rajah 4 pula menunjukkan kekuatan hentaman melawan nisbah campuran abu terbang ke atas aluminium tulen. Nilai kekuatan hentaman yang paling tinggi antara semua sampel adalah pada nisbah campuran 3% dengan nilai kekuatan hentaman 1.51 J/m^2. Kekuatan hentaman pada nisbah campuran 6,9,12 dan 15% adalah 1.5, 1.49, 1.24 dan 1.15 J/m^2. Untuk ujian hentaman ini, dapat dilihat kadar kekuatan hentaman bertambah dengan penambahan abu terbang ke dalam sampel aluminium tulen, namun ia mula menurun apabila nisbah campuran abu terbang melebihi 12%.



Rajah 4 : Graf kekuatan hentaman melawan nisbah campuran

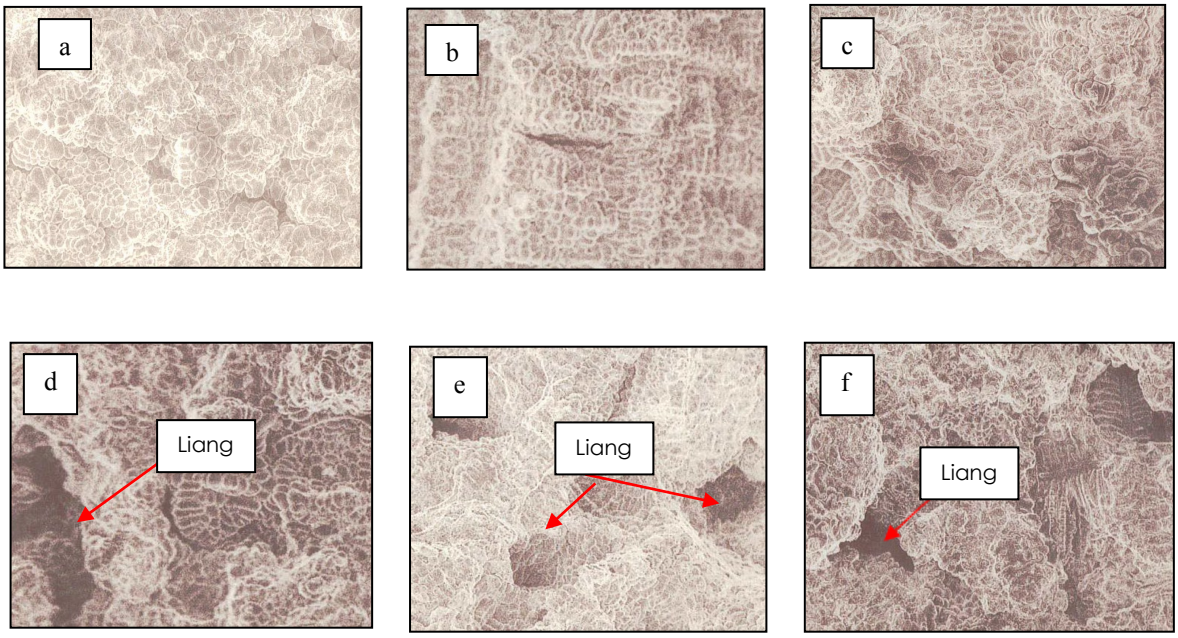
4.4 Analisis Mikrostruktur

Didapati bahawa struktur permukaan bagi campuran yang berbeza akan menunjukkan keadaan fizikal yang berbeza. Pemerhatian secara visual menunjukkan terdapat beberapa sampel aluminium dan abu terbang yang tidak homogen serta wujud gumpalan partikel abu terbang dalam matriks. Faktor yang menyebabkan penyebaran abu terbang dalam matriks tidak homogen adalah disebabkan pencampuran sampel yang tidak sekata.

Pemeriksaan mikrostruktur dengan menggunakan SEM pula mendapati terdapat liang-liang di dalam sampel yang dihasilkan. Keliangan ini menyebabkan ikatan antara muka menjadi lemah dan secara tidak langsung memudahkan perambatan retakan apabila daya dikenakan. Kewujudan keliangan semakin bertambah dengan pertambahan peratus komposisi abu terbang menyebabkan ikatan antara muka lemah dan kemuluran bahan semakin berkurang.

Berdasarkan kepada mikrograf yang diperolehi dalam Rajah 5, dapat diperhatikan bahawa porositi wujud apabila nisbah campuran abu terbang semakin bertambah. Ini jelas kelihatan pada sampel dengan nisbah campuran 12% dan 15%.

Pemerhatian melalui mikrograf yang diperolehi telah digunakan untuk membuat perbandingan permukaan patah antara aluminium tulen dengan aluminium yang telah ditambah dengan abu terbang. Pembesaran yang digunakan ialah 200x dan 400x. Diperhatikan daripada hasil keputusan pemerhatian, kesemua sampel mengalami keadaan patah rapuh.



Rajah 5: Mikrograf pembesaran 200x; a) Al tulen, b) Al + 3% abu terbang c) Al + 6% abu terbang, d) Al + 9% abu terbang, e) Al + 12% abu terbang dan f) Al +15% abu terbang

5. KESIMPULAN

Pertambahan peratus komposisi abu terbang menyebabkan nilai tenaga hentaman meningkat pada campuran abu terbang sebanyak 3%, namun ianya kembali menurun apabila campuran melebihi 3%. Keputusan yg sama juga diperolehi untuk nilai kekerasan. Secara keseluruhannya, sifat kekerasan yang baik adalah pada peratus komposisi berat 3%. Dapat diperhatikan juga permukaan patahnya adalah dalam keadan rapuh. Dapatan dari ujian tegangan juga menunjukkan percampuran komposisi 3% adalah yang terbaik, dimana nilai Modulus Young yang diperolehi adalah 1.01 GPa. Salah satu fakrtor yang akan mempengaruhi nilai Modulus Young adalah saiz partikel di mana nilai Modulus Young boleh ditingkatkan dengan mengurangkan saiz partikel bahan pengisi (George Wypych, 2016).

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A STUDY ON DESIGNING JIG AS A TRIMMING GUIDE FOR ORNAMENT BIG D20N

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Abstract. A local plastic manufacturing company usually produces a wide variety of plastic products every day. Company operators and engineers have to manually remove plastic runners from some of these plastic products. This should be done after the plastic mould has completed the process. A pair of plyers and a cutting knife are used as cutting tools in this process, which needs to be repeated several thousand times a day for trimming process. This process is a long-term and ergonomically dangerous process because once the cooling process goes on, the plastic runner is quite stiff. The purpose of this research is to design and develop tools to assist operators and engineers at local plastic injection moulding companies. These devices are known as jigs and fixtures, which serve as a trimming guide for the operator trimming process. The design and development process of this tool is using a methodology based on the CDIO model. Analysis using CATIA V5 R12 software clearly shows that the design of these jigs and fixtures is really strong and can perform well. Thus, this study has had a significant impact on the productivity of the company based on the reduced number of rejections.

Keywords: Design, Jig, Trimming Proces, Injection moulding

1. INTRODUCTION

The dashboard, also referred to as the instrument panel (IP), is usually located directly in front of the driver of any vehicle. It features instruments and control systems for vehicle operations. Initially the dashboard contained a variety of simple controls, such as steering wheels and modern dashboards that could accommodate a variety of measuring and control devices, as well as information, climate control, and entertainment systems to indicate speed, fuel levels, and oil pressure. The contemporary dashboard may include several functions such as speed meter, tachometer, odometer, and fuel gauge. In addition, the dashboard can also show rotation indicators, gear shift position indicators, seat belt alarm lights, and parking brake alarm lights.

Sipro Plastic Industries Sdn Bhd is one of the leading regional manufacturers specializing in precision injection molding and assembly components for the automotive industry in Malaysia. In this study, the quality problems that occur on the Instrument Panel or Big D20n Ornament issued by Sipro Plastic will be given special emphasis. This part is used in the installation of Myvi car models. It is the structure or physical body of the part that has been excessively trimmed by the operator while in the process of trimming. This has made the structure of the body part imperfect for the next process. This issue contributes to the quality problem as it causes the Big Ornament D20N to be part of the rejection and will not go to the next process. This issue is concluded as a lack of guidance tools or fixture problems on the Big Ornament D20N for the Perodua Myvi instrument panel.

This research will develop a jig design for the enhancement of the Ornament Big D20N part product fixtures on Myvi model. The new design development phase for the Big Ornament D20N has been implemented from concept design to software selection, testing in the form

of software simulations, and data analysis. The project has started with a literature review to gather all the information. The design concept or sketch of the Ornament Big D20N equipment for the Perodua Myvi instrument panel will be evaluated in advance by Perodua itself. It is to choose the best fixture design. Then, the selected design will be drawn using CATIA software and the data will also be processed using CATIA software.

2. LITERATURE REVIEW

The literature review conducted includes the process of reading, analyzing, evaluating, and summarizing past research in designing fixtures that can reduce the number of over-trimmed defects, caused by human behavior. Data from previous studies have been collected to improve the existing jig design. Once the literature review is completed, the researcher has adapted the findings accurately into the new jig design. This is in line with the procedure outlined by Knoll (2017) where every plan to develop a new design needs to be supported by a strong argument or literature review.

The production line in the factory usually consists of a series of sequential processes in which raw materials come out through refining operations to produce products that are suitable for the consumer market or industrial market. In addition, the production line is also intended to install components on the product either finished or partially completed. On the production line, each product produced will go through rigorous quality inspections such as defect inspection, labelling and packaging before the product is released (Swee et al., 2017). Products with quality problems will undergo a refining or rework process. High product rejection rates will result in a waste of time and an increase in raw material costs. Therefore, identifying the root cause of problems and solutions is a very important agenda in the production line (Shah et al., 2000).

There are several types of equipment that can be used as a reference in designing new fixtures. This guides the researcher in choosing the best design based on the reasons to curb the defect. Designing the installation will help overcome the defects. (Hoffman, E., 2013). It will be planned based on the situation of the manufacturing organization and feedback from car buyers. The design of performance measurement systems should take into account organizational aspects, behaviour and culture of the organization, as proposed by (Bititci, 1995).

2.1 CDIO

In this study, the research concept will use CDIO as the main framework for the whole research process. The CDIO method has proven to be very helpful for students to master basic knowledge of technical basics. The CDIO model framework is based on the principle that the development and provision of product and system life cycles is an acceptable context for engineering education. the study method using this CDIO model is shown in Figure 1 below.

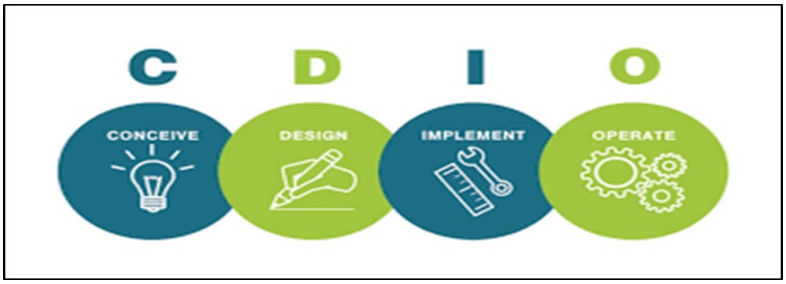


Figure 1: Example figure of CDIO concept

CDIO is one of the strategies to study the basics of engineering using the context of conceiving, planning, implementing, handling (Liu et al., 2005). The universal approach used

in thinking strategies focuses heavily on three mutually supportive elements (Brown, 2009), namely consumer desire, technical fields related to current technology, and having great opportunities in the market. By using the CDIO model, it can guide engineers to plan problem solving to be more holistic as it requires a good understanding of consumer needs through empathy studies, and various levels of ideation and literacy (Monsalve et al., 2016). However, this method still has its limitations, where the conditions that need to be met at the planning stage are not always clear.

3. METHODOLOGY

In this study, the framework of CDIO-based development model has been fully applied. CDIO is an innovative educational framework to produce the next generation of engineers / technologists. By using the CDIO framework, it is expected to provide students with an education that emphasizes the engineering / technology foundation for real systems and products through the context of Conceiving - Designing - Implementing - Operating (CDIO).

3.1 Data collection method

The process of designing and creating new innovations begins with awareness of the problems encountered before obtaining solutions. The problems encountered in the production line need to be understood in detail first and not just continue to draw conclusions and produce designs immediately. most likely, there will be a misinterpretation of the issue trying to be resolved. This will lead to the production of products that do not meet the needs of consumers.

Research and studies have been done to ensure that the jig design to be used at Sipro Plastic Industries can really solve the problems faced by entrepreneurs. The research approach is divided into two (2) namely quantitative, qualitative and a combination of the two. To obtain more accurate data, qualitative methods are performed through interviews and observations. While conducting this research, both of these methods are used as research tools. Research tools are used as the basis for data collection to achieve project objectives. Pre-study questionnaires, observation methods, interview methods, and related data collection are instruments that can be used by researchers. Data collection is the process of obtaining or collecting and measuring current data related to target variable problems. This ensures data accuracy and results analysis. All scientific data to be conducted must have a source and be a proven data sheet study.

Data collection is the most important aspect of research studies. The data that has been collected must be accurate. If the data collection procedure is inaccurate, it will affect and affect the results of the study and will lead to invalid results. In this study the data is collected through many techniques for example, cheek sheets that have been provided by the company where the cheek pieces are divided into several aspects such as; Unstructured Interviews, Molding Daily Report, Problem Mapping Communication Sheet and Operator Performance Skills.

4. RESULTS AND ANALYSIS

Data collection and data analysis that has been done throughout the course of this study will be in-depth discussed in this chapter. Findings that support or reject the objectives of the study and hypotheses are also explained for this research. Narrative explanations, design modeling, simulations, idea implementation, manufacturing processes and key test results are presented. This chapter concludes by presenting trends in quality issues in current procedures and changes during the first two months of implementation.

4.1 Rejection part analysis

This research has been done due to quality problems reported by customers. In this case; internal customers as well as Perodua to their vendors Sipro Plastic Industries are those directly

involved. The complaint involved a dashboard section containing a part named as the Ornament Big D20N for the Perodua Myvi. The complainant claimed that the surface of the part was too not very neat. The cause of this problem is caused by the operator during the manual trimming process by the operator. This problem leads to the rejection of the quantity of either internal customers or key customers.

One of the objectives of this research is to reduce the quality problems that occur in Ornament Big D20N products. This is due to the process of careless handling performed excessively. Data were collected from the Quality Control Department for the Ornament Big D20N division for the Perodua Myvi within three months prior to the implementation of the new design trimming jig for the Ornament Big D20N.

These quality problems have been analyzed using the total percentage of product demand and the total rejection found internally at the Sipro Plastic Industries plant. It was also obtained from customer complaints about surface part defects that occurred by the operator for three months prior to the implementation of the trimming of the jig guide. Previous data was provided to internal customer drawings on 1 October 2018. Various complaints issued by customers include; the problem of the Ornament Big D20N is over-trimmed and this leads to research and research being compiled to find the cause and apply improvements for future reference.

Table 1: Quantity of rejection on 2018

Previous Condition	
Month	Rejection (pcs)
October	800
November	920
December	740
Total	2460

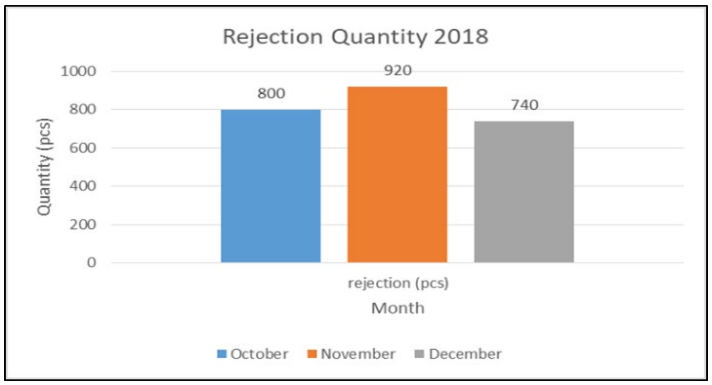


Figure 2: Bar chart of quantity rejection in 2018

Based on Table 1 and Figure 3, it is clear that the rejection quantity that has been produced by the production department at Sipro Plastic Industries is quite serious. the information displayed is data on total product rejections, specifically the Big Ornament D20N for the Perodua Myvi for three months. The total rejection in October was 800 pieces out of a total of 5200 pieces produced. Meanwhile, the quantity of rejections has increased to 920 pieces in November. Total rejections in November were the highest compared to the other two

months. The latest data obtained the following month, has shown that the quantity of rejection for December has decreased by 740 pieces. The rejection of this quantity is due to the many types of defects that occur on the Big Ornament part of the D20N for the Perodua Myvi.

4.2 Percentage of rejection quantity over normal quantity

Sipro Plastic Industries has set a target so that the percentage for the rejection rate that occurs is only around 1.5% for all normal quantities that have been produced. This percentage has been set for the purpose of monitoring and ensuring the quality of the products produced truly achieves the standards set by Perodua. From the data that has been recorded by the production department, this study has determined the quantity of rejection rate for Ornament Big D20N products up to three months in 2018. Many costs have been wasted as a result of product rejection. However, everything changed starting in January 2019 when the new jig design was started to be applied in the production line.

Table 2: Percentage of rejection rate of Ornament Big D20N in 2018

Month	Rejection	Demand	Rejection (%)
October	800	5200	15.38
November	920	5200	18
December	740	5200	14

Table 2 and Figure 2 illustrate that the percentage of rejection rates of the Ornament Big D20N product is quite critical and needs serious attention. the overall data shows that the product rejection rate exceeds the conditions set by the company which is 1.5% of the normal quantity that has been produced. In general, the overall rejection is due to the critical defects that occur in the Ornament Big D20N product. All types of critical defects were selected to see which type of defect had the highest rejection.

Table 3: rejection material quantity previous and actual condition

	Previous condition				**Actual condition**		
Month	Normal qty	Rejection qty	Rejection material qty	Month	Normal qty	Rejection qty	Rejection material qty
October	5200	800 pcs	168 kg	January	5200	0	0
November	5200	920 pcs	193.2 kg	February	5200	0	0
December	5200	780 pcs	163.8 kg	March	5200	0	0

According to Table 3, the data obtained clearly shows the comparative data between before and after the implementation of the production process of the Ornament Big D20N Perodua Myvi using a new jig design. It is amazing when there is not a single rejection of the product when the resulting jig was first used in January 2019. It shows that this designed jig is very effective in reducing the number of defects and rejections on the product.

The following Table 4 shows more detail the quantity of rejection according to the type of defect, in the first 3 months in 2019. The data obtained clearly show that the quantity of over trim defect is recorded as zero rejection after the implementation of jig guide trim for Big Ornament D20N. The data also shows that the rejection cost for 2108 was recorded as RM 15,523.2 and for the first three months of 2019, the rejection cost recorded a significant

decrease of RM 4,476.15. This of course gives huge profits to companies and the country's automotive industry.

Table 4: rejection quantity

Defects	October to December 2018 (pcs)	January to March 2019 (pcs)
Over trim	2500	0
Short mould	220	210
Black dot	360	355
Silver streak	280	270
Flow mark	160	180
Total	3520	1015

5. CONCLUSION

From the findings of the study and analysis that has been conducted, it can be concluded that the work process assisted by a special jig has been able to minimize the work order of an operator. The jig has greatly improved the level of work efficiency of an operator which in turn improves the quality of the products produced. The new trimming jig design for the Ornament Big D20N only involves runners on the surface part of the Big Ornament.

Compared to the previous situation, the trimming process for the Ornament Big D20N was only done manually. Everything depends on the individual skills of an operator. This has resulted in the quality of work can not reach the maximum level in ensuring the quality of the product really meets the specifications that have been set by Perodua. It all stems from the declining level of focus among operators when faced with a very high volume of production and product demand.

However, this problem has been successfully overcome when the design development for this special jig has successfully reduced product defects to zero. Overall, this study has succeeded in achieving its objectives. There are no more defects in the products recorded within a period of three months throughout the beginning of 2019. It has at once successfully saved production costs and at the same time has been able to improve quality and productivity.

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URBAN FARMING USING IoT SYSTEM

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Abstract. Urban Farming is an agricultural practice that is suitable for urban environments. The purpose of this study is to design an autonomous and self-fertilizing hydroponics system. In this study, AB fertilizer solution (AB solution) is used as planting medium. Therefore, an IoT based system is designed to read the values of area temperature and humidity, AB solution level, AB solution temperature, and Electronic conductivity (EC) value in AB solution in real-time and to control motorized pump remotely through the internet by integrating the NodeMCU ESP8266 Wi-Fi module. Testing was done by comparing the system reading with actual measurement tools for the system reliability. AB solution level, EC of AB solution, AB solution temperature and area temperature/ humidity varied are differed from the actual measurement for 0.5cm, 0.02mS/cm, 0.5°C, and 1.0°C/2%. respectively. This insignificant difference verified that the system functions to display accurate readings approximately to actual measurement. This system benefits the hydroponic farmer to maintain their plants growth.

Keywords: urban farming, hydroponic, AB solution, Electronic conductivity (EC) level.

1. INTRODUCTION

Since the Movement Control Order was implemented when the Covid-19 pandemic hit Malaysia (National Security Council, 2020), people began to engage in home planting activities. However, for people lives in urban areas, space is the most serious concern. Urban farming utilizes the unused or void space in the house areas such as housetops, balconies, porches, and even the building walls. One of the farming methods utilized in urban farming is hydroponic (Crisnapati et al., 2017). Hydroponic farming method is planted in water which mineral nutrients have been added to form water solution as an alternative to soil medium. One of the common water solution used in hydroponic farming is AB fertilizer solution (AB solution). AB solution which contains several chemicals to promote plant growth (Harahap et al., 2020) are applied in the form of salts and when these salts dissolve into water they break down into ions. These ions conduct electricity because of their positive and negative ions. The two most important parameters of nutrient solution are electronic conductivity (EC) and acidity (pH).

Hydroponic farming required particular care in controlling water temperature, water level, acidity (pH) of the nutrient solution, and higher densities of nutrient solution (Crisnapati et al., 2017). Users who have busy schedule have difficulty to maintain the plant growth according to standard operating procedures for planting. However, this controlling process still requires human power to do so. Therefore, this study focused on designing an internet of Thing (Iot) based hydroponic system that could read AB solution temperature, AB solution level in supply tank, density of AB solution, area temperature and area humidity by using suitable sensors that are connected to the microcontroller via Wi-Fi. The system allows user to remotely read the real

time values of all the parameter of AB solution and to control the motorized pump for plant irrigation by using smartphone.

2. LITERATURE REVIEW

Research has been done by comparing previous researches related to urban farming and hydroponic, stated that the framework of an IoT farming system contains sensing system, controlling system, and software system as in Table 1.

Table 1: Summary of selected IoT – based urban farming system

Authors	Sensing system	Controlling system	Software system
(Kularbphettong et al., 2019)	Ultrasonic sensor pH sensor Ambient light sensor	Arduino WeMos	Firebase Real-time Database
(Sihombing et al., 2018)	LM35 Ultrasonic sensor	Arduino Uno Wi-Fi ESP8266 module	ThingSpeak server
(Lukito & Lukito, 2019)	EC sensor DHT11 pH sensor	Raspberry-Pi Model-B WiDo v1.0	MySQL Web browser application
(Crisnapati et al., 2017)	EC sensor DHT11 sensor pH sensor Ultrasonic sensor DS18B20 sensor	Raspberry Pi 2 Model B ARM Cortex-A7 Wi-Fi ESP8266 module	Web browser application
(Namgyel et al., 2019)	EC sensor DHT11 sensor pH sensor Camera	NodeMCU Arduino Mega 2560	Web browser application
(Madushanki et al., 2019)(Islam et al., 2018)	DHT11 DHT22 (temperature and humidity sensor)	Arduino Uno Wi-Fi ESP8266 module	ThingSpeak server Blynk mobile application.

From Table 1, the most popular microcontroller used in the controlling system is Arduino Uno and Raspberry Pi. However, Arduino Uno must be utilized with a Wi-Fi module for monitoring plant. Raspberry Pi is more expensive compared to the Arduino-based controller. Since the IoT system serves as a backbone in urban farming, the Arduino-based controller is favored due to low cost, can be powered by using a battery, and has simple interface. DHT11 sensor is widely used for measuring the temperature and humidity of plants in the IoT system for the environment's monitoring system. EC sensor is also being used to monitor the concentration of the nutrient (EC/PPM) for plant growth. In most cases, Wi-Fi is used as the mode of data transmission and monitoring considering the network coverage proximity range. As for the software system, most of the proposed systems are web browser applications.

As a conclusion, this study focuses in using Arduino NodeMCU ESP8266 Wi-Fi module as the main controller that can enable IoT, DHT11 for area temperature and area humidity, ultrasonic sensor for detecting solution level in supply tank, DS18B20 sensor to read AB solution temperature and EC meter to check density of nutrient solution. The Blynk application is used as interface for displaying real-time reading in smartphone.

3. METHODOLOGY

This study is implemented in an automated hydroponic system based on IoT and smartphones to support planting hydroponic plants. The system can measure and display all the AB solution parameter such as temperature, humidity, EC, AB solution level as well as to control the AB solution supply system (water pump) by using smartphone. An Arduino NodeMCU ESP8266 Wi-Fi module is used as a controller to integrate between the sensors and smartphones. Furthermore, it is also used as a transmission medium through a wireless network to the internet. The system overview is shown in Figure 1.

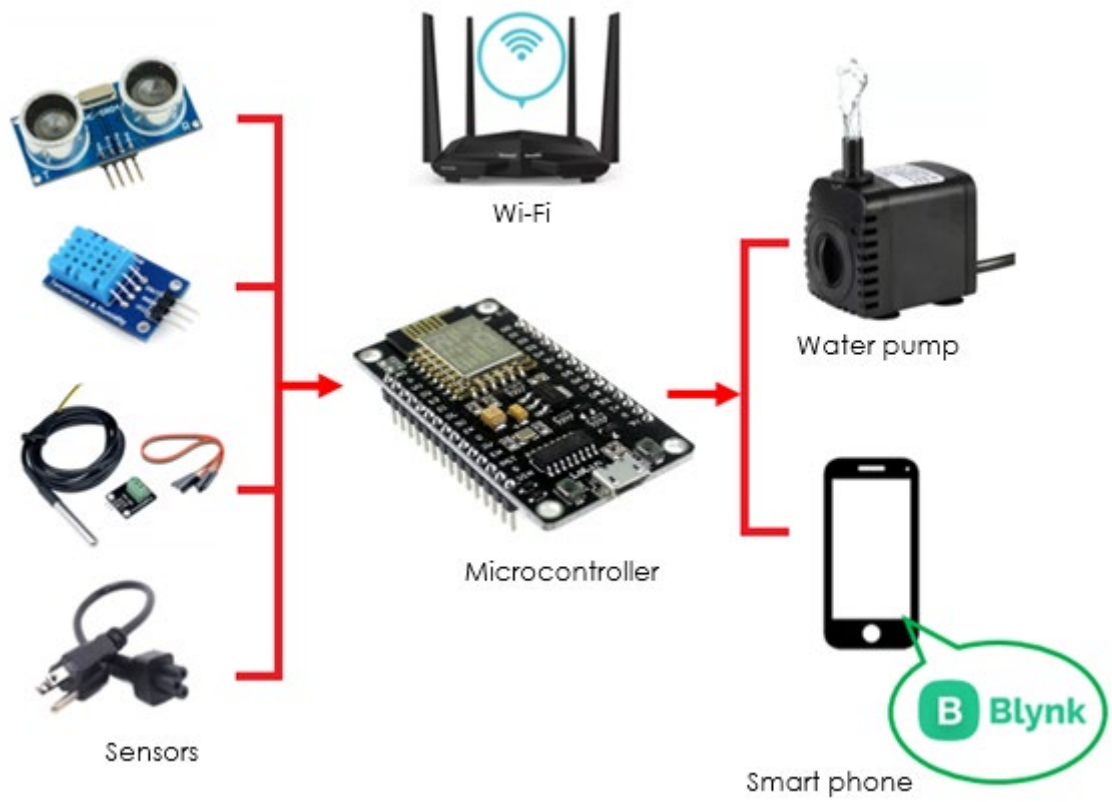


Figure 1: System Overview

3.1 Sensing System

The system operation mechanism is as follows; Ultrasonic sensor (HC-SR04) detects the water level of the AB solution supply tank (in cm). Next, the DHT11 sensor senses the temperature (°C) and humidity (%) of the area surrounding. DS18B20 sensor will sense the AB solution temperature (°C) of the AB solution supply tank. EC sensor measures the electrical conductivity in a solution which usually used in aquaculture for plant growth.

3.2 Controlling System

Arduino NodeMCU ESP8266 Wi-Fi module is used to process sensors data and control the water pump. NodeMCU operates as a central processor that receives output voltage from all sensors and converts them to temperature (°C), humidity (%), water level (in cm), and EC value. These values will be sent to the smartphone Blynk application via Wi-Fi. A water pump is connected to relay that received signal from microcontroller via Blynk application

3.3 Software System

Blynk application is designed for the IoT platform that can control hardware remotely over the internet. It also displays sensor data and stores data. In this study, the Blynk application is used to display real time values of temperature, humidity, AB solution level, EC level and to control the water pump of the AB solution supply tank.

Through the Blynk interface, the water pump can be switched ON manually when the water level of the AB solution supply tank is low. It also can alert the user by sending a notification when the area temperature is too high. The overall system operation is displayed in Figure 2.

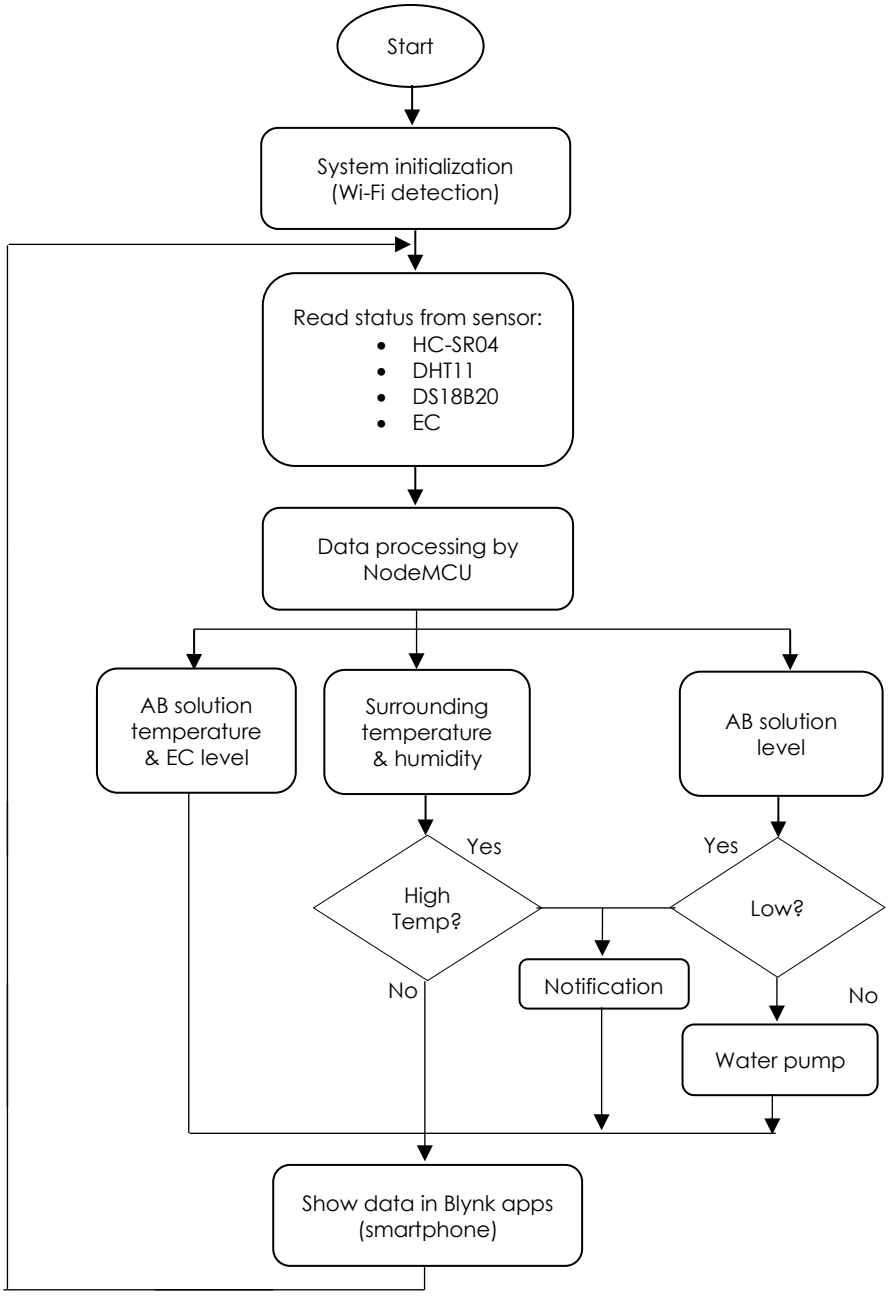


Figure 2: Flowchart of System Operation

3.4 System operation

Figure 3 shows the structure design of urban farming using IoT system. It is a vertical type pole that has stacked levels with a hole called crown port. The tube system with pump is used to transmit water to the top level. With the assistance of gravity, the excessive water will flow back to the supply tank. The system initializes by using Wi-Fi detection. First, sensors provide data on ambiance temperature and humidity, fluid level, temperature and EC value of AB solution supply tank. Next, the NodeMCU as a microcontroller will process all incoming data. The reading value from the DHT11 on ambiance temperature and humidity, DSB18B20 on AB

solution temperature and EC sensor will always appear in the smartphone interface by using Blynk. Meanwhile, fluid level in AB solution supply tank is indicated by HCSR04 to detect low AB solution level. The pump can be ON and OFF by using the Blynk Application. The position of these sensors can be seen in the structure design in Figure 3.

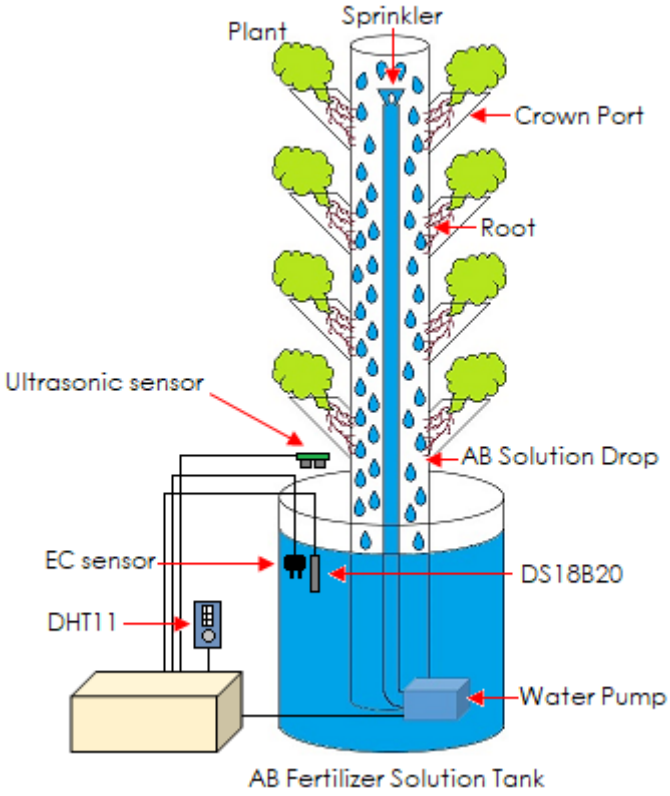


Figure 3: Structure Design

4. RESULTS AND DISCUSSION

When the user switched ON the system, NodeMCU will connect to the Wi-Fi and Blynk application will show the real time reading of all the AB solution parameters as shown in Figure 4. Blynk application contains real time data of EC values, AB solution temperature, water level of AB solution supply tank, area temperature, and humidity. The reading of AB solution level, EC, temperature and temperature/ humidity of area can be seen through the Blynk application as shown in Figure 4. Moreover, ON/OFF button is placed in the Blynk application so that the pump can be turned ON or OFF manually by user in order to refill the supply tank.

After the hardware (sensors) on the tower system integrated, sensors need to be tested to quantify the level of accuracy. The tests include testing of ultrasonic sensors, EC sensor, AB solution temperature, area temperature and humidity. The results of these tests can be seen in Table 2, 3, 4, and 5.

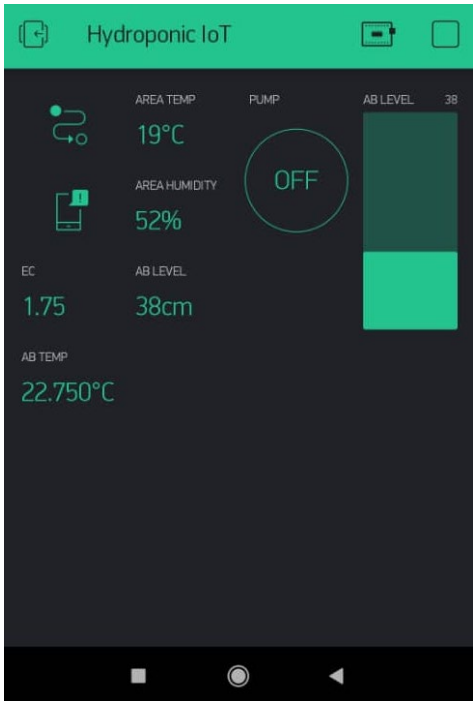


Figure 4: Blynk Applications

Table 2: Level Sensor Test Result

Testing Number	AB Solution Level (cm)		
	HC-SR04 (Ultrasonic), A	Ruler, B	|A–B|
1	3	3	0
2	4	4	0
3	8	7	1
4	10	9.5	0.5
5	11	10.5	0.5

Table 2 presented the AB solution level reading in supply tank from HC-SR04 (ultrasonic) and ruler as actual measurement. Only testing number 1 and 2 shows no reading difference between HC-SR04 and ruler. Testing number 3, 4 and 5 show a slight differences of 1cm, 0.5cm, and 0.5cm respectively. This showcases the system is reliable in detecting low level of AB solution. Thus, complies the purpose of this study to notify the user when the AB solution is low.

Table 3: EC Sensor Test Result

Testing Number	AB Solution Concentration (EC) (mS/cm)		
	EC Sensor, C	Hanna Meter, D	|C–D|
1	1.70	1.71	–0.01
2	1.71	1.73	–0.02
3	1.72	1.73	–0.01
4	1.73	1.72	0.01
5	1.71	1.70	0.01

Table 3 shows the EC reading of AB solution from EC sensor and Hanna Meter DiST WP4 as actual measurement. This tells how much concentration nutrient in the water. In most readings, EC Sensor displays low concentration of AB Solution except at Testing Number 4. Since the difference is recorded between 0.01mS/cm and 0.02mS/cm only, it is verified that the EC Sensor functions to give approximately accurate reading of AB Solution Concentration.

Table 4: Temperature Sensor (AB Solution) Test Result

Testing Number	Temperature (°C)		
	DB18S20, E	Hanna Meter, F	|E–F|
1	24	24	0
2	25	24.5	0.5
3	25	25.5	–0.5
4	25	25	0
5	24	24	0

From Table 4 is the reading of temperature for AB solution from DB18S20 Sensor and Hanna Meter DiST WP4 as actual measurement. Temperature in AB solution is measured to prevent the root plant from burning. All readings from the sensor are similar to actual measurement except at Testing Number 2 and 3, with 0.5°C respectively. This is not significant and thus the DB18S20 is reliable in measuring the AB Solution temperature.

Table 5: Area Temperature & Humidity Sensor Test Result

Testing Number	Temperature (°C) / Humidity (%)		
	DHT11, G	LCD Digital Thermometer, H	|G–H|
1	25 / 89	24.8 / 90	0.2 / –1
2	27 / 78	27.5 / 80	–0.5 / –2
3	30 / 72	29.5 / 73	0.5 / –1
4	28 / 75	27 / 76	1 / –1
5	26 / 78	26.8 / 80	–0.8 / –2

Table 5 shows the difference between temperature/ humidity reading of area from DHT11 and LCD Digital Thermometer as actual measurement. The difference for temperature is between 0.2 - 1.0 °C, meanwhile for humidity is between 1-2%. This difference is not significant, therefore, the measurement of DHT11 is accepted in reading the area temperature and humidity.

5. CONCLUSIONS

In conclusion, Urban Farming using IoT is successfully developed for autonomous and self-fertilizing hydroponics system using NodeMCU ESP8266 Wi-Fi module and sensors. The reading of AB solution level, AB Solution concentration, AB solution temperature and surrounding area temperature/ humidity are notified and monitored through Blynk Application on smartphone. This system eases farming management and helps urban farmers to maintain and organize the planting by just using the smartphone. Further, for its vertical structure design, it benefits the concern of space limitation faced by urban communities in hydroponic farming

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TO STUDY THE IMPLEMENTATION OF JIG IN CONTROLING THE SURFACE OF GLUE AREA FOR SPORT REAR COVER-STOCK

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Abstract. This thesis is entitled to study the implementation of a jig in controlling the surface of the glue area for the rear sport cover stock. Jig is an important working tool in the automotive industry, where all assembly processes or production is carried out. For the purpose of this project, the rate of defect after the jig has been implemented will be evaluated. The CDIO is the method of this research on an instructional paradigm that emphasizes the fundamentals of engineering in the concept, design, implementation and functioning of real-world systems and products. The finding is important to evaluate the data obtained yielding an interpretation-based conclusion. Furthermore, all data obtained are based on previous data to compare data before and after results. It focuses more on masking jig development in spraying glue process production.

Keywords: Sport Rear Cover-Stock, Masking jig, CDIO

1. INTRODUCTION

Armrests may be placed on a trim panel, e.g. on the interior surface of the door or in the center console adjacent to the seat. In addition, the materials to produce armrest door panels are such as plastic, polyvinyl chloride and foam. Moreover, the substrate is typically made from the toughest plastic and cover material made of polyvinyl chloride in foam sheets.

All standard operating procedures have been designed to ensure that the work cycle is carried out in a secure manner and that the JT / JL armrest guidelines are complied with. In addition, the standard operating procedure for the solution of the problem in the assembly line has been accepted, reviewed and evaluated. Next, the armrest is developed through a variety of processes, such as spraying, wrapping and stacking. They have their own standard operating procedure for each phase, but the other operator has not followed the standard operating procedure. The popular problem is the rejection of the armrest door panel, which was mostly found at the quality gate and the final inspection.

2. LITERATURE REVIEW

2.1 Masking jig
According to Toyota Jidosha Kabushiki Kaisha (2013) a masking jig is to designate a coating area where copper powder is sprayed on the front surface of an insulating substrate surface from a cold spray tool. This masking jig requires an opening-shaped metal part to assess the coating area and to bring it into contact with the front surface of the insulating substrate.

Based on Figure 2.1 shows the present invention concerns a masking jig to specify or define a coating region on the front surface of the substrate which constitutes a power module when the coating is to be formed in the coating region by spraying the material powder on the

surface and by means of a substrate heating device for heating the substrate. The latest invention also concerns the method of coating the coating by spraying the product material from the spray device onto the front layer of the substrates.

This cold spraying method is a process for the formation of a coating on the front surface of a substrate surface by means of a spraying system designed to discharge a jet of material powder from a nozzle at high speed along with a working gas heated to a temperature below the melting point or to soften the temperature of the material powder by allowing the material powder to impact or collide again. The process of cold spraying does not require the heat of the material powder at high temperatures compared to the thermal spray system in which the material powder is sprayed at high speeds in a melted or saturated state on the front surface of the substrate.

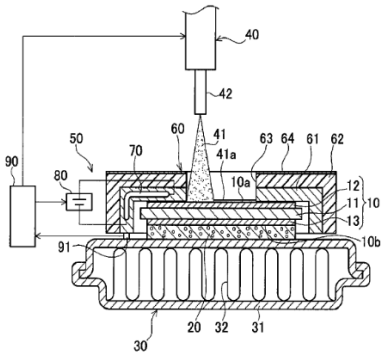


Figure 2.1: Example of masking jig

2.2 Adhesive

Based on Figure 2.2 shows the cool-melt adhesive formulations of this technology remove several of the problems previously established (Ornsteen et al. 1991). Their application temperature typically ranges from 180 ° F to 230 ° F (82 ° C to 110 ° C), which decreases or removes the production of the carbon and at least prevents any potential degradation. Many tests used in mixtures of cool-melt glue are the same as those used in similar hot-melt glue systems. Glue gun architecture offers greater flexibility as the consumer does not need to be shielded from high temperatures. For its handle grip area, the gluing piston can be constructed far closer to the casting than regular gluing pistons. The location of the glue gun will also cover the casting; as the plunger, it can mimic a syringe with a stick of glue.

The temperature range with the formula for the cool-melt stick is between 230 ° and 75 ° F. (110 ° to 24 ° C) While the transition from liquid glue to solid glue is still taking place, the temperature range and distance needed are greatly reduced. The needed distance is only around 0.1 to 0.4 inch, even under heated steady-state conditions. Feeding risks are also reduced as glue sticks are not exposed to air temperatures, which could significantly lower their dial gauge readings below normal temperatures.



Figure 2.2: Glue bucket

2.3 Glue nozzle

The nozzle has a nozzle face with a hole and a surface that taps outwards and downwards from the hole to the end of a smooth circular top According (Carl & Brook 1985). Figure 2.2 shows the nozzle has a bore in which the spring-loaded plunger has surfaces in the bore that work with the valve seat to secure the flow of the glue to the orifice. The end of the plunger passes through the orifice and travels around the rim to meet a piece of product and essentially open the nozzle as the nozzle pushes forward towards the work piece. When the nozzle is removed from the work piece, the extra adhesive on the face of the nozzle is dispersed over the tapering surface and the smooth circular rim to prevent it from leaking out.

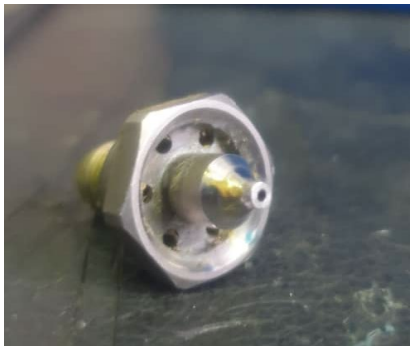


Figure 2.3: Nozzle of glue gun

3. METHODOLOGY

According to The CDIO Initiative (2018). The CDIO stands for Conceive Concept Implement Operate. Figure 3.1 shows the CDIO is an instructional paradigm that emphasizes the fundamentals of engineering in the concept, design, implementation and function of real-world systems and products.

i. Conceive - Description of customer requirements
ii. Design - Creation of the design
iii. Implement - Transforming the design into the product
iv. Operate - Use of the product to deliver the intended value

3.1 Conceive

Conceive is a way of understanding the problem that initiated this project. In this project, the key problem was found in the rear cover of the sport during the spraying process. The manpower removes the parts from the box and places the pieces on the spraying table in an overlapping condition. In addition, the problem arises when the cover material starts spraying

without any guide or jig to monitor the surface sections of the glue field. Next, when the parts are over-sprayed without supervision, the cover stock will not be nice (NG) and the parts may be rejected. So, with this problem, the idea is to construct a masking jig to solve the problems mentioned.



Figure 3.1: With glue (OK)

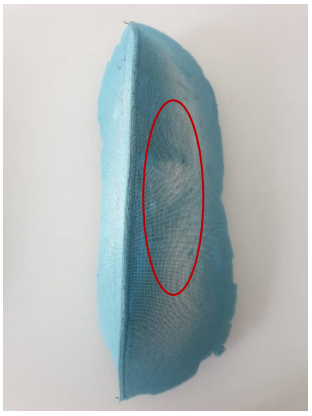


Figure 3.2: Over glue (Not Good)

3.2 Design

3.2.1 Concept Design

After conceiving, an idea to create new things to solve the problem that has been detected is called designing. Design is the most important method for drawing jigs or fixtures. It focuses more on jigs or known as masking jigs for this project. The Figure 3.3 and 3.4 shows the concept of masking jigs covers the surface of the cover material that does not need to be sprayed. This masking jig is important to solve the problem of rejection that occurred during spraying. First, the implementation of this masking jig must consider that the manpower can monitor the glue area and the wasted portion of the spray booth.

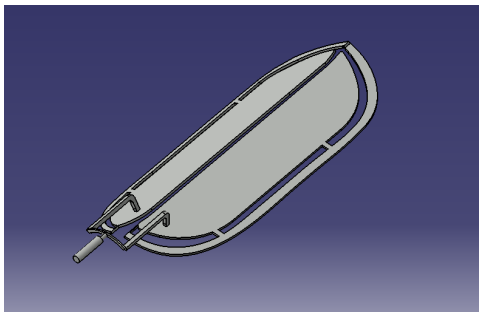


Figure 3.3: Concept design of masking jig

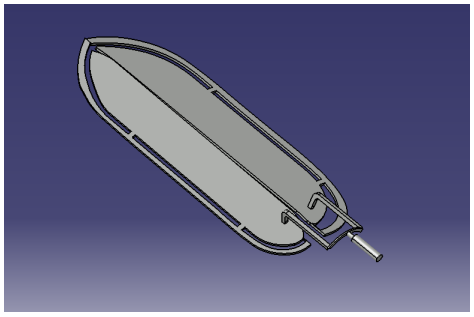


Figure 3.4: Side view design of masking jig

3.3 Implementation

This section will cover the beginning of the implementation process. This implementation includes the execution of the project program. In addition, this segment must follow the goals of the project plan. The idea of masking jig comes from kaizen department engineers who came up with a new concept to shield the component from defects and increase productivity, while the fabricated came from a conversation between the manufacturer and the Kaizen team to improve design and handling before beginning to spray the glue. The sprayer worker needs to contact the masking jig. The Figure 3.15 and 3.16 shows the masking jig is more effective and simpler for sprayer worker to manage during the spraying process. Standard operating procedures are organized and effective.



Figure 3.15: The masking jig



Figure 3.16: Side view

3.4 Operation

Operation is an important step that follows the implementation. This section will clarify the purpose and methods of using the masking jig, which is as depicted in the following table:

Table 3.1 (A-C): Step after fabricating the final product

After implementation	Step while spraying the glue
A. 	Firstly, put the cover-stock in the correct position on the table spray booth. Hold the masking jig holder on the cover-stock before starting to spray the glue.
B. 	Start spraying by following the guide area that has been designed for the convenience of the sprayer workers. The surface glue area on cover-stock will perfectly apply without any over glue or defect.
C. 	After spraying, take out the masking jig from the cover-stock. The masking jig holder will facilitate the sprayer worker. The final result follows the SOP that had been created by the company.

4. RESULTS AND ANALYSIS

4.1 Design analysis

The masking jig will be tested on glue pressure during spraying process. Figure 4.1 and 4.2 shows the analysis will show the maximum and minimum value after the pressure was applied. Furthermore, this analysis will focus on endurance and capability the masking jig. The pressure was applied in the analysis and the value was 2.5 Newton per meter square. Besides that, the

clamp is applied at the holder jig to ensure that the masking jig has an accuracy in analysis. Next, the von-mises stress for maximum and minimum value of the jig is 5.72e+005 and 4.01e+005 respectively, indicating the masking jig limit.

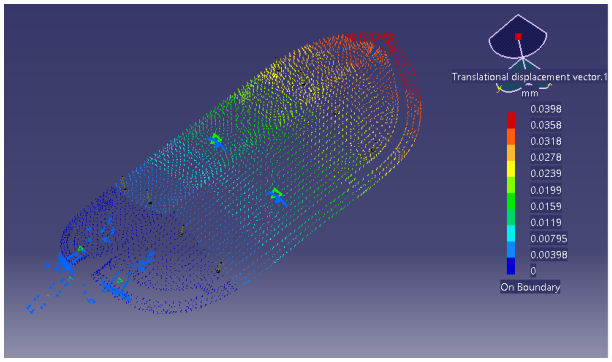


Figure 4.1: Total deformation

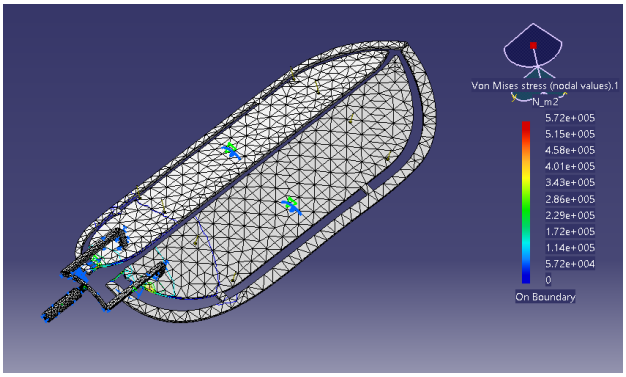


Figure 4.2: Von-mises stress

4.2 Result after implementation

Table 4.1: Result after implementation

Sport rear cover-stock	**Month**			
	Dec 2019	Jan 2020	Feb 2020	Mac 2020
Production quantity	3210	3347	3129	2142
Reject quantity	270	92	83	32
Percentage rejection	8.41%	2.75%	2.65%	1.50%



Figure 4.3: Comparison of results

5. CONCLUSION

As a conclusion, this chapter has presented the result of the implementation of masking jig to reduce the rejection of over glue defects at spraying glue process. The data was verified by comparing the data before, and after the implementation of the masking jig for Sport rear cover-stock armrest production. Besides that, this jig implementation also helps to facilitate the manpower at the spraying process to avoid over glue defects. Thus, this will help the company to reduce the amount of cover-stock waste.

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BANANA PEELS: A GREEN SOLUTION FOR HEAVY METAL REMOVAL FROM WATER

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Abstract River water one of the types of water resources that being affected because of water pollution. The quality of water that being referred are Malaysian Interim National Water Quality Standards (INWQS) which is important tools that classifying the suitable uses of water and also representing the quality of water. Sungai Sarawak (SS) fronting Kuching and its tributaries in Kuching are significantly polluted with organic matter resulting from industrial, residential, commercial (hawker stall) areas, illegal logging, water transportation and sport water activities. The process of treatment involves of a combination of chemical, physical and also biological processes and operations which use to remove solids, organic matter and sometimes nutrients from wastewater are water treatment process. In this research, banana peels *(Musa Acuminate)* has been used to treat heavy metal (HM) in river water compared to river water sample (control). Banana peel has been studied to determine their potential in treating HM. Banana peels have been divided into two types which sample A (cut banana peel) and sample B (uncut banana peel). Fe concentration were tested to measure the potential of banana peels in treating HM in water. After 7 to 14 days for water sample of SS for sample A (cut banana peel) water of 0.56 mg/L, 0.52 mg/L and sample B (uncut banana peel) for 0.58 mg/L, 0.54 mg/L. The control sample, the reading for water sampling is 0.64 mg/L, 0.62 mg/L. The longer hydraulic retention time, banana peel will give better results.

Keywords: Sungai Sarawak, Ferum, Banana Peels

1. INTRODUCTION

Sungai Sarawak (SS) is lifeblood of the state capital of Sarawak, Kuching city. This river serves as a life sustaining water source for the residents in Kuching city and surrounding areas. SS has two main tributaries which is Sungai Sarawak Kiri and Sungai Sarawak Kanan, ascending south of Kuching in the mountain ranges at the border to Indonesia. The discharge of several minor tributaries to Sungai Sarawak like Sungai Maong, Sungai Bintagor, Sungai Padungan, Sungai Sekama, Sungai Bintawa and also Sungai Biawak. The raw water draw from SS will be treated at Batu Kitang Water Treatment Plant (BKWTP) before distributing for domestic and industrial used. SS also is an important navigation channel that connected a few landmarks in Kuching city by using River Taxi and the river also being used for activities such as annually Sarawak Regatta, to boost the tourism industry in Kuching Sarawak.

SS and its tributaries are receiving sewage and wastewater from a variety of sources in Kuching including households, food outlets markets, restaurants and industries. In addition, Sungai Sarawak receives pollutants from agriculture, mining and land clearing activities as well as sewage from cities and villages that a located upstream of Kuching. (Anon,2000). The water quality of SS was very poor and falls between the class IV and class V. The high concentrations of Biochemical Oxygen Demands (BOD) and Ammoniacal Nitrogen (NH3-N) and very poor oxygen conditions are encountered. The concentration of oxygen are in fact so low and only very few organisms can survive in the water. (Sabtuyah,1995). In addition, the sources of pollution to Sarawak river also caused by the poultry and domestic sewage waste.

The pathogen and microorganisms that can causes disease are excreted in faces of infected person or animals and may carried into river. Sewage also contains of oxygen demanding substance organic waste that exert biochemical oxygen demand (BOD). BOD change the ecological balance in water by reducing the dissolver oxygen content. The spillage oil from the boat also contribute to water pollution and very danger to aquatic life and affect environment. Sarawak river also contaminated with heavy metals discharge from untreated water (Chapman,1997).

A heavy metal (HM) is a toxic metal at low concentrations. While the term heavy metal is common metal are not classified as heavy metals by standard definition. Many heavy metals have a large atomic number, atomic weight and a basic gravity greater than 5.0. Some heavy metals include metalloids, transition metals, basic metals, lanthanides and actinides. (Anne, 2008). Heavy metals cannot be degraded or destroyed. HM enter our bodies through food, drinking water and by air. Heavy metals are dangerous because they tend to bioaccumulate (Sabtuyah,1995). Iron or Ferum (Fe) is the most abundant metal on the Earth's crust. Fe in water has many effects to aquatic life, both good and bad. Fe comes from various minerals in the soil, which makes groundwater contains the highest Fe concentrations. Iron levels in water vary depending on several factors and can affect human behavior, health and extremely affect aquatic life (Andromeda, 2018). Larger amounts they can become toxic or dangerous. Iron in water has many negative effects for human such as it can affect human health, skin also our food and drink (Jason, 2018). Higher levels of Fe do not dissolve in water; aquatic life cannot digest all the Fe they take from water. The Fe can build up in animals' internal organs, eventually killing them. Higher levels of Fe in fish and aquatic life also have negative effects on the people or creatures consuming them (Andromeda, 2018)

This study used Pisang Nipah peel (*Musa Acuminata*). Banana peels usually a waste and is commonly used to feed animals, in water decontamination and in the manufacture of some biochemical. Banana peel actually has many beneficial benefits. The peels are full of antioxidants, minerals and vitamins used for beauty product, relieve mosquito bites, whiten teeth, polishing shoes and more (Erin, 2018). Banana peels comprise nitrogen, sulfur and carboxylic acids; the acids can help the ability of banana peel to bind the toxic metals and eliminate them from water. This high amount of acid in the peels, it not only can remove the contaminants. The sample also easy to obtain in large quantities, cheap and does not require high technology in production the sample (Candace, 2012). This study is based on data collection of 7 and 14 days, the result that obtain from the laboratory test are able to achieve the objective of this study which is to determine Fe contamination in Sungai Sarawak and the potential of banana peel to adsorb Fe.

2. LITERATURE REVIEW

2.1 Absorption of heavy metals using banana peels

Previous research which is related to absorption materials has been extensively conducted. While the fermentation method based on banana peel for the absorption of iron (Fe) which is a heavy metal is one of the methods used to remove heavy metals in water. The parameters used are good absorption methods because they take into account the factors of absorption capacity, regeneration ability, kinetic parameters, price and marketability in the market. Biomass of banana peel itself consists of polysaccharides, proteins and fats which is among the factors and function to be used to bind heavy metal irons. Recent studies have shown that agricultural waste product and natural polymers can be used as potential biosensors for the removal of heavy metals. The absorption process itself can be used to treat wastewater treatment with low metal concentrations because its alternative source is cheap, standard and more effective when compared to conventional methods. The binding process of metal iron itself consist of many physiochemical processes such as ion exchange, composition and electrostatic interaction (Kusuma, 2011).

2.1.1 Iron (Fe)

The fourth most common element on the Earth are Fe or Iron. It forming much of Earth's outer and inner core. Fresh iron surfaces look like lustrous silvery-grey, but oxidize in common air to give hydrated iron oxides, normally known as rust. Contrasting the metals that form passivation oxide layers, iron oxides occupy more volume than the metal and thus flake off, exposing fresh surfaces for corrosion. Iron chemical compounds have many uses. (Zhou, 2016). Iron oxide which mixed with aluminum powder will produce explosion in the presence of a termite and it is widely used in the process of classification and production of ore. Apart from that, iron greatly affects the biological system in human body with the formation of oxygen molecules in hemoglobin and myoglobin. Both of these compounds are common oxygen transport proteins in vertebrates. This iron is distributed throughout the body in the form of hemoglobin, tissue, muscles, bone marrow, blood proteins, enzymes, ferritin, hemosiderin and as a transport in plasma.

2.1.2 Effects of Fe to human health

The effect of Fe to human health cannot be unquestionable even though it is one of the top plentiful metal. Certain vegetables such as potatoes, whole meal product and meat also contain iron. Compared to plant or vegetable products, human body tend to absorb more iron from meat products. In the hemoglobin, the most necessary part is Fe as a red agent in the body. The most common problem that attack human because of lack of iron are anemia and too much inhalation of Fe oxide fumes will increase the chance of lung cancer. Fe not only effect to human body, too much consumption of iron also will cause serious hazards and it also give negative impact to environment. Due to that, those iron which containing chemicals enter into the environment, our ecosystem will be affects and can caused various health problem (Tinaroth,2012)

Must strongly advise factories and industries not to let iron-containing chemicals into the environment. However, although long-term consumption of large amount of iron can lead to iron overload. If left untreated, iron overload can lead to hemochromatosis, a serious disease that may damage the organs of the body. Early symptoms include fatigue, weight loss, and joint pain, but if hemochromatosis is not treated it can lead to heart disease, liver disease, and diabetes. A blood test can identify iron overload.

3. RESEARCH METHODOLOGY

3.1 Apparatus

Iron (Fe) were determined by sending the water sample to the laboratory. There are two methods that being used to detemined the parameters, which is 3030 E Nitric Acid Digestion and 3111 B Direct Air-Acetylene Flame method. Apparatus such as hot plate, *Griffin* beakers, volumetric flasks, watch glasses, safety goggles, safety shield, block heater, *Polypropylene tubes*, pipettors with assorted sizes, pipet tips and centrifuge were used in the 3030 E Nitric Acid Digestion laboratory works. Besides that, apparatus such as atomic absorption spectrometer, burner, readout, lamps, pressure-reducing valves and vent were used in 3111 B Direct Air-Acetylene Flame laboratory works. All apparatus are being used in the laboratory works. Water gallon, plastic basins were also being used to collected the water sampling.

3.2 Materials and method

Our wastewater sample were collected at Sungai Sarawak (Kuching Waterfront). The samples then were placed in 3 different basin, 1st basin were the control sample without any plant and the another 2 basins were placed with the banana peel which was cut and uncut. The water sample have been collected for 7 and 14 days to react with banana peel as shown in Figure 3.1., Figure 3.2 and Figure 3.3.



Figure 3.1 Control sample



Figure 3.2 Sample of cut banana peel



Figure 3.3 Sample of uncut banana peel

The water sample then send to Evo Chemical Analysis & Consultancy Laboratory to determine the Fe concentration.

3.3 Paramater - Iron (Fe)
Within the aquatic environment, the chemical behavior of Fe is decided by oxidation-reduction responses, pH and the presence of co-existing inorganic and natural complexing specialist. Iron does not clearly change in unadulterated water or in dry air, but when both water and oxygen are display (moist air), Fe erodes. Its silvery color changes to a reddish-brown because hydrated oxides are shaped.

3.3.1 Nitric Acid Digestion Method
a) Procedure ford Digestion for Atomic Absorption Spectrometry (AAS) and High-Level Concentrations
Transfer the measured volume (100 mL recommended) of the sample preserved with acid and suitable for the expected metal concentration into a thermos or beaker. In a hood, add 5mL of HNO3. If a beaker is used, cover with a ribbed watch glass to reduce contamination. Boiling chips, glass beads can be added to boil and minimize splashes when high concentrations (> 10 mg /L) are determined.

Then slow the temperature of boiler and let it evaporate on a hot plate until the lowest volume possible which is about 10 to 20ml before precipitation happened. Heating must be continuing by adding HNO_3 as necessary until digestion is complete and it shown by light-coloured and clear solution. During the digestion, do not let the sample dry out. Flask or beaker wall must be wash while glass cover with metal-free water must be watch properly (if used) and then filter it if necessary. Transfer filtrate to a 100ml volumetric flask with two 5ml portion of water and adding these rising to the volumetric flask. Let it cool and dilute to mark while mix it thoroughly. The portion of these solution must be taken out for required metal determinations.

b) Procedure for Digestion for Flame Atomic Absorption (FAA) and High Level Concentrations
The new polypropylene tubes and caps must be soak overnight or at least for several days in $2NHNO_3$. Then use metal free water to rinse those tubes and caps triple time, dry it in the baskets or poly rackets under low temperature of oven overnight. All cleaned tubes must be always kept in plastic bags to maintain it cleanliness. Before experiment done, pipet tips need to be clean and being evaluate. Pipette 10ml well mixed, acid preserved sample into a pre cleaned then labeled the tube with micro pipet. Add appropriate amount of analyze for matrix fortifies samples with a minimum volume change which is less than 0.5ml. By using pipette, add 0.5ml HNO_3 or 1.0ml HNO_3 to all samples and quality control samples. Place tubes in block heater in a hood and adjust temperature to 105˚C. Drape caps over each tube to allow escape of acid vapors while preventing contamination. Digest samples for a minimum of 2h. Prevent the samples from boiling that make failure the sample. Continue by

add nitric acid as required until digestion is complete by observation of a clear solution. Then remove those tubes from heat and let it cool to the room temperature. Dilute again to original 10ml volume by using metal free water. The volume of samples being adjust to the next appropriate gradation for calculation and all the volume data must be written. Tighten screw caps and store at 4˚C until all sample are ready for analysis.

3.3.2 Direct Air-Acetylyne Flame Method
Atomic absorption spectrometer, comprising a light source that emits a line spectrum of an element (light cathode hollow or lamp electrode less discharge), a device for evaporating samples (usually flame), a tool to isolate the absorption line (monochromatic of filter and slit adjustable) and photovoltaic detectors with associated amplifiers and electronic measuring instruments. Premix are the most common type of burner, which inserts the spray into the condensing chamber to remove large droplets. The burner can be equipped with a conventional head containing one slot: three slot Boling head, which maybe preferred for direct aspiration with air-acetylene flame: or special heads for use with nitric oxide and acetylene. All equipment is equipped with null meter mechanism or with digital mechanism.

A large number of modern instruments equipped with a microprocessor or computer control stand-alone capable of integrating signal absorption over time and liberalize the calibration curve at high concentrations. Use a hollow cathode lamp or low emission electrode lamp (EDL). Use one lamp for each measured element. Compared to single element lamps, multi element hollow cathode lamp generally can provide much lower sensitivity. EDL takes longer to warm up and stabilize. Place the vent about 15cm to 30 cm above the burner to remove smoke and steam from fire. This provision is to protect laboratory people from toxic vapors, protect instruments from corrosive vapors, and prevent fire stability from being affected by room drafts. A damper blower or variable speed is required to modulate airflow and prevent flame disturbance. Choose a blower size to provide the airflow recommended by the manufacturer apparatus.

4. ANALYSIS

Average heavy metal during sampling from Sungai Sarawak indicates that the overall values still meet the effluent standards that states in Environmental Protection Agency (EPA) Regulations 1970. The initial concentration of Fe in Sungai Sarawak was 0.72 mg/L. Table 4.1 shows the result of Fe concentration for control sample, cut and uncut banana peel.

Based on the experimental results that have been tested, it is proven that the use of banana peels to absorb heavy metals in the water which is Sungai Sarawak. The initial Fe concentration in the water was 0.72 mg/L. After testing for 7 days, the experimental results for the control sample were decreased by 11% which is 0.64 mg/L, while for the sample cut banana peels was reduced to 0.56 mg/L and for sample uncut banana peels decreased to 0.58 mg/L. Next testing for 14 days, the experimental results for the control sample were decreased by 17% which is 0.60 mg/L. The sample cut and uncut was reduced by 28% and 25%.

Table 4.1 Concentration of Fe in Sungai Sarawak

Heavy Metal		**Days**	**Parameter (mg/L)**	**Percentage Fe Removal (%)**
Iron (Fe)	Initial Concentration	0	0.72	-
	Control	7	0.64	11
		14	0.60	17
	Cut Banana peel (A)	7	0.56	22
		14	0.52	28
	Uncut Banana peel (B)	7	0.58	19
		14	0.54	25

The table above shows that the iron removal percentage of control sample in 7th days is 11% and 14th days is 17%. The iron removal percentages of sample A for 7th days is 22% and 14th days is 28%. Meanwhile, sample B for 7th days is 19% and 14th days is 25%. The result of percentage of removal iron in water show that sample A which is cut banana peel is more effective than control sample and sample B.

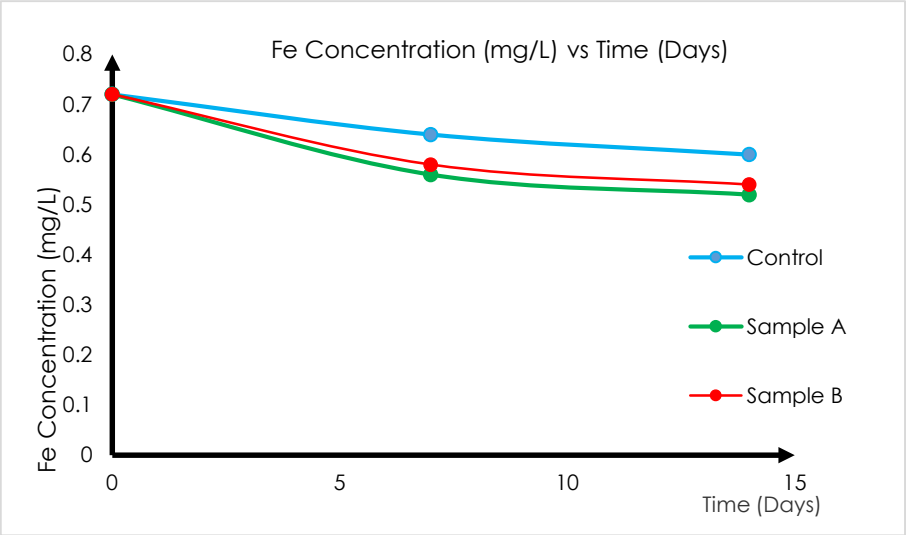


Figure 4.1 Fe concentration (mg/L) vs Time (Days)

From Figure 4.1, we can see the results of Fe concentration in control, sample A and B was reduced from 7 to 14 days. Thus it declined drastically after the banana peel have adapted to the water. It was caused by the banana peel reacted in removing the heavy metal (Fe) in the water. According to Mohapatra et al. 2010 banana peel is found to be good sources of pectin, lignin, cellulose, hemicelluloses and galactouroninc acid. Banana peel is recognized to be an economically viable and environmentally sound adsorbent for removal of heavy metals from contaminated waters. The studied by Edi et al,2019 shown that, there parameters to be considered as adsorption method which is the right adsorbent selection especially the absorptive capacity for removal of heavy metals. The adsorption process itself can be used as potential to treat wastewater with low concentrations of low metals due to its low cost, simple and more effective alternatives.

5. CONCLUSION

The study showed that Sungai Sarawak of Kuching Waterfront meet the parameter values of effluent standards that have been set out in Environmental Protection Agency (EPA) Regulations 1970. Most of the parameters value of the Sungai Sarawak at Kuching Waterfront is accordance with the environmental eligible. By using banana peel, cut and uncut can be used to remove Fe in water.

This project has proven that Fe concentration in Sungai Sarawak can be treated naturally by using banana peel by comparing it with control sample, cut and uncut banana peel. Within the first 7 days of sampling was taken and it showed the sample of both sample A (cut) and sample B (uncut) banana peel result was better than control sample. While the result for 14 days of sampling, the water sample was taken, and the sample of uncut banana peel result was better than cut banana peel result.

As the conclusion, banana peel method is the simplest, cheapest, environmentally friendly method that can be done in treating and polishing wastewater. From this study all of the

result shows good sign in implementation of banana peel method at Sungai Sarawak. The banana peels appeared to be useful in the removal of Fe in the river.

For further research, to improve the result banana peel water is banana peel (*Musa Acuminate*) must been dried clearly to avoid the river water condition become worse caused by the origin of the fungi. Besides that, the retention time of banana peel also can be increase. The efficiency produced of banana peel attached to the peel (bacteria smooth and deplete oxygen in the water). So the longer time it takes the better result will get.

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DESIGN AND FABRICATION OF CHECKING FIXTURE FOR DOUBLED-FLARED ENDFORMING TUBING PARTS

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Abstract. This project is about to design and manufacturing of inspection fixture for tubing end forming checking which involves define shape based on the tube brake. The purpose of inspection fixture is to inspect the inner diameter, outer diameter, angle of hole tube brakes. Inspection fixture plays key role in the mass production system. In the present fixture inspection of the product is carried out manually, which leads to problems of leaking and inaccuracy. This inaccuracy will increase the rejection rate of components. In order to minimize this error and reduce the rejection, it becomes essential to design a special purpose auxiliary to the existing fixture. To design the inspection fixture, CATIA V5R21 software is used. The aim of the project is to design and develop an inspection fixture by using CNC machining to recognize how it will inspect the diameter, angle and structure. By using this inspection fixture we inspect the diameter and size of hole tube brake.

Keywords: End forming, Inspection fixture, Rejection rate, CATIA V5R21

1. INTRODUCTION

The common automotive part products under IQMSB are Tubing (brake tube), Door Check Assy, Handle Door Inside, Grip Assist Assy, Parking Brake, Jack Sub Assy, Lock Assy Hood and many more. IQMSB does not only produce and supply automotive parts, but also provides a lab facility for testing part and also for inspection activity. Every new or current part supplied to Original Equipment Manufacturer (OEM) is required to be tested by following certain parameters and customer's requirements. The testing part is important in the development stage and part quality because the endurance of parts can only be determined through various types of testing.

There are various types of products produced for OEM such as Proton, Perodua, Honda, and others. In product manufacturing, some problems have been identified. Tubing (brake tube) is a product installed in the area of the car and functions as a tubing for the brake. Brake tubes are used to transfer the hydraulic pressure produced by the master cylinder to the wheel brake systems. Brake tubes use brazed steel tubing due to the excellent pressure strength of the material, despite given the high maximum pressure of the braking systems. This study focuses on the problem occurring at the production line end forming process for tubing parts, where the operator does not have the specific checking fixture (CF) for inspection. At the end forming line, the operator needs to inspect the parts after the process is complete.

The operator uses improper ways in checking the parts only using vernier callipers and sometimes the operator only uses visual checking on parts. In addition, if the brake leak can lead to brake failure, this is not an issue to be taken lightly and requires immediate attention for self-well-being and the safety of others. A checking fixture is a device that locates, supports and holds the workpiece during the manufacturing process. Then, a checking fixture is used to securely locate and help manpower to place the product in an arranged form between the fixtures. The fixture should also be an easy device to operate in any processes.

A checking fixture is required to perform the quality inspection process of the end forming process for tubing. The end forming of tubing part needs to pass the quality inspection by human to ensure that it is a smooth operation and no problem occurs during the assembly process. Critical parts of the products are outer diameter, inner diameter, and radius of end formed at the tubing must follow the specs to avoid leaking when being installed into the car. Every critical part needs to be evaluated in detail to ensure that the tubing part is in a good condition and ensuring smooth operation at the production line. Thus, the following research objectives are as follow:

i. To analyse the number of rejection at the production line of the end forming for tubing parts.

The scope of the project is determined by the objectives or goals of the project. Hence the scopes of this project are:

i. An analysis is done in production line of the end forming.
ii. An analysis is focused on the design and fabrication of a fixture using CATIA V5R21.
iii. The checking fixture is designed to check the outer diameter, inner diameter, and inner angle double-flared end process of tube formed.

This research focuses on designing a checking fixture for double-flare end process of forming at the productions line at the end forming process. This project is hoped to give benefits to the operator and the company. For the operator, the checking fixture will ease the checking process of the double-flare type end forming process for daily checking without waiting for the quality control inspector to confirm if the part is 'OK' or 'NG'. And for the company, by designing a checking fixture for double-flare end process of forming at productions line at the end forming, the company's productivity will be improved.

2. LITERATURE REVIEW

The inspection fixtures is one of the inspection devices that high precision and interchange ability (Cheikh & McGoldrick, 1988). Besides that, the uniformity of the devices must be limited. Furthermore, the devices also need to be taken into the capability of the machine. Also, several of the variations in size or hole should be taken as important data and must be allowed for some of the economic reasons. Moreover, the inspection fixtures are very important in industry because it can speed up the inspection procedure to increase the rate of manufacturing in the industry.

The parts after getting finished with the manufacturing operation have to be checked for its accuracy in shape or dimension. That will be performed with inspection fixtures and they are extensively used in automotive industries. The fixture will be the master in shape and every part will be compared for its shape conformity. For checking the dimension, the fixture is prepared in such a way that it could accommodate the correct dimensioned parts only. The main advantages of using inspection fixtures are to produce higher quality parts, reduce cost, and achieve higher productivity.

Checking fixtures design is required in the automotive parts manufacturing, specifically to check the accuracy of the produced part according to the standard design and reduce the human error. A type of inspection fixture is shown in Figure 1.



Figure 1: A fixture constructed from inspection elements

This section highlights different journal papers regarding the area of the project study. These researches uphold the effective methods and techniques which will enhance the project. The literature review for the rejection rate of production focuses mainly on topics such as root cause analysis, data analysis, Pareto analysis, statistical process control.

Discussed the work, which has been carried out in the area of tolerances with cost, function, and process capability the main parameters in mind. So that the resulting functional variables of the assembly can meet their respective functional tolerances requirement and cost of manufacturing all the components to their respective functional tolerances is minimized (Tanvir et al., 2013). It shows that when manufacturing cost information and process capability information is available, functionally correct design at minimum cost can be achieved.

This paper presents the use of Pareto chart and cause and effect diagram in analysing the defect caused in the garment industry(Tanvir et al., 2013). This paper aims at reducing the defect rate caused while stitching clothes. Using these methods it was identified about 80% defect rate in the process of stitching. The top five defects were identified and analysed. Using cause and effect diagram causes and effects are constructed. The study provided a suggestion to reduce the defect rate (Jha, Tyagi, & Gupta, 2013). Thus this paper gives an idea of how effectively minimizing the rework and defect rate.

Other than that, the six sigma approach is to improved efficiency and quality of the production(Alfaro, Madrigal, & Hernández, 2020) especially use in automobile industry. The six sigma processes like define, analysis, measure, improve, and control are applied. This study includes tools like quality management tools such as Pareto analysis, data analysis, cause and effect diagram, and design of experiments. This study aims at finding out the root cause of the problem and providing a solution. This paper aims at reducing the rejection rate from 38% to 13%. Hence six sigma approach was effective in reducing the defect.

Furthermore, in his paper on use of quality tool in minimizing the rework in the apparel industry. This paper gives an idea of quality and productivity improvement in the apparel industry. The methods help to provide the framework in identify the defect and analyse. It helps to reduce the defect rate. This paper gives the idea of application of process performance of critical process which leads to proper utilization of machines and time

3. METHODOLOGY

The method of conceiving, designing, implementing, operating (CDIO)(Lingling et al., 2012) may be used as a tool for defining the problem and the methods of effectiveness in fixing the problem. It is a broad, hands-on, proven approach to filling the gap between engineering learning and practical engineering needs. Besides, the CDIO approach uses active learning tools, such as group projects and problem-based learning, to better provide engineering students with technical know-how as well as communication and professional skills. The framework of CDIO will provide students with an education stressing engineering

fundamentals set in the context of conceiving, designing, implementing, and operating real-world systems and products. Meanwhile, CDIO stands for:-
i. Conceive (C) – Defining customer needs, considering technology, enterprise strategy, and developing the concept.
To complete this project, the conceive method was implemented. Conceive is a method of understanding what problems are going on for a project. In this project, the problem was detected in the production line of end forming process. Conceive is a method of understanding what problems are going on for a project. In this project, the problem was detected at the end forming the production line.

ii. Design (D) – Creating the design, the plan, and algorithms that describe what will be implemented.
After conceiving has done, an idea to create something to solve a problem has been detected and implement. Design is an important method or element designing checking fixtures. The engineering design process is one of the steps required for the development of the product. Step in designing a checking fixture is by evaluation of its functional requirements to find the balanced combination of design characteristics at a reasonable cost. At this step, the tool design process should clearly state the problem to be solved and achieved as needed. The design process also included the analysis that involves the product such as the clamping position, the load distribution, the material selection, and more analysis and information from the design.

iii. Implement (I) – The transformation of the design into the product, including coding, testing, manufacturing, and validation.
After the design is approved , the proposed design and project proceed to implementation. Implementation is a method after the design is done. For the next stage, more studying about tools, material to be used, assembly, and finishing for a new fixture. An implement is one of the plans to achieve and make something such as plan, idea, system, and also tooling to start the work to be used. In this project, to fabricate this project some planning must do. The manufacturing process begins with the selection of materials suitable for component machines. After that, all the materials are combined to produce the desired design. CNC machining is a manufacturing process in which preprogrammed computer software dictates the movement of factory tools and machinery. The process can be used to control a range of complex machinery, from grinders and lathes to mills and routers. With CNC machining, three-dimensional cutting tasks can be accomplished in a single set of prompts.

iv. Operation (O) – Using the implemented product to deliver the intended value, evolving maintaining and retiring the system.
Checking fixtures that have been developed will be assessed to see if checking fixtures can resolve the problems identified in the early stages (conceive). The checking fixture will be tested at the end forming a production line. The checking fixture must be able to operate as described in the objective and scope of the study early chapter where it can ease the operator for everyday checking of end forming on tubing parts. Besides, the checking fixture must be able to reduce quality issues and rejection at the production line end forming for tubing parts due to the correct specification.

4. RESULTS AND DISCUSSION

Analysis of data is an important task. The production data were collected for five months and analysis of rejection rate was done for the production line(Tanvir et al., 2013).

Table 1: Rejection rate before the implementation of checking fixture

Months / Number of parts	Sept. 19	Oct. 19	Nov. 19	Dec. 19	Jan. 20
Production (pcs)	8000	8000	8000	8000	8000
Rejection parts (before)	42	38	40	45	50
Percent. rejection parts, % (before)	0.53	0.48	0.50	0.57	0.63
Average percent. rejection	0.54 %				

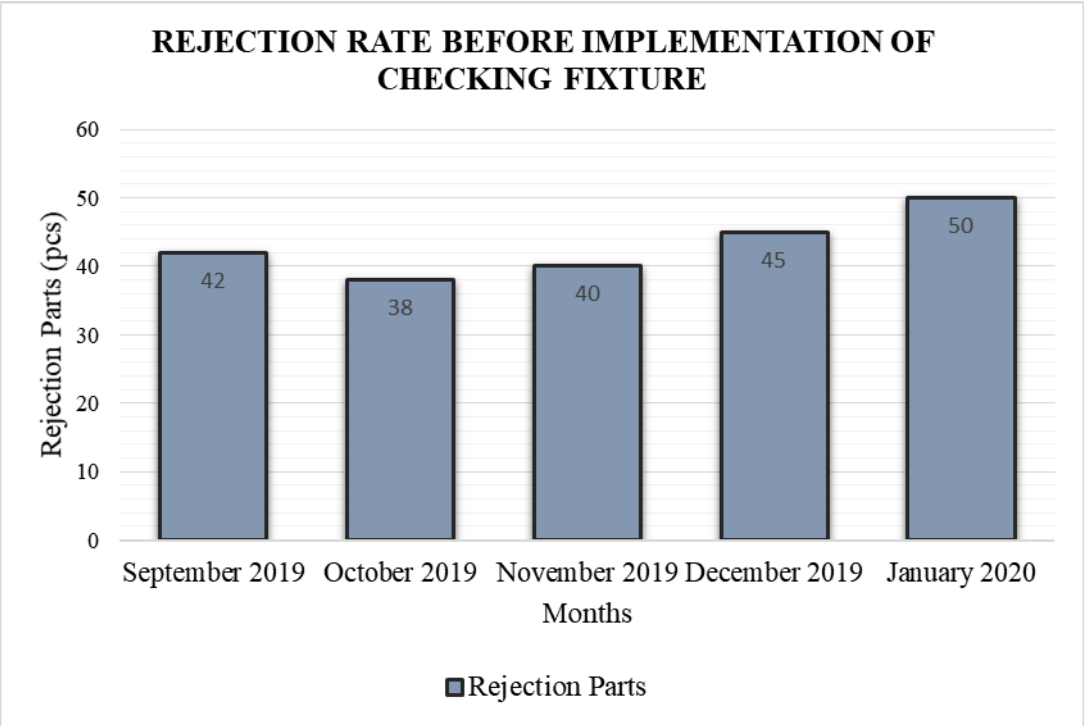


Figure 2: Bar chart of rejection rate before the implementation of checking fixture

The data in Table 1 and Figure 2 above show that the percentage of rejection rates of parts is less than 1%. The above table shows the rejection parts with its percentages. The rejection parts are the result of the existing method of checking, which is a common occurrence in the production line. A number of parts are rejected every month at the tube end forming production line.

The highest rejection part occurred in January 2020 with a total of 50 pcs, where there are parts being rejected daily. Therefore, checking fixture modification is required for the reduction of rejected parts. The data is measured and collected to analyze any improvements that can be made using a new checking fixture.

The data in Table 4.2 shows the rejection rate after the implementation of the checking fixture. By using a new checking fixture, the number of rejected parts was reduced for 3 consecutive months. Comparing the data before using a new checking fixture, the average percentage is 0.54 % while after the implementation of the new checking fixture, the average percentage rejection was only 0.07 %. This shows that the company can reduce the cost of material at the tube end forming production line.

Table 2: Rejection rate after implementation of checking fixture

Months / Number of parts	Jan. 2020	Feb. 2020	Mar. 2020
Production (pcs)	8000	8000	8000
Rejection parts (after)	10	5	2
Percent. rejection parts, % (after)	0.13	0.06	0.03
Average percent. rejection	0.07 %		

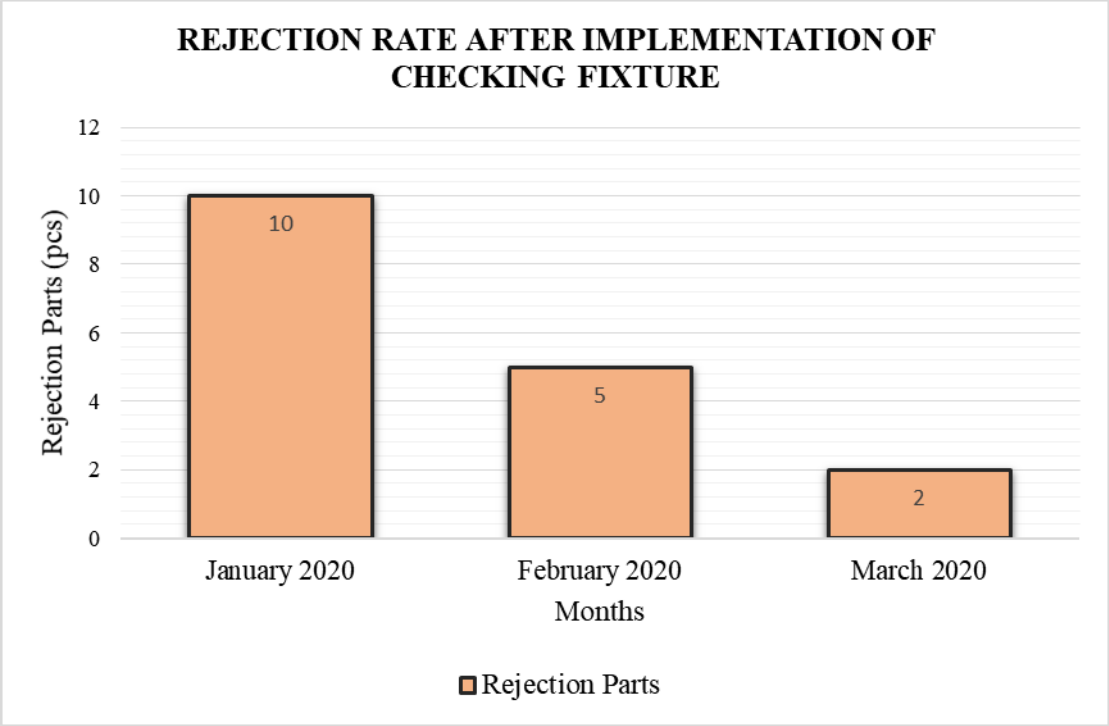


Figure 3: Rejection rate after implementation of checking fixture

The data in Figure 3 shows the analysis of the rejection rate after the implementation of the checking fixture. From the observation throughout the three months starting from January, it was found that there was a total of 10 pcs of rejected parts in January, which decreased by 5 pcs in February and only 2 pcs were rejected in March. The pattern of the bar chart illustrates that the number of rejected parts reduced by months.

Besides, if the operators are consistent in using the checking fixture with the right standard operation procedures (SOP), it can help to increase the productivity at the production line by decreasing or eliminating the number of rejected parts. Here. it can be seen that the checking fixture can reduce the number of rejected parts. By using the checking fixture, operators can detect the problems on the parts.

Therefore, it can be seen that before implementing the checking fixture, the rejection rate was high, every month. After the implementation of the checking fixture in January 2020, it can be seen that the rejection rate has successfully been reduced. With a checking fixture, the number of rejected parts decreased from 0.54 % to 0.07 %, requiring only one operator. With a checking fixture, it will help the operators in charge at the production line to notice the abnormalities at the tube end forming production line. Before the implementation of the new

checking fixture, two operators were needed; one worker to run the end forming on tubing with the machine and another worker to check the diameter of the tubes.

After using a checking fixture, the problem is solved and the checking process is easy without causing inconvenience to the workers to check using improper tools and consequently saving the cycle time. Hence, the use of the new fixture will reduce the rejection rates, in line with the company's aim.

5. CONCLUSION

To conclude, this research focused on designing a checking fixture for the double-flared end forming. From the finding and problem statement, it can be concluded that the former method of checking the inner diameter, outer diameter, and inner angle yielded bad results in terms of time and rejection rate at the production line.

This checking fixture is important to the company because product checking or analysis, also known as consumer checking or comparative checking, is a process of measuring the properties , performance, or requirements of the products. It is one of the stages to ensure that there is no problem that occurred during mass production. If this checking fixture is not implemented in the production line, the production line needs to spend more time in daily check of parts and will increase the number of rejected parts.

Besides that, the number of rejections of the part is also high in quantity. This is because when the Vernier calliper is used, the percentage of defects is more than 2 % of total production. It automatically makes the company profit to decrease and can affect the worker's salary. The rejection also makes the company lose the confidence of its customers for the next project because the company had supplied the parts with defects to the customers especially Perodua.

Lastly, the problem has been found and analyzed, and the checking fixture has successfully been designed, where all the fixture components are designed in detail especially the dimensions, materials, and tolerances.

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EXPERIMENTAL STUDY ON THERMOSYPHON HEAT PIPE HEAT EXCHANGER TO IDENTIFY POTENTIAL ENERGY SAVINGS IN AIR CONDITIONING SYSTEMS

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Abstract. Half of the total amount of electrical energy pumped into the building is used for air-conditioning and ventilation systems. The use of Heat Pipe Heat Exchanger (HPHE) is one of the option and most likely has great potential to save energy. An experimental study was carried out to investigate the effects of air-to-air thermosyphon heat pipe heat exchanger (THPHE) on the centralized air conditioning system, typically used in Malaysia. The 6-row of 12mm outside diameter, plain heat pipe heat exchanger was tested. This THPHE was 60% filled with R134a refrigerant as a working fluid. The inlet air dry bulb temperature ranges from 28°C to 36°C while the air face velocities varied from 1.0m/s to 2.2m/s. The THPHE effectiveness, reheating and pre-cooling effects were investigated in the experiment. As expected, the values of the overall effectiveness are shown to vary with the air mass flow rate. The reheat energy provided by the condenser of the THPHE ranges from 0.38 to 0.73 times the power input of the compressor. The precooling effects significantly lower but it still contributes to the energy saving for the whole system. This paper provides a basic understanding of THPHE characteristics and performances which is expected to emphasize the potential of energy saving by applying THPHE in Malaysia's air conditioning systems.

Keywords: Thermosyphon, Heat Pipe Heat Exchanger, Energy Saving

1. INTRODUCTION

Buildings located in countries that experience hot and humid weather throughout the year such as Malaysia need an air conditioning system to be inhabited. Cooling with sufficient level of temperature and relative humidity is necessary to provide great level of comfort. The whole process is greatly done by the existing conventional air conditioning systems. However, the amount of energy pumped into the air conditioning system is significantly high. In a typical office building, more than half of the energy (57%) is used for air conditioners (Rahman, 2009).

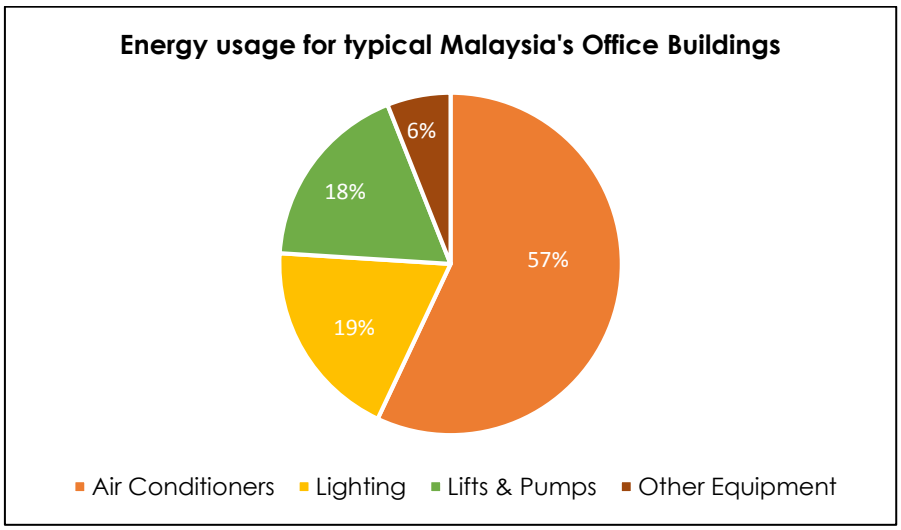


Figure 1: Energy use in Malaysia's office buildings (Rahman, 2009).

This high energy consumption has an unhealthy effect on the environment. Various methods have been developed to reduce energy consumption in air conditioning systems including the use of Thermosyphon Heat Pipe Heat Exchanger (THPHE).

THPHE consists of airtight tubes typically made from aluminium or copper. Working fluid is charged under a vacuum condition through a small pipe located at one end of the tubes. It is commonly built with three main sections known as evaporator, where the heat is absorbed, adiabatic section, where the energy is transferred between the evaporator and condenser, and condenser section, where the heat is rejected.

The operating principle of THPHE begins when heat is applied to the evaporator section. The heat in this section is absorbed by the working fluid until it reaches saturation temperature and evaporates. This creates a high pressure in the evaporator section that allows the saturated vapor of the working fluid to rise to the condenser. Lower temperature at the condenser section cause the working fluid vapor to lose energy and changing it phase into a liquid. The liquid returns to the evaporator section and the process is repeated. The cross section of a typical THPHE is shown in Figure 2.

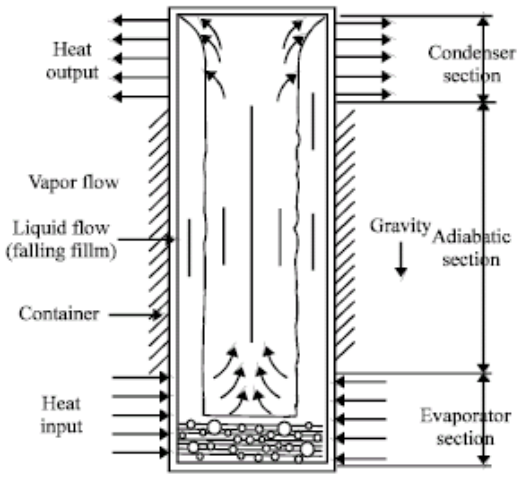


Figure 2: Thermosyphon Heat Pipe Heat Exchanger (THPHE) (Kannan & Natarajan, 2010)

THPHE is a gravity-assisted heat exchanger that is capable of transferring a high volume of heat in a long distance. This capability allows THPHE to be used widely in waste heat recovery applications and air conditioning systems to reduce energy consumption.

2. LITERATURE REVIEW

Various techniques have been applied using Heat Pipe Heat Exchanger (HPHE) to increase the energy efficiency of air conditioning system. Nandy et al. (2017), applied HPHE in a hospital operating room HVAC system as a heat recovery equipment. Earlier, Xiao et al. (1997) has applied HPHE for HVAC humidity control. In addition, Wan et al. (2007) theoretically investigated the effect of HPHE on cooling and reheating energy for an office building's centralized HVAC system.

Thermal efficiency of HPHE has been studied and improved continuously. Imansyah et al. (2018), experimented the utilization of HPHE to improve energy efficiency of clean room air system in hospital and concluded that the energy saving could reach up to 0.5kW. Shung et al. (2006), conducted an experimental investigation of silver nano-fluid on heat pipe thermal

performance and the result showed that the thermal conductivity increased directly proportional to the additive particle size and concentration. Similarly, Paisarn et al. (2009) experimented the heat pipe efficiency enhancement by adding nanoparticles mixtures and also concluded the increase of thermal efficiency.

The flexibility and compatibility of thermosyphones with various experiment control parameters encouraged many researchers employed (THPHE) on their research. Wu et al. (1997) studied the effectiveness, relative humidity control and energy recovery capabilities of supplied air using THPHE. Muhsen et al. (2016) used plain and rifled tubes to compare the effectiveness and thermal performance of THPHE. Different configuration of THPHE tilt and bending angle was studied by Thanapol et al. (2016).

3. METHODOLOGY

In order to study the effect of thermosyphon heat pipe heat exchanger on a conventional air conditioning system experimentally, a test rig was set up. The test rig was designed with the maximum of intake air dry bulb temperature and relative humidity of 36°C and 70% respectively as controlled parameters.

3.1 Malaysia's weather data

The average daily weather performance in Malaysia is fairly consistent throughout the year. The average dry bulb temperature ranges from 25°C in the morning and reaches its peak of 35°C at noon and decreases gradually by midnight. The average percentage of relative humidity uniformly decreased from 80% in the morning, 60% at noon and around 50% during late evening.

The weather data for 10 years from 1972 to 1998 was collected from MET Malaysia. The average hourly (8.00am – 5.00pm) temperature and relative humidity in Malaysia is shown in Figure 3.

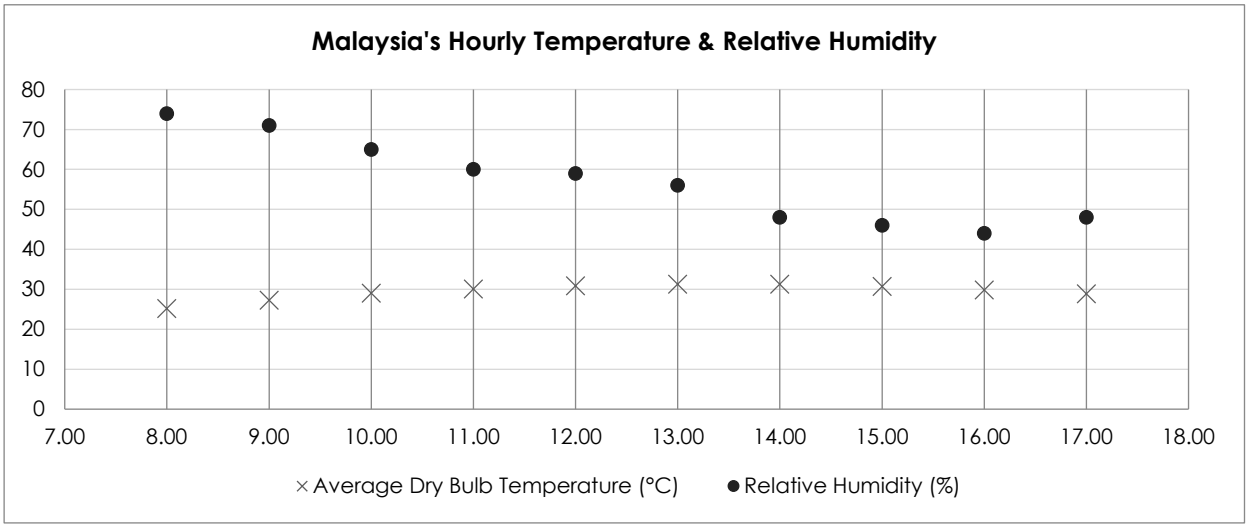


Figure 3: Hourly dry bulb temperature and relative humidity of Malaysia

3.2 Test facility

Test rig with two configurations was set up for the experiment. First configuration was used to investigate the effectiveness of the THPHE and second configuration with minor changes was used to investigate the pre-cooling and reheating effect. The effectiveness test was carried out first and followed by the other tests. "U" shape duct was installed to connect both evaporator and the condenser sections to create a closed-loop system.

The test rig configuration used to investigate the effectiveness of THPHE was similar to the configuration used by the previous study done by Jouhara (2012). However, the heat pipe heat exchanger was fitted horizontally 90° instead of rotating. The experimental test rig used for the effectiveness investigation is shown in Figure 4.

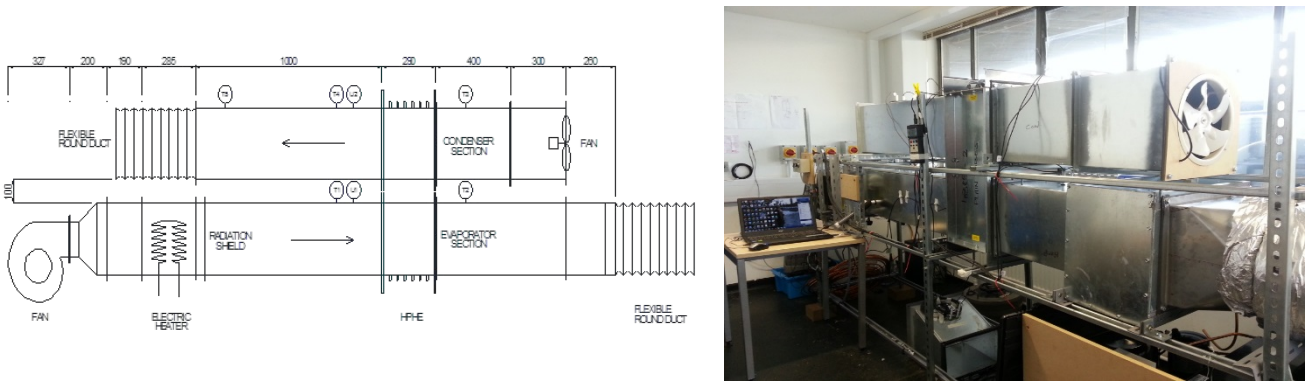


Figure 4: Test Rig used for THPHE Effectiveness

The HPHE constructed with a number of thermosyphons arranged horizontally. The test rig was designed to use hot outside air to reheat the supply air to the conditioned space. By introducing the heat pipe heat exchanger in the conventional air conditioning system, pre-cooling (passing the evaporator section) and reheating (passing the condenser section) can be achieved (Kusumah, Hakim, Sukarno, & Rachman, 2019)
Rectangular galvanized ducts (300mm x 300mm) were used to supply warm air which has been provided by 9kW electric heater. The heater was placed between the centrifugal fan and the evaporator section of the heat pipe heat exchanger. The heater is equipped with pressure switch and temperature sensor to measure the rate of heat added into the air stream accurately. This allows the effectiveness to be tested at different temperature of airflow. Radiation shield was placed between the heater and the sensor where the measurement was taken. This provides a line barrier to reduce the radiation effect from the heater to the sensor.

A centrifugal fan was installed at both sections of THPHE via galvanized ductwork to create a counter flow air stream across the thermosyphon heat pipe heat exchanger. In order to avoid mixing air from the evaporator outlet and the condenser inlet, flexible duct was used to channel the warmer air stream from the evaporator outlet to the outside of the room. The air velocity was measured using an anemometer which uses a single probe. One probe was fitted in the middle of the duct on each section to measure the air flow velocity accurately.

Temperature of air entering and leaving each section was measured by sensor with thermoset polymer capacitive sensing element with on-chip integrated signal. The inlet and outlet air temperatures at each section were measured 200mm away from the thermosyphon heat pipe heat exchanger. The sensors sent the analogue voltage signal to a PICO 16-channel data logger. This data logger was connected to both temperature and humidity sensors. Data logging is performed automatically with a microcomputer-based data logging software called PicoLog. The computer records air temperature at each point in the system, before and after (HPHE) and cooling coil. The PicoLog is capable of producing all the measured data in an Excel format for subsequent analysis. The experimental test rig used for the investigation are illustrated in Figure 5.

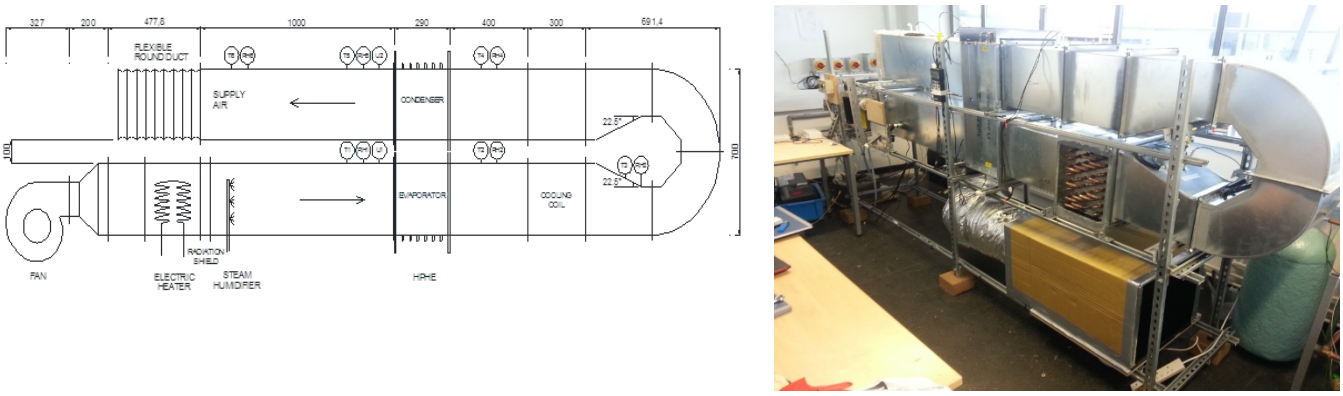


Figure 5: Test Rig used for pre-cooling and reheating effects

For the precooling and reheating experiment, the evaporator and condenser sections were connected by the "U" shape duct to create a loop between the two sections. 5kW direct expansion cooling coil was installed to provide cooling for the system. The cooling coil was connected to L' Unite Hermetique condensing unit with 2hp hermetic compressor and R134a refrigerant as a working fluid.

Temperature and relative humidity of air entering and leaving each section were measured by sensor with thermoset polymer capacitive sensing element with on-chip integrated signal and recorded with PICO 16-channel data logger, similar to the configuration used for the effectiveness test.

Thermosyphon heat pipe heat exchanger (THPHE) was the main component for this experiment. The THPHE was manufactured and supplied by S&P Coil Products Limited. It consists of 6-row thermosyphon heat pipes, with wavy aluminium fins to increase the surface area. The thickness and the space between the fins were 0.2mm and 2mm respectively. Each row of thermosyphons was charged and sealed individually using R-134a refrigerant as a working fluid. The dividing plate was constructed by two plates of 50mm centre section filled with expanding foam insulation. The details of the THPHE are listed in Table 1. Figure 6 shows the actual heat pipe heat exchanger used in the experiment.

Table 1: Technical specification of Thermosyphon Heat Pipe Heat Exchanger (THPHE)

Internal surface profile	Plain
Number of row	6
Outer diameter	12mm
Wall thickness	0.4mm
Filling ratio	60%
Working fluid	R-134a



Figure 6: 6-row plain thermosyphon heat pipe heat exchanger (HPHE)

4. RESULTS AND ANALYSIS

4.1 THPHE Effectiveness

The effectiveness was used to quantify the performance of the THPHE. The heat exchanger effectiveness defined as the ratio of the rate at which heat is transferred by the heat pipe to the maximum theoretical rate (Jouhara, 2012). The maximum theoretical rate was defined as the heat transfer which would result if the fluid with the smallest thermal capacity rate underwent a temperature change equal to the maximum temperature difference available, i.e., the temperature of the entering hot fluids minus the temperature of the entering cold fluids.

$$\text{Effectiveness } (\varepsilon) = \frac{\text{Q Actual}}{\text{Q Maximum}} = \frac{\text{mCp (tco}-\text{tci)}}{\text{mCp (tei}-\text{tci)}} \qquad (1)$$

Since the air mass flow rate at both sections of THPHE was assumed equal;

$$\text{Effectiveness } (\varepsilon) = \frac{\text{Q Actual}}{\text{Q Maximum}} = \frac{(\text{tco}-\text{tci})}{(\text{tei}-\text{tci})} \qquad (2)$$

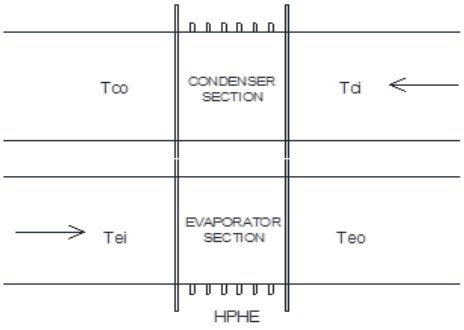


Figure 7: Schematic diagram of THPHE effectiveness duct configuration

The actual heat transfer is simply the heat either given up by the hot fluid, or gained by the cold fluid. In this configuration, the maximum theoretical rate is assumed to be the temperature difference of air entering the evaporator and the condenser. The actual heat transfer would be the temperature difference at the condenser section as it gives the lower limit on the effectiveness values. Hence, the numerical effectiveness model can be developed by using explicit equation which predicts the effectiveness of the heat exchanger (Jouhara, 2012).

The heat pipe heat exchanger effectiveness test was done by varying the evaporator inlet air temperature at constant velocity and mass flow rate. The variation of the evaporator inlet air temperature creates a generic pattern of outdoor air temperature. This pattern can be used to predict the effectiveness of the heat pipe heat exchanger at particular evaporator inlet air temperature.

Preliminary results show that the thermosyphon heat pipe heat exchanger has the ability to transfer heat effectively between two different temperatures of air streams. This result has opened the opportunity of investigating the energy saving potential on THPHE. The performance of the test rig is valid for experimental investigation and the model for predicting the heat pipe heat exchanger effectiveness can be used to investigate the further effects of pre-cooling and reheating on actual air conditioning system. These have proven that the heat pipe heat exchanger used in the experiment is adequate enough to produce reasonable outcomes stated in the main objective of this study. Figure 9 shows the experimental effectiveness at different evaporator inlet air temperature.

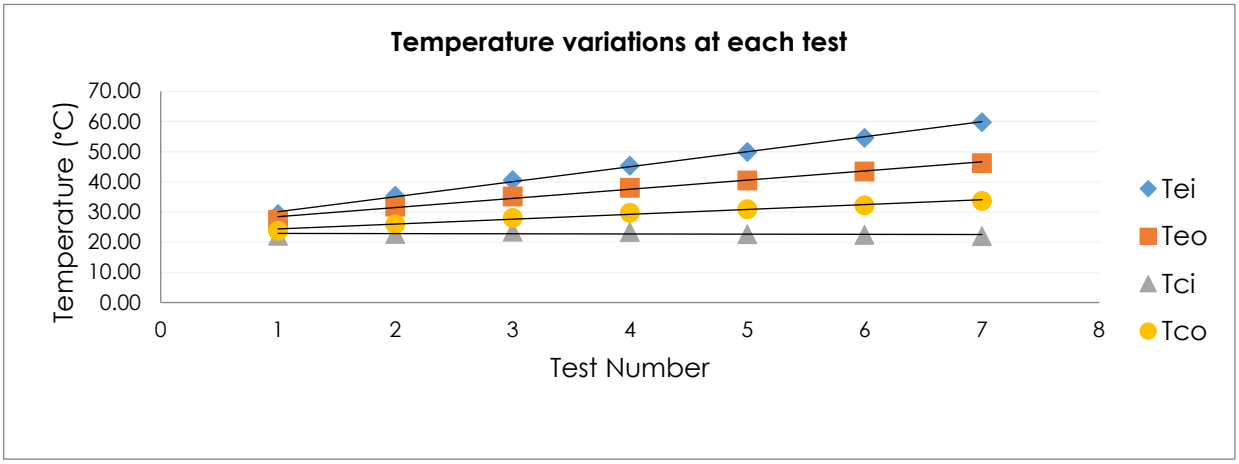


Figure 8: THPHE condenser and evaporator temperature variations

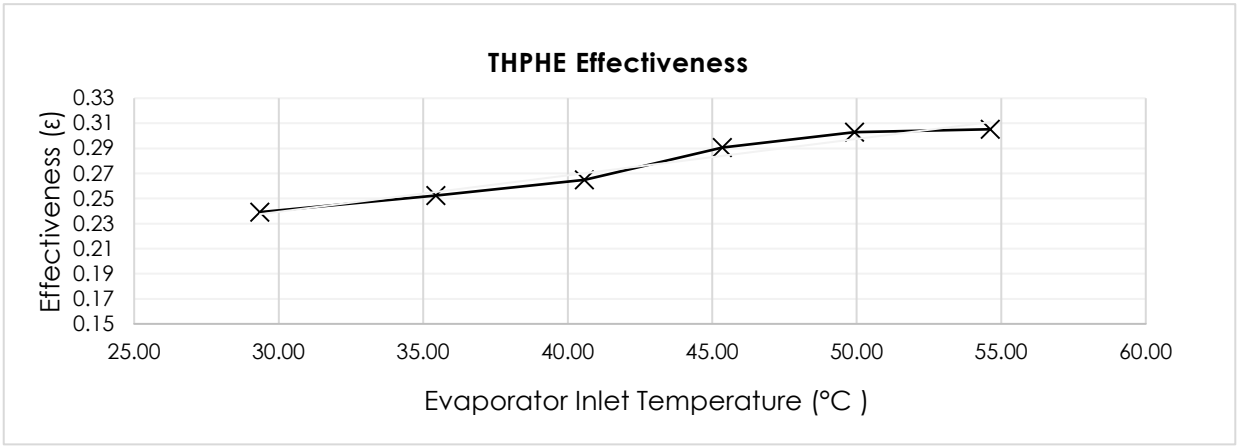


Figure 9: Experimental HPHE effectiveness at different evaporator inlet temperature

4.2 Reheat effects

The condition of air leaving the cooling coil (air OFF) in the conventional HVAC system usually too low in temperature (normally 10°C - 11°C) and too high in relative humidity (normally 100%). The condition of air is inappropriate to be supplied directly to the occupied space. A heater is

required to reheat the cold air to obtain a satisfactory supply air condition. The air conditioning system with heat pipe heat exchanger (HPHE), reheat process by heater is replaced with the condenser section. The heat energy absorbed in the evaporator section is rejected at condenser section of the THPHE. Colder and moist air from the primary cooling coil passing through the condenser section of the THPHE and absorbs the heat; the air temperature at the condenser outlet is higher and the relative humidity is reduced and acceptable. Xiao (1996) investigated the application of HPHE to humidity control in air-conditioning systems in Australia. His studies included the recovered heat provided by the THPHE to the air conditioning system. The study concluded that the reheat energy from the conventional heater would be replaced by the condenser section of the heat pipe heat exchanger.

$$Qrh = \dot{m}\,(hco - hci) \qquad (3)$$

Since the test rig was designed to be a closed-loop system, the mass flow rate is constant along the system. The mass flow rate in the evaporator section is equal to the mass flow rate at the condenser section of the THPHE. The low enthalpy of condenser inlet air hci is the air leaving the primary cooling coil while the higher enthalpy hco is the enthalpy of air leaving the HPHE condenser. Figure 10 shows the schematic diagram of air conditioning with thermosyphon heat pipe heat exchanger.

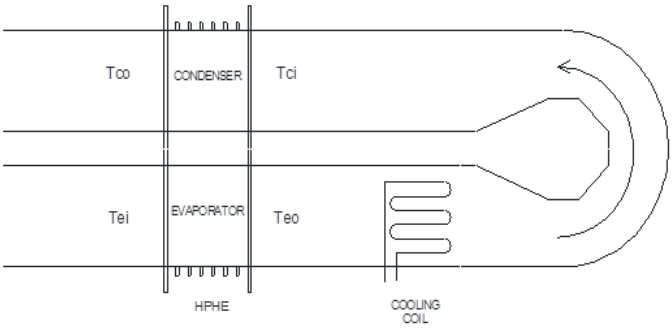


Figure 10: Schematic diagram of reheat effects duct configuration

The reheat recovery energy provided by the condenser of heat pipe heat exchanger test was done by varying the mass flow rate and the evaporator inlet air temperature. The results shown in Figure 33, 34 and 35 demonstrate that the reheat energy can be supplied efficiently by the condenser of the thermosyphon heat pipe heat exchanger (HPHE) at various inlet air temperatures. The performance of the reheat energy recovered from the condenser section of HPHE can be used to estimate and predict the amount of energy could be potentially saved by replacing the conventional heater to heat pipe heat exchanger. Figure 11 illustrates the reheat recovery pattern done by the condenser section of the heat pipe heat exchanger at inlet temperature of 28°C, 32°C and 36°C accordingly with various air mass flow rate.

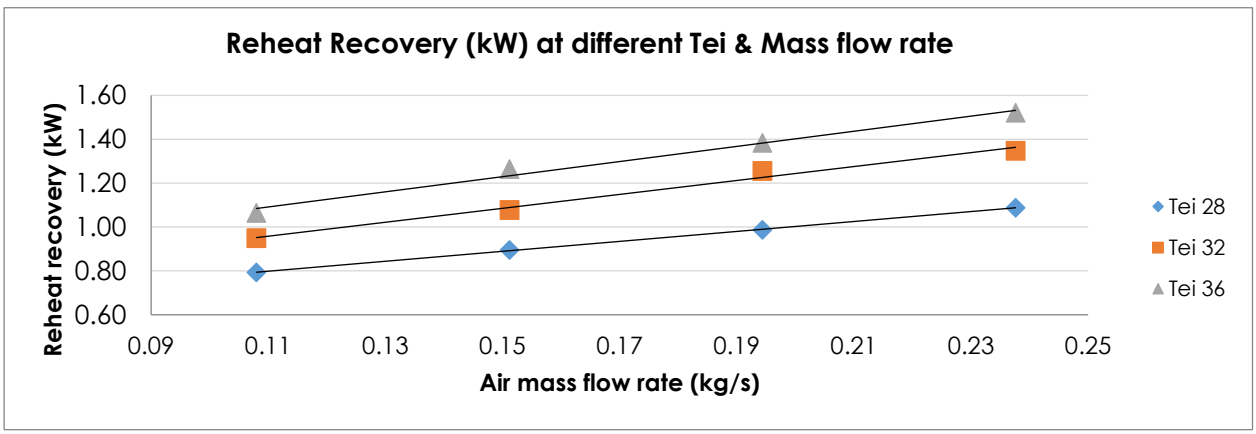


Figure 11: Reheat energy recovery by the condenser at various evaporator inlet temperature and air mass flow rate

Since the specific enthalpy is a product of both heat recovery and the air mass flow rate, it was found that when the inlet air temperature increased from 28°C to 32°C, the enthalpy also increased by 35%. By increasing the inlet air temperature from 32°C to 36°C, the specific enthalpy slightly increased by 15%. This result can be used to model the potential energy saving to reheat the cooled air during the daily operation. The estimated maximum energy saving for reheating is up to 54%. In this study, the power input of the compressor was approximately $W_c = 2.082\text{kW}$. It can be shown that the reheat recovery was Qrh/Wc = from 0.38 to 0.74 times the power input. It clearly proves that the heat pipe coil passively reheats the cooled air and has a potential to replace an electric resistance for reheat.

4.3 Pre-cooling Effects

The cooling load in the conventional air conditioning systems is 100% compensated by the cooling coil. However, in the air conditioning system installed with HPHE, the cooling load is shared between the evaporator section of the HPHE and the cooling coil of the cooler. The combined cooling load is given by;

$$\text{Qcc} = \dot{m}[(\text{hei} - \text{heo}) + (\text{heo} - \text{hci})] = \dot{m}(\text{hei} - \text{hci}) \qquad (4)$$

The higher evaporator inlet air temperature cooled down by the evaporator section of the heat pipe heat exchanger. Then it further cooled down by the primary cooling coil of a cooler unit until the desired set point is achieved. The fraction of energy used to cool down the outside air is higher in conventional air conditioning systems. This requires the bigger size of the compressor to run the system. By introducing the THPHE into the air conditioning system, the pre-cooling process done by the evaporator section of the THPHE allows a smaller compressor unit to be used and at the same time help to reduce the energy consumption for primary cooling unit. Figure 12 shows the pre-cooling effects.

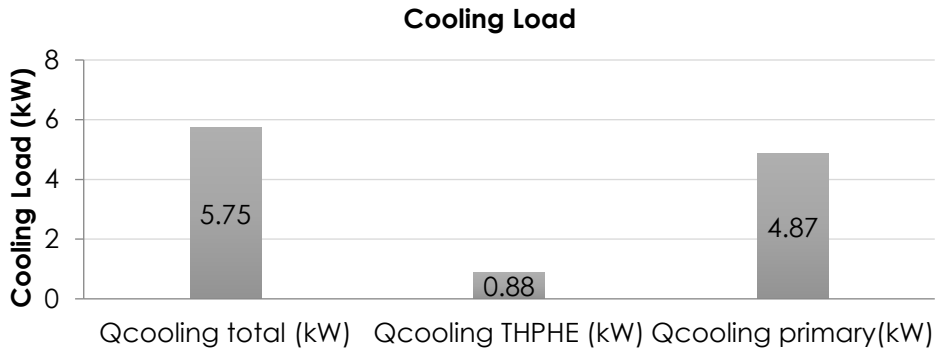


Figure 12: Pre-cooling effects

The maximum total combined cooling capacity of 5.75kW was reduced by 0.88kW on the evaporator side of the THPHE. Even though the value of the energy saved during pre-cooling was not significant, it still contributes to the whole energy saving for the system. By applying the THPHE, the energy used for cooling can be reduced up to 15%. In this study, the power input of the compressor was approximately 2.082kW. It can be shown that the input power of the compressor could be reduced to 1.769kW. Pre-cooling done by the evaporator section of the heat pipe heat exchanger allows the use of smaller compressor.

5. CONCLUSION

Overall, the results from the experiment clearly shown that the THPHE have a potential to be applied in conventional air conditioning systems in Malaysia. The high energy consumption for air conditioning systems could be reduced and help to promote more energy efficient

inventions especially in building services industry. However, in the future, the integrated control systems could be introduced and may help to improve the energy saving potential.

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AN ERGONOMIC STUDY ON PACKING LINE WORKSTATION DESIGN

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Abstract. With the growth of technological and economical, most of the manufacturing industries are competing each other to produce their products with high demand. In order to achieve it require human workers to work in consistent, efficient and faster where possibly contribute to un-ergonomically workstation. Lack of an ergonomic workstation and unsuitable work method may cause fatigue to the workers which lead to less efficiency of the workstation. This study was conducted at an automotive fastener's factory to investigate ergonomic workstation and find the best recommendation to lessen worker's fatigue. Ten workers are working at the packing line participated as the subject in this study. The observations were made and recorded with respect to working postures while performing their packing task. Anthropometrics data from these workers were measured and used on modification workstation design from sitting to standing. The modification of the workstation design from sitting to the standing workstation can solve MSDs and ergonomic problems, increase energy, enhance thought processes, foster teamwork, improve work environment and increase efficiency. The new standing workstation design is based on recommended standing height and distance of work area. Mechanical lifting aid proves to be beneficial as it not only saves task time by increasing frequency of lifting but also it reduces the physical stress associated with the worker by bringing lifting index within limits as per revised NIOSH lifting equation.

Keywords: Workstation design, Musculoskeletal Disorders (MSDs), packing line workstation, anthropometric data, NIOSH Lifting Equation

1. INTRODUCTION

Ergonomics can be defined as the science of workstation's design which make the job fit the person instead of the person fitting the job. Kroemer says that Ergo means Work while Nomos means Rules (Kroemer, 2003). The basis of ergonomics is to decrease physical strain by adapting the work station, working techniques, and tools to abolish the excessive force and uncomfortable postures and to lessen repetitive motion. In this research, the ergonomic workstation is investigated and recommendation has been proposed to lessen the workers fatigue. All the data has been recorded and analyses using NIOSH lifting equation.

2. LITERATURE REVIEW

'A forced position' is known as a working for a long time in the sitting position. It has been proposed that continued working in forced position may cause a Musculoskeletal Disorders (MSDs) (Pensri et al. 2010). The World Health Organization (WHO) outlines MSDs as "a disorder of the muscles, tendons, peripheral nerves or vascular system which are not consequence from the sudden event. Environment and performance at work contribute significantly to these disorders, nevertheless only one factor has caused a multifactorial disease. Inadequate equipment, inappropriate work area design, direct injuries, repetitive movements, or sitting for

extended times with a stretched and twisted back are contributing factors to neck and low back ailments (Kierklo et al. 2011). People who work in the sitting position have to consider that their health will become worsen if they do not exercise or physically active. Hypokinesia may occur if less movement is involved during working. Employees working in the sitting position may fatigue at the end of the workday because it will be reduced the blood flow due to less psychical movement (Beladev et al., 2011). MSDs can restrict the activities at work and lead to reducing an efficiency, sickness absence and severe occupational disability. Furthermore, it will reduce companies' profitability and increase the government's social costs (Podniece & Taylor 2008). Lifting weights during the sitting position can cause excessive wear and tear on a rotator cuff, a cartilage, and a joint capsule.

Ergonomics plays an important part in determining the workers' safety and health at the workplace (Deros et al, 2013). An ergonomics approach for designing an industrial workstation aims to achieve an acceptable balance between worker skills and work requirements in order to optimize: worker efficiency and the overall system, as well as ensuring worker physical and mental well-being, job satisfaction and safety (Ismail & Deraman 2010). A workstation adjustment is an alternative solution which can be used to address MSDs and ergonomic issues (Deros et al., 2011). Anthropometry plays a major role in the planning process for the development of an ergonomics workstation. The key goals of this study are the redesign of the current sitting workstation to a standing workstation based on calculated anthropometric data.

3. RESEARCH METHODOLOGY

The company is a fastener's manufacturer, located in Klang, Selangor, Malaysia. This company employs 22 fulltime workers. For the purpose of this study, observation was conducted at the packing line. The average packing output for this line is between 33,000 pcs to 45,000 pcs which mean 33 boxes to 45 boxes per day per worker. The company activity is performed in a regular shift and 7.5 hours of daily work commence from 8.30 am until 5.30 pm. There are three break times; 15 in the morning, 45 in the lunch and 15 in the afternoon. In this study, ten male employees working at the packing line took part as participants. The age of the sample varied from age 23 to 44.

This research focuses on the action and posture used when carrying out the task of packing. The observer witnessed and documented these events using video recorder. Video recording advantages include no need for regular data collection, simple review of the computer software task information and improved accuracy. There is also plenty of time for observers to view motion and posture used by subject.

There are numerous postural analytical methods available to determine employees' exposure to the hazards and potentially dangerous activities within their workstation. The evaluation tools were shown to be useful methods for reducing workplace disorders and increasing industrial productivity. The methods for postural analysis are divided into observation method and direct method of measurement.

Methods for determining the ergonomic risk factor such as Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), NIOSH lifting equation, and other methods of assessment. This research would use the Revised NIOSH lifting equation as a method for defining, measuring or classifying risks associated with a lifting job, and reducing the incidence rate and severity of low back injuries to staff. The revised NIOSH lifting equation (RNLE) contains of two basic indicators which are the Recommended Weight Limit (RWL) and Lifting Index (LI). The RWL is the main indicator of the revised NIOSH lifting equation. The RWL is defined by the following equation:

$$\text{Eq 1: } RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM,$$

Where:

Multiplier	Abbreviation	Metric
Load Constant	LC	23 kg
Horizontal	HM	25/H
Vertical	VM	1 – (0.003|V-75|)
Distance	DM	0.82 + (4.5/D)
Asymmetric	AM	1 – (0.0032 * A)
Frequency	FM	
Coupling	CM	1.0, 0.95, 0.90

Source: Waters et al. (1993)

The LI is a term for a relative estimation of the physical stress associated with a manual lifting task. The estimation of the physical stress level is calculated by the relation between the weight of the lifted load and the recommended weight limit. As the severity of the LI increases, the risk level for a given worker increases, and a greater percentage of the workforce is likely to be at risk for developing low back pain associated with lifting. The LI is defined as below:

Eq 2 : LI = Load Weight / Recommended Weight Limit = L/ RWL

Figure 1 shows the current layout of workstation for packing line and process flow for performing packing task for the Centering Bolt Type-B product as follow: -

a) The process starts when the worker takes and open a plastic packaging and placed on weighing scale.
b) Second, WIP parts of Centering Bolt Type-B in a polybox taken by using a shovel and filled into the plastic packaging. The parts are weighed according to the standard packaging quantity (1,000 pieces per box) as shown in figure 2.
c) After that, the plastic packaging is lifted and placed in front of weighing machine. Then, plastic packaging is folded so that the contents do not come out and finally complete with stapler clasps for 4 times.
d) Plastic packaging lifted and then inserted into the box and seal using sellotape. FIFO and traceability ID sticker affixed on the box.
e) At the end of the process, the box is lifted and stacked on the pallets.



Figure 1: A current layout of workstation for packing line



Figure 2: Photo of packaging and workpiece.

4. ANALYSIS AND RESULT

The worker carries out the job while in the sitting position. The worker has to complete the task with a standard cycle time of 100 seconds or less and lifting 12.14 kg plastic packaging during performs certain task. It means the worker need to handling heavy objects and make repetitive frequent movements in large work area. Based on the information obtained during the oral interview, the majority of workers reported that fingers pain, back pain and neck pain are the three major complaint MSDs while performing repetitive task; stapler a plastic packaging, bending during weighing and putting boxes on the pallet. In this study, two anthropometric data were collected among ten subjects as shown in table 1 for redesign workstation from sitting workstation to standing workstation.

Table 1: Anthropometric data

Subject No.	Name	Age, years	Stature, cm	Elbow height, cm
1	Ahmad Sabri	44	162	102
2	Dzularsil	29	166	109
3	Faizal	24	159	102
4	Shazni	23	170	108
5	Firdaus	23	164	103
6	Nizar	33	163	103
7	Ashraf Raj	31	165	104
8	Asraf Ali	39	152	95
9	Alif	23	177	110
10	Zariman	26	156	98

Figure 3 and Figure 4 show overall data for ten subject including mean, standard deviation, 5th percentile and 95th percentile for stature and elbow height. Figure 3 shows that 90% of worker stature lies between 148.75cm and 176.49cm and Figure 4 shows that 90% of worker elbow height lies between 93.77cm and 112.02cm (satisfy the requirement of the majority of workers). The data collected is appropriate since both anthropometric data were established by Deros et al. (2009) and Daruis et al. (2010) within reasonable ranges suitable for 90 per cent of Malaysian population anthropometric data. The elbow height and stature are taken from Malaysian anthropometric data. From the data, 5th and 95th percentile for elbow height is between 88.39cm to 116.80cm and 5th and 95th percentile for stature is between 147.3 cm to 177.37cm.

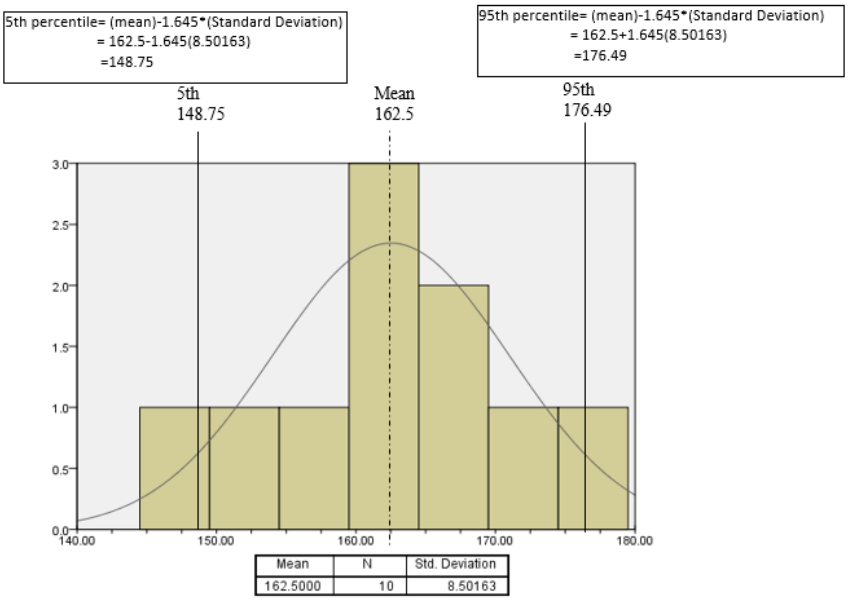


Figure 3: Normal distribution of 5th and 95th percentile for the stature

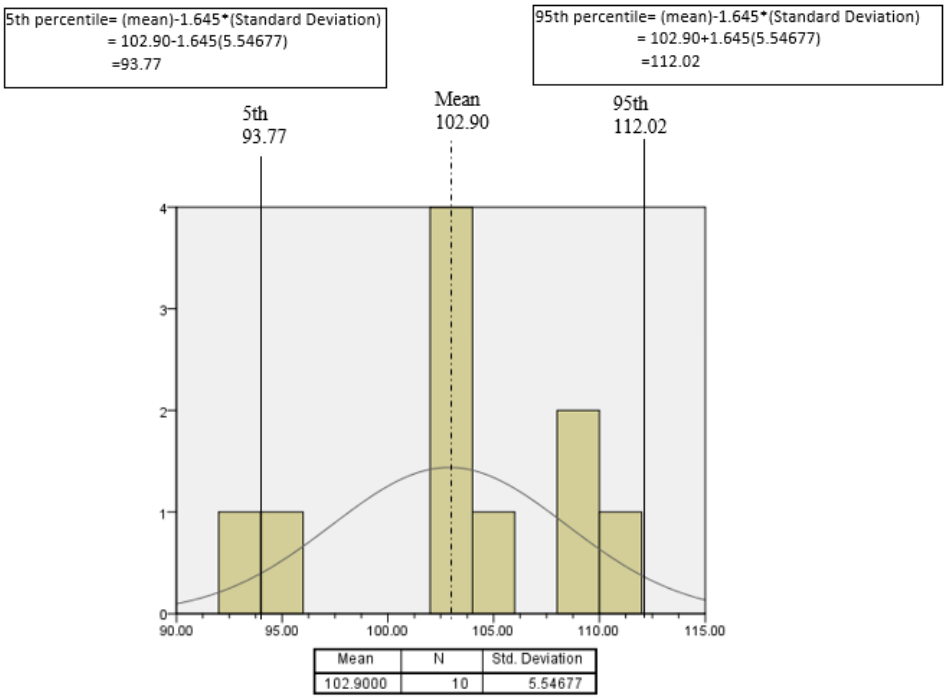


Figure 4: Normal distribution of 5th and 95th percentile for elbow height.

The type of work performed for standing activity can be categories such as light , medium or heavy work depending on whether the worker is expected to exert downward forces and manipulate heavy objects (OSHA, 2003), as shown in Figure 5. The job performed in this study may be described as hard work. The work surface should be 10 cm below elbow height for heavy work where significant downward or upward forces are required. For workstation measurements, the figure 5 standing heights for heavy work tasks is 71.12 to 88.90 cm (Deros et al. 2013). Therefore, the recommended standing height for packing table is 84cm (10cm below elbow height).

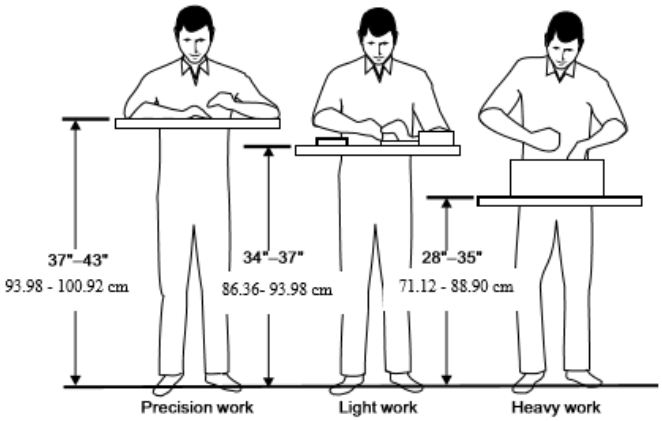


Figure 5: Dimension for standing work
Source: Deros et al. (2013)

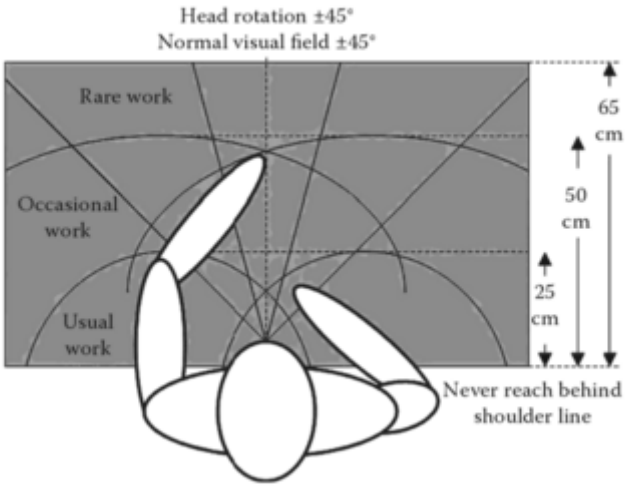


Figure 6: Recommended working distance for the arms.
Source: Bhattacharya & McGlothlin (2012)

Figure 6 shows the recommended working distance for the arms in horizontal. In general, the area within comfortable reach of your extended arm is called the maximum work area or occasional work area, while the normal work area or usual work area is within the limits of a comfortable sweeping movement of the worker arm. The recommended distance of the work area and the worker must not reach 50cm.

To lift of 12 kg plastic packaging in front of the weighing machine, the position of horizontal hand location is 60cm, vertical hand location is 50cm, vertical travel distance is 10cm, asymmetry is 0^0, frequency rate is 1 lifts/min and lifting duration of 7.75 hours with fair coupling is performed. The corresponding values of horizontal multipliers destination is 0.42, vertical multiplier is 0.93, frequency multiplier is 0.75, asymmetry multiplier is 1, distance multiplier is 1, coupling multiplier is 0.9 were found out. Using NIOSH equation, the recommended weight limit is 5.98 kg and lifting index is 2.01. Both the values of RWL and LI are exceeding the safe limits of NIOSH the recommendations hence existing system requires design modifications.

To lift of 12.14kg box on the pallet the position of horizontal hand location is 40cm, vertical hand location is 40cm, vertical travel distance is 30cm, asymmetry is 90^0, frequency rate is 1 lifts/min and the lifting duration is 7.75 hours with fair coupling is performed. The corresponding values of horizontal multipliers destination is 0.63, vertical multiplier is 0.90, frequency multiplier is 0.75, asymmetry multiplier is 0.71, distance multiplier is 0.97, coupling multiplier is 0.9 were found out. Using NIOSH equation, recommended weight limit is 6 kg and lifting index is 2.02. Both the values of RWL and LI are crossing the safe limits of NIOSH recommendations hence existing system requires design modifications.

The improvement has been made in the workstation. The worker now doing the tasks in standing position instead of sitting position. Figure 7 and figure 8 show the recommended position of the worker while working. It can be seen that the worker only required lifted 12.14kg box on the self-levelling pallet positioner horizontal hand location is 25cm, vertical hand location is 84cm, vertical travel distance is 0 cm, asymmetry is 0^0, frequency rate is 2 lifts/min and lifting duration of 7.75 hours with good coupling is performed. The corresponding values of horizontal multipliers destination is 1, vertical multiplier is 1, frequency multiplier is 0.65, asymmetry multiplier is 1, distance multiplier is 1, coupling multiplier is 1 were found out. Using NIOSH equation, recommended weight limit is 14.95 kg and lifting index is 0.83. Both the values of RWL and LI are acceptable. The table 2 below shows the summary of the values of NIOSH Lifting Equation.

Table 2: Summary of the values of NIOSH Lifting Equation

No	Multiplier	Form	Sitting Position				New standing workstation (Lifted box on the self-levelling pallet positioner)	
			Lifted plastic packaging in front of weighing machine		Lifted box on the pallet			
			Parameter	Value	Parameter	Value	Parameter	Value
1	Load Constant (LC)	23kg	23kg	23	23kg	23	23kg	23
2	Horizontal (HM)	25/H	60cm	0.42	40cm	0.63	25cm	1
3	Vertical (VM)	1-(0.003|V-75|)	50cm	0.93	40cm	0.90	84cm	1
4	Distance (DM)	0.82+(4.5/D) and if D ≤ 25mm , DM =1	10cm	1	30cm	0.97	0cm	1
5	Assymetry (AM)	1-(0.0032*A)	0^0	1	90^0	0.71	0^0	1
6	Frequency (FM)	Refer table Waters et al. (1993)		0.75		0.75		0.65
7	Coupling (CM)	Good,Fair,Poor		0.9		0.9		1
8	Recommended Weight Limit (RWL) ,kg	RWL= LC x HM x VM x DM x AM x FM x CM	5.98		6.00		14.95	
9	Load Weight (LW), kg		12kg	12	12.14kg	12.14	12.14kg	12.14
10	Lifting Index (LI)	LI= LW/RWL	2.01		2.02		0.81	
11	Remarks		Engineering or administrative controls should be implemented		Engineering or administrative controls should be implemented		This lift acceptable	

To minimize issues with musculoskeletal disorders (MSDs) other changes need to be made:-
a) Provide anti-fatigue mat to reduce fatigue because of standing for a long period on a hard surface.
b) Provide a good quality of safety shoes to ensure sufficient support and cushioning of the arch and heel when offering comfort to the wearer.
c) Provide a height adjuster for the table so that each worker can match the work surface to their own needs.
d) Provide training and instruction to the worker to prevent the worker twisting his waist by change directions of pointing feet and turning a whole body.

e) Fabricate pallet's stand to avoid the worker bending his body while putting boxes on pallet.
f) Replace from using a stapler to plastic sealing machine to seal plastic packaging.
g) Fabricate a special design feeder to transfer WIP parts to weighing machine and then transfer to plastic packaging without lifted.
h) Purchase self-levelling pallet positioner as shown in figure 6. The easy loader responds the load weight and automatically adjust the height and the rotation to maintain an ergonomic working height.



Figure 6: Self-Levelling Pallet Positioner

Source: http://www.bishamon.com/ezloader.html

i) Install a conveyor to transfer box from weighing scale to plastic sealing machine and from a plastic sealing machine to pallet on self-levelling pallet positioner.

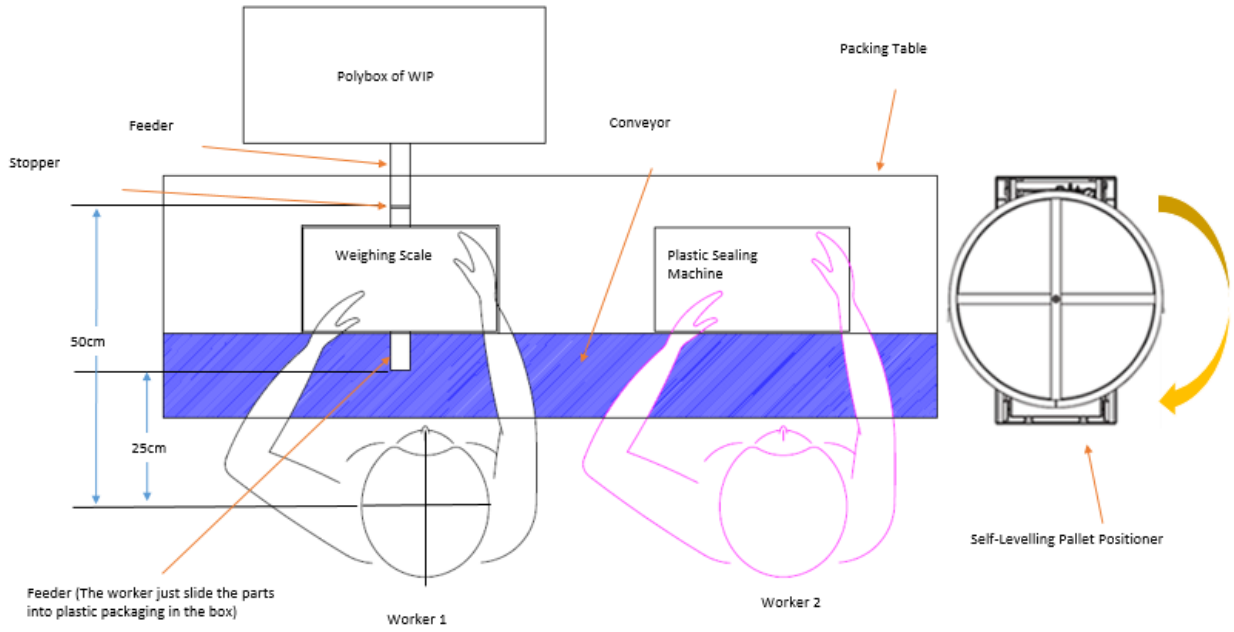


Figure 7: A recommended plan view for the packing line workstation

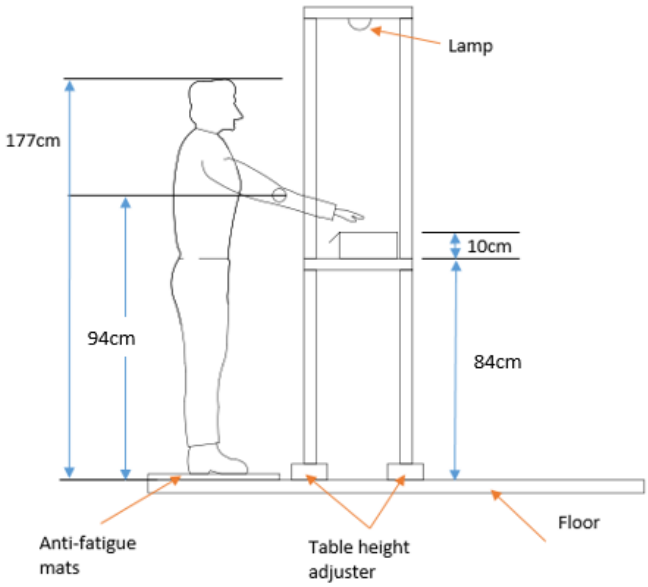


Figure 8: A side-view of the recommended workstation

5. CONCLUSION

Good design of workstation that incorporated ergonomic principles can be very comfortable for workers in doing their job. The problems such as fatigue, lack of focus, decrease of jobs performance and the main risk is work related musculoskeletal disorder such as lower back pain, neck pain and fingers pain can be solved by using good design of workstation.

Anthropometric data are very useful to manufactures to produce a comfortable and improve productivity. Ten workers were involved in collecting the anthropometric data. Two body dimensions were measured and the data was analyzed. The results show collected data is fit when compared with anthropometric data was developed by Deros et al. (2009) and Daruis et al. (2010). The new standing workstation design is propose based on recommended standing height and distance of work area. Mechanical lifting aid proves to be beneficial as it not only saves task time by increasing frequency of lifting but also it reduces the physical stress associated with the worker by bringing lifting index within limits as per revised NIOSH lifting equation.

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PEMBANGUNAN APLIKASI PMU STRUCTURE LABSHEET SERTA TINJAUAN KEBAIKAN DAN KELEMAHANNYA DALAM PERLAKSANAAN UJIKAJI MAKMAL STRUKTUR DI JABATAN KEJURUTERAAN AWAM POLITEKNIK MUKAH

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Abstrak. Helaian makmal struktur Jabatan Kejuruteraan Awam Politeknik Mukah telah digunakan lebih daripada lima tahun. Sehubungan itu ia telah disemak semula dan ditambahbaik oleh peyelaras kursus selaras dengan perubahan silibus. Susulan itu pengkaji membangunkan helaian makmal dalam bentuk aplikasi android di namakan "*PMU Structure Labsheet*". Dibangunkan menggunakan model ADDIE memerlukan aplikasi ini dinilai pada fasa "*Evaluation*" untuk mengenalpasti kelebihan dan kekurangan supaya dapat ditambah baik. Dari itu, kajian ini dijalankan untuk mencapai objektif tersebut. Penilaian aplikasi ini dibuat dengan kaedah pemerhatian temubual. Hasil daripada kajian ini mendapati bahawa aplikasi *PMU Structure Labsheet* ini hanya boleh digunakan oleh pelajar yang menggunakan peranti android. Aplikasi ini juga mempunyai kelemahan untuk menyimpan data ujikaji serta tidak dapat memplot graf data ujikaji. Walau bagaimanapun, penggunaan aplikasi ini dalam menjalankan ujikaji makmal struktur juga mempunyai kebaikan. Kajian ini mendapati pelajar lebih bersedia untuk menjalankan eksperimen, lebih mudah merekod data, ujikaji lebih cepat disiapkan serta laporan makmal lebih mudah dihasilkan dan dihantar. Selain itu, penggunaan aplikasi *PMU Structure Labsheet* ini menyumbang pada konsep hijau kerana dapat mengurangkan penggunaan kertas dalam penghasilan laporan makmal.

Kata Kunci: Aplikasi, Helaian Makmal, Makmal Struktur

1. PENGENALAN

Jabatan Kejuruteraan Awam Politeknik Mukah sebelum ini menggunapakai helaian makmal yang telah digunakan lebih daripada lima tahun bagi menjalankan ujikaji makmal struktur kursus CC505 – Structural Analysis (Jabatan Kejuruteraan Awam, 2016). Apabila kursus ini dijumudkan dan diganti dengan kursus DCC5172 – Structure, Hydraulics & Water Quality Laboratory, prosedur ujikaji 2,3 dan 5 daripada helaian makmal CC505 telah diserap untuk digunapakai dalam helaian makmal DCC5172 selaras dengan keperluan silibus (Jabatan Kejuruteraan Awam, 2018).

Setelah setahun helaian makmal DCC5172 digunakan, ia disemak semula. Dalam semakan ini didapati ia mempunyai masalah antaranya penggunaan kertas sebagai helaian makmal yang mana ia menyukarkan pelajar sewaktu menjalankan ujikaji kerana memerlukan ruang yang besar untuk merekod data pada helaian dan mengakibatkan helaian makmal kotor dan koyak serta beberapa masalah lagi. Pensyarah juga akan menerima timbunan laporan makmal setelah pelajar siap melaksanakan ujikaji.

Oleh itu bersempena dengan penyemakan semula helaian makmal ini, kajian ini dijalankan untuk membangunkan helaian makmal yang boleh digunakan dari telefon pintar pelajar selaras dengan saranan Ketua Menteri Sarawak, Datuk Patinggi Abang Johari Tun Openg agar mengadaptasikan teknologi terkini untuk pembangunan Sarawak (Jawing, 2018). Aplikasi yang dibangunkan ini akan dikenalpasti kelemahan yang yang timbul supaya dapat ditambah baik. Kajian ini juga akan mengenalpasti kelebihan penggunaannya berbanding dengan helaian makmal konvensional.

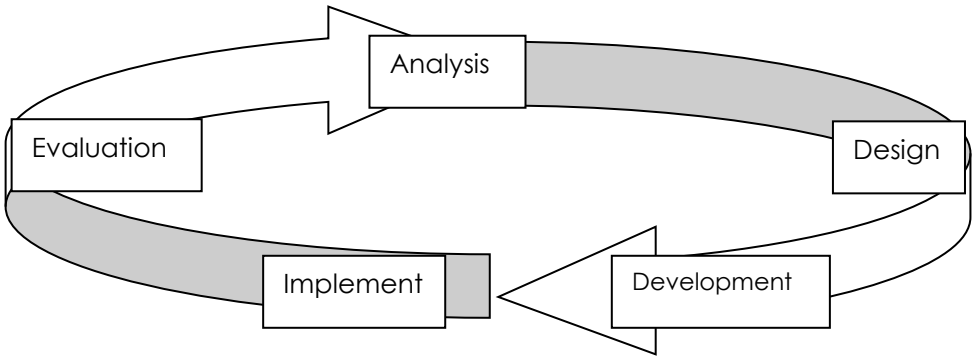
2. SOROTAN KAJIAN DAN PEMBINAAN HIPOTESIS

Pada masa ini, teknologi android telah berkembang dengan cepat. Sekiranya teknologi android ini. McKimm et al. (2003) menyatakan pembelajaran berasaskan web juga disebut pembelajaran atas talian atau e – pembelajaran kerana kandungan kursus disampaikan atas talian. Perbincangan dapat dibuat melalui forum, emel, *video conference* dan *video streaming*. Maka sekiranya teknologi android ini digunakan untuk menjalankan aktiviti pengajaran dan pembelajaran, ia juga dianggap sebagai pembelajaran berasaskan web.

Menurut kajian Kim et al. (2005) beliau menyenaraikan faedah pembelajaran atas talian adalah cara pembelajaran yang fleksibiliti, lebih banyak peluang interaksi antara pelajar dan pengajar serta dapat mebina kemahiran berpasukan secara maya (*virtual teaming skill*).

PMU Structure Labsheet dibangunkan berdasarkan model A.D.D.I.E iaitu "*analysis*", "*design*", "*development*", "*implementation*", dan "*evaluation*". Model ADDIE telah dibangunkan oleh Dick dan Cary pada tahun 1978 dan ditambahbaik oleh Russell Watson pada 1981 adalah merupakan asas dalam pembangunan program latihan dan pendidikan (Muruganantham, 2015).

Model ini dipilih kerana mengikut Kruse (2002), model ADDIE ini adalah satu pendekatan pembangunan latihan berasaskan teknologi (technology – based training) yang sistemik dan banyak kelebihan. Malachowski (2002) pula menyatakan model ADDIE adalah satu model rekabentuk yang ringkas, mudah diaplikasi dan bersifat kitaran. Sifat kitaran ini dipersetujui oleh Peterson (2003) dan menggambarkannya seperti dalam Rajah 1.



(Peterson, 2003)

Rajah 1: Kitaran model ADDIE

3. METODOLOGI KAJIAN

3.1 Analisis (*Analysis*)
Muruganantham (2015) mengatakan pada fasa analisis, masalah dan punca masalah dikenalpasti serta cara penyelesaiannya. Menurut Allen (2006) pula pada fasa analisis, tugas – tugas yang hendak dicapai akan disenaraikan dan dibandingkan dengan kemahiran, pengetahuan dan keupayaan pelajar untuk mengenalpasti bentuk arahan yang diperlukan.

Setelah helaian makmal DCC5172 Jabatan Kejuruteraan Awam (2018)diteliti, didapati ada kemahiran yang diperlukan untuk menjalankan ujikaji dipelajari pada semester dua pengajian sedangkan ujikaji dilaksanakan pada semester empat pengajian. Kebiasaannya pelajar telah lupa kemahiran ini dan perlu diajar semula seperti mana yang disebut oleh Saville (2011) bahawa ulangan adalah proses pembelajaran yang sangat penting.

Selain itu, dari pemerhatian, pelaksanaan ujikaji makmal struktur menggunakan helaian makmal sedia ada, didapati ia menghadapi masalah penggunaan kertas sebagai helaian makmal yang mana ia menyukarkan pelajar sewaktu menjalankan ujikaji kerana

memerlukan ruang yang besar untuk merekod data pada helaian makmal, helaian makmal kotor dan koyak serta beberapa masalah lagi. Pensyarah juga akan menerima timbunan laporan makmal setelah pelajar siap melaksanakan ujikaji yang mana laporan makmal ini memerlukan ruang penyimpanan yang besar.

3.2 Rekabentuk (Design)
Mayfield (2011) menyatakan pada fasa rekabentuk, pereka akan memilih kaedah intruksi yang sesuai untuk menerapkan strategi pengajaran yang dipilih supaya dapat mencapai objektif pembelajaran yang spesifik.

Chen et al., (2013) mengatakan kemahiran pelajar menjalankan ujikaji makmal adalah perlu diperbaiki. Bagi permasalahan makmal struktur di Politeknik Malaysia, ada ujikaji makmal yang kemahiran asasnya dipelajari pada semester dua sedangkan ujikaji makmal dijalankan pada semester 4. Jadi kebiasaannya pelajar telah lupa kemahiran yang dipelajari pada semester dua.

Bagi mengatasi kelemahan pelajar telah lupa kemahiran yang diperlukan untuk menjalankan ujikaji kerana jarak tempoh belajar kemahiran asas dengan menjalankan ujikaji adalah berselang satu semester, satu slot ulangkaji akan dibuat pada aplikasi PMU Structure Labsheet ini. Ia bertujuan supaya pelajar dapat mengulangkaji dahulu kemahiran asas yang diperlukan untuk menjalan ujikaji dan dapat mengaitkan teori konsep dengan keadaan sebenar.

Slot video mendiri siap alat juga akan dibuat supaya dapat membantu pemahaman pelajar terhadap prosedur menjalankan ujikaji. Ia juga bertujuan menjimatkan masa pengajar memberi penerangan mengenai prosedur ujikaji.

3.3 Pembangunan (*Development*)
Reinbold (2013) menyatakan pada fasa ini produk dihasilkan untuk melaksanakan perkara yang dirancang pada fasa rekabentuk. PMU Structure Labsheet ini dibangunkan menggunakan aplikasi "*MIT apps inventor 2*".

Aplikasi ini dipilih kerana ia mudah digunakan dan dipelajari, banyak contoh – contoh dan tutorial serta aplikasi ini percuma (open license) untuk digunakan di internet. Perdikuri (2014) menyatakan *MIT App Inventor* adalah pengaturcaraan dengan persekitaran visual untuk mencipta aplikasi telefon pintar dan *tablet*. Ia mudah digunakan namun berupaya menjadi *platform* yang berkuasa untuk membangunakan aplikasi pangkalan data, peta interaktif dan pelbagai lagi dengan tidak perlu menulis kod pengaturcaraan.

3.4 Perlaksanaan (Implimentation)
Menurut Allen (2006), pada fasa pelaksanaan adalah aktiviti untuk penilaian operasi dengan cara mendapatkan maklumat di lapangan. Maka perlaksanaan ujikaji makmal struktur menggunaan aplikasi PMU Structure Labsheet telah dibuat oleh pelajar Diploma Kejuruteraan Awam Politeknik Mukah iaitu kelas DKA4A pada sesi Jun 2019. Pelajar kelas DKA4A yang mengambil kursus DCC5172 – Structure, Hydraulics & Water Quality Laboratory tidak akan menggunakan helaian makmal yang biasa tetapi menggunakan aplikasi PMU Structure Labsheet untuk menjalankan ujikaji makmal struktur.

3.5 Penilaian (*Evaluation*)
Menurut Peterson (2003) komponen penilaian pada model ADDIE boleh dibuat dalam bentuk penilaian formatif terhadap pelajar atau pengajar dan penilaian sumatif pula digunakan pada akhir kursus sebagai penambahbaikan arahan. Penilaian dibuat tertumpu kepada sama ada pembangunan aplikasi ini dapat menyelesaikan masalah penggunaan halaian makmal lama.

Penilaian *PMU Structure Lab Sheet* dijalankan dengan menggunakan kaedah pemerhatian tidak ikut serta di mana segala perkembangan tingkahlaku pelajar diperhatikan. Kaedah

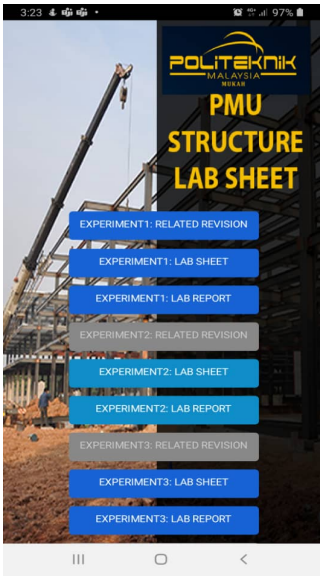
pemerhatian ini dipilih kerana menurut Nasha (2008) melalui pemerhatian penyelidik dapat mengamati sesuatu tingkahlaku subjek berpandukan pembolehubah – pembolehubah yang dipilih. Hal ini disokong oleh Achan (2014) dan menambah bahawa pemerhatian tingkahlaku ini perlu dibuat dalam tempoh yang ditetapkan.

Lai (2015) menyatakan terdapat tiga jenis penilaian melalui kaedah pemerhatian iaitu pemerhatian tingkahlaku, pemerhatian perbualan atau interaksi dan juga pemerhatian hasil kerja. Berpandukan kepada pernyataan ini, kajian ini melakukan pemerhatian terhadap tingkahlaku dan hasil kerja secara pemerhatian tidak ikut serta. Manakala pemerhatian perbualan dan interaksi dilakukan secara temubual.

4. ANALISIS DAN KEPUTUSAN

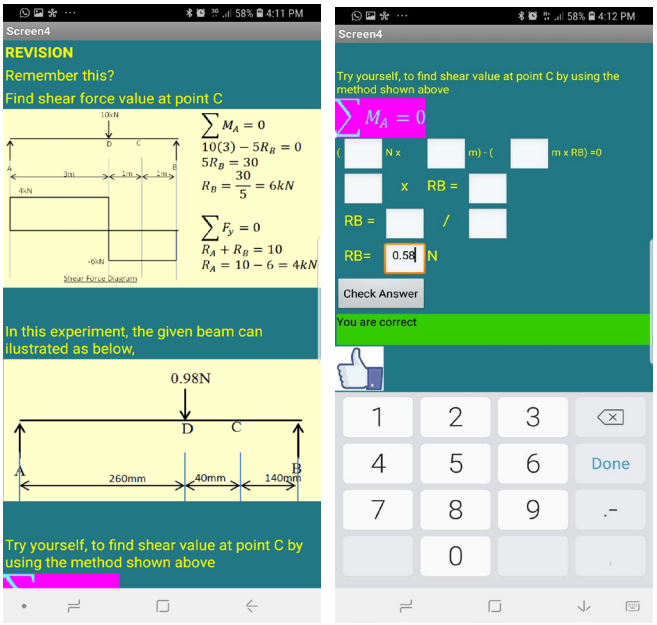
4.1 Aplikasi Yang Telah Dibangunkan

Aplikasi android yang telah dibangunkan dinamakan PMU Structure Labsheet**.** Rajah 2 menunjukkan antaramuka utama aplikasi PMU Structure Labsheet yang telah dibangunkan. Ada lima ujikaji dimuatkan dalam alikasi ini sepertimana keperluan kursus DCC5172 Structure, Hydraulics & Water Quality Laboratory. Setiap ujikaji ini pula terbahagi pula kepada tiga slot iaitu slot ulangkaji, slot helaian makmal dan slot laporan makmal.



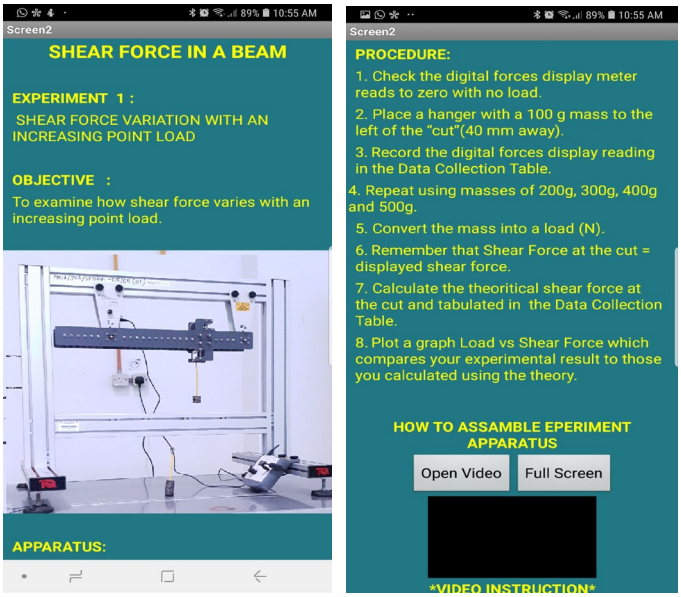
Rajah 2: Antaramuka aplikasi PMU Structure Labsheet

Rajah 3 di bawah menunjukkan slot ulangkaji salah satu ujikaji yang ada di dalam aplikasi PMU Structure Labsheet. Slot ini diwujudkan bagi menangani masalah pelajar lupa akan kemahiran yang diperlukan untuk melakukan ujikaji kerana kemahiran tersebut dipelajari pada semester dua sedangkan ujikaji dibuat pada semester empat. Pada slot ini juga ada bahagian yang pelajar boleh mencuba sendiri secara interaktif latihan yang disediakan.



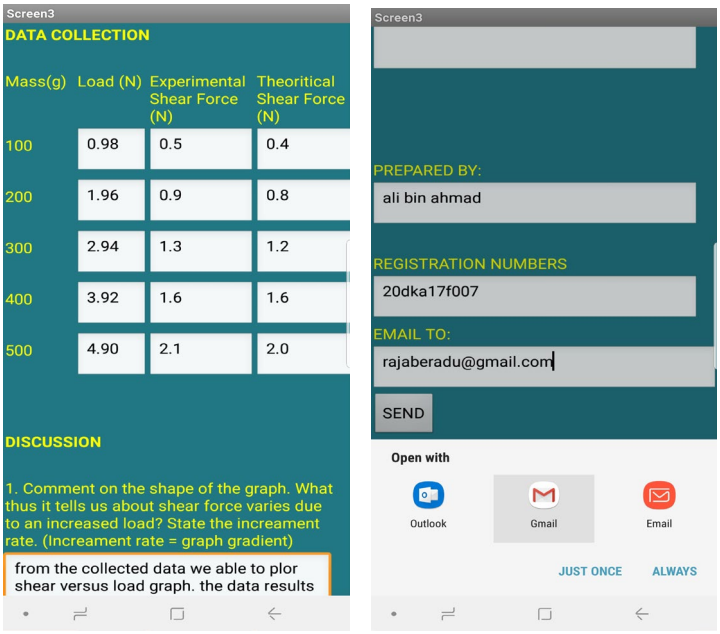
Rajah 3: Slot ulangkaji pada PMU Structure Labsheet

Rajah 4 menunjukkan slot helaian makmal pada aplikasi PMU Structure Labsheet. Kandungan slot ini adalah sama seperti helaian makmal konvensional seperti tajuk, objektif ujikaji, radas dan perkakas, serta prosedur ujikaji. Selain itu slot ini ditambah dengan video tatacara mendiri siap alatan ujikaji supaya pelajar mudah memahami prosedur ujikaji dan supaya pelajar dapat bersedia awal sebelum sampai ke makmal.

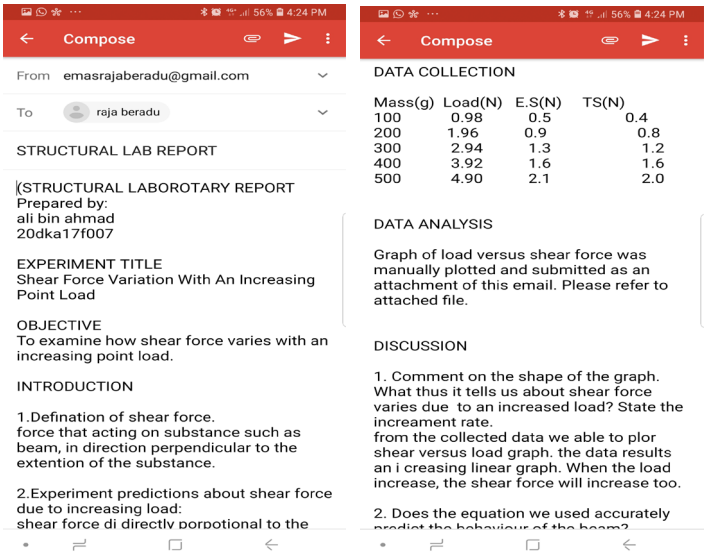


Rajah 4: Slot helaian makmal pada PMU Structure Labsheet

Rajah 5 menunjukkan slot laporan makmal pada aplikasi PMU Structure Labsheet. Pada slot ini pelajar akan mengisi data ujikaji pada ruangan yang disediakan. Selain itu, pelajar juga akan menjawab soalan perbincangan ujikaji dan membuat kesimpulan pada ruangan yang disediakan. Pelajar kemudiannya mengisi maklumat yang diperlukan seperti nama , nombor pandaftaran dan alamat emel pensyarah dan tekan butang "send" untuk menghantar laporan makmal secara emel. Rajah 6 menunjukkan contoh laporan makmal yang Berjaya dihantar menggunakan aplikasi PMU Structure Labsheet.



Rajah 5: Slot Laporan makmal pada PMU Structure Labsheet



Rajah 6: Laporan makmal hasil aplikasi PMU Structure Labsheet

4.2 Kelemahan

Masalah yang dihadapi apabila menggunakan aplikasi PMU Structure Labsheet adalah seperti berikut:

a) Ada pelajar pengguna MacOs. Oleh kerana aplikasi ini dibangunkan menggunakan sistem operasi android, maka pelajar yang menggunakan telefon pintar berjenama Apple tidak dapat menggunakan aplikasi ini.

b) Data yang direkod tidak dapat disimpan. Dalam sesi temubual pelajar ada mengadu bahawa data tidak dapat disimpan sementara mereka menyiapkan plotan graf, menyiapkan perbincangan dan kesimpulan. Mereka perlu mengisi semua maklumat

sekaligus dan hantar secara emel.
c) Plotan graf data ujikaji makmal perlu dibuat secara manual. Dari pada temubual dengan pelajar, mereka menyatakan sekiranya aplikasi PMU Structure Labsheet dapat plot graf data ujikaji makmal, ia akan lebih memudahkan mereka. Namun pengkaji merasakan bahawa plotan graf perlu dikekalkan secara manual sebagai proses pembelajaran supaya pelajar dapat melihat perkaitan antara teori dengan ujikaji makmal.

4.2 Kelebihan
Hasil daripada pemerhatian didapati dengan menggunakan aplikasi PMU Structure Labsheet dalam menjalankan ujikaji makmal struktur:
a) Pelajar lebih bersedia untuk menjalankan uijkaji. Hal ini kerana telah menyaksikan video prosedur ujikaji yang ada dalam aplikasi PMU Structure Labsheet. Ini mematuhi pernyataan (Seri Syahliliana, 2015) yang menyatakan medium pengajaran dalam bentuk visual adalah kaedah yang terbaik untuk subjek –subjek praktikal dan dapat mengatasi masalah pensyarah memerlukan masa yang panjang untuk memberi penerangan. Maka pensyarah hanya memberikan taklimat ringkas kepada pelajar sebelum me menjalankan ujikaji sebagai peringatan kepada pelajar.
b) Pelajar lebih mudah merekod data. Berbanding sebelum ini semasa menggunakan helaian makmal konvensional, penggunaan aplikasi PMU Structure Labsheet lebih memudahkan pelajar untuk merekod data. Ini kerana data dapat terus direkod pada telefon pintar berbanding helaian makmal konvensional yang memerlukan ruang kerja untuk menulis.
c) Ujikaji lebih cepat disiapkan. Sebelum ini pelajar lambat menyiapkan ujikaji makmal struktur kerana kekurangan kemahiran untuk menjalankann ujikaji seperti yang dinyatakan oleh (Chen et al., 2013). Semasa menggunakan helaian makmal konvensional pelajar hanya mampu menyiapkan dua ujikaji dalam satu pertemuan tiga jam. Didapati setelah menggunakan aplikasi PMU Structure Labsheet, pelajar dapat menyiapkan tiga ujikaji dalam satu pertemuan tiga jam.
d) Mengurangkan penggunaan kertas dalam penghasilan laporan makmal. Aplikasi PMU Structure Labsheet telah menyediakan template laporan makmal yang seragam. Pelajar cuma perlu lampirkan graf-graf yang berkaitan untuk dihantar bersama laporan yang dihasilkan oleh aplikasi ini.
e) Laporan makmal lebih mudah dihasilkan dan dihantar. Data, perbincangan dan kesimpulan yang telah diisi dalam aplikasi PMU Structure Labsheet boleh dihantar secara emel atau jika perlu dicetak dari emel tersebut untuk dihantar secara salinan berjilid.

5. KESIMPULAN

Sebagai kesimpulan, aplikasi ini telah berjaya dibangunkan dan diaplikasikan dalam proses pembelajaran makmal struktur di Politeknik Mukah sebagai ujilari. Didapti dengan menggunakan aplikasi ini, pelajar lebih bersedia untuk menjalankan ujikaji dan mudah untuk merekod data. Selain daripada itu, ujikaji makmal juga dapat disiapkan dengan lebih cepat serta laporan makmal lebih mudah dihasilkan dan mudah dihantar. Penggunaan PMU Structure Labsheet ini juga dapat mengurangkan penggunaan kertas dalam penghasilan laporan makmal.

Namun beberapa kelemahan juga ditemui seperti adanya pelajar yang menggunakan telefon pintar dengan aplikasi MacOs berbanding android. Kelemahan dari segi teknikal pula adalah aplikasi ini tidak dapat menyimpan data ujikaji yang direkod dan plotan graf data ujikaji perlu dibuat secara manual.

Kajian ini telah melengkapkan proses pembangunan aplikasi menggunakan model ADDIE pada kitaran pertama yang mana hasil dapatan kajian ini akan dibawa ke fasa "Analisis" semula untuk proses penambahbaikan melalui model ADDIE pada kitaran kedua.

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KEBERKESANAN PROGRAM LATIHAN PLIOMETRIK TERHADAP PERUBAHAN SAIZ OTOT BETIS DAN OTOT PAHA ATLET SEPAKTAKRAW DI SEBUAH POLITEKNIK

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Abstrak. Tujuan kajian ini dijalankan adalah untuk menguji kesan program latihan pliometrik yang di dilaksanakan sama ada ianya mampu mengubah saiz fizikal otot betis dan otot paha para pemain sepaktakraw di Politeknik Sultan Azlan Shah, Behrang. Responden kajian ini adalah seramai 40 orang pemain sepaktakraw lelaki yang berumur di antara 18 - 20 tahun. Responden kajian telah dibahagikan kepada dua kumpulan kajian iaitu kumpulan rawatan (n = 20) dan kumpulan kawalan (n = 20). Kumpulan rawatan diberikan latihan pliometrik selama (6) minggu berturut - turut dengan (2) sesi latihan pada setiap minggu, manakala kumpulan kawalan pula menjalani latihan rutin tanpa latihan pliometrik. Data ukur lilit saiz otot betis dan paha bagi kedua-dua kumpulan telah dianalisis setelah berakhir sesi latihan salama 6 minggu dengan menggunakan analisis *one way* Anova. Kesimpulannya berdasarkan data yang telah dianalisis menunjukkan terdapat perbezaan saiz fizikal otot dari segi ukur lilit betis dan ukur lilit paha antara dua kumpulan kajian di mana kumpulan yang menerima rawatan menunjukkan perubahan otot betis dan otot paha yang lebih besar berbanding dengan kumpulan kawalan yang menjalani latihan rutin. Oleh itu, pemain sepaktakraw yang mendapat latihan pliometrik boleh meningkatkan lagi saiz fizikal otot betis dan otot paha yang boleh memberi kekuatan bagi membantu meningkatkan lagi prestasi permainan.

Kata Kunci: Sepaktakraw, fizikal otot, pliometrik

1. PENGENALAN

Sepaktakraw adalah sejenis permainan yang melibatkan antara dua regu di dalam gelanggang yang sama dan dipisahkan antara keduanya dengan jaring. Setiap regu di anggotai oleh 3 orang pemain iaitu tekong, apit kanan dan apit kiri. Bola jenis sintetik digunakan dalam permainan ini. Bola ini dimainkan dengan menggunakan kaki. Sepaktakraw dimainkan secara meluas terutamanya di negara - negara Asean dan Asia. Kini permainan ini telah berkembang ke serata pelosok dunia dan dipertandingkan di kejohanan - kejohanan utama seperti Sukan SEA dan Sukan Asia.

Sukan ini sama seperti sukan - sukan lain yang melibatkan kekuatan otot - otot pada bahagian kaki. Kekuatan otot betis dan otot paha dalam sukan sepaktakraw penting bagi menghasilkan kuasa eksplosif / letupan dalam perlakuan aktiviti hubungan kaki dan bola seperti apabila tekong melakukan sepak mula, rejaman kaki, lompatan dan ketahanan otot apabila melakukan aktiviti berdurasi panjang . Program latihan secara pliometrik dipilih untuk menguji sama ada ianya mampu meningkatkan saiz otot paha dan betis atlet sepaktakraw. Latihan pliometrik yang dirancang dengan baik dapat memberikan perubahan terhadap saiz otot atlet (Chu, 1998; Haji Ahmad Gapor 2007; Vissing, Sorenson & Lonbro, 2008). Merujuk kepada (Baechle, 1994) dengan latihan pliometrik kekuatan kaki dapat ditingkatkan dengan membina ketahanan otot, kekuatan otot dan koordinasi otot untuk mendapatkan kuasa eksplosif yang tinggi.

Bagi mendapatkan kesan yang maksimum ke atas perubahan otot betis dan paha, latihan pliometrik hendaklah dirancang dengan kesesuaian umur, bebanan, masa latihan, intensiti latihan dan sela masa rehat di dalam latihan yang dijalankan supaya tidak menjejaskan dan memberi kesan negatif fizikal tubuh atlet. Perancangan program latihan pliometrik yang spesifik untuk atlet sepaktakraw dibuat bersesuaian dengan peringkat umur 18 - 20 tahun untuk

melihat perubahan saiz otot betis dan juga saiz otot paha selepas menjalani satu program latihan dalam tempoh masa 6 minggu yang ditetapkan. Latihan pliometrik perlu dirancang dan dilaksanakan dengan mengambil kira tempoh masa tertentu dan mestilah mengambil kira kesesuaian dengan umur atlet yang dilatih (Adams, K., J.P. O'Shea, K.L. O'Shea, and M. Climstein, 1992).

2. TINJAUAN KAJIAN DAN HIPOTESIS

2.1 Objektif kajian
Kajian ini adalah bertujuan untuk melihat keberkesanan program latihan pliometrik terhadap perubahan saiz otot betis dan paha atlet sepaktakraw selepas menjalani program latihan pliometrik yang dirancang selama 6 minggu.

2.2 Hipotesis kajian
a) Terdapat perbezaan signifikan pada ukuran paha bagi atlet yang menerima latihan pliometrik dalam kumpulan rawatan.
b) Terdapat perbezaan signifikan pada ukuran betis bagi atlet yang menerima latihan pliometrik dalam kumpulan rawatan.

3. METODOLOGI KAJIAN

3.1 Reka bentuk kajian
Kajian yang dijalankan ini adalah berbentuk eksperimental dengan menggunakan kaedah eksperimen kuasi. Kaedah eksperimen kuasi dipilih kerana kawalan yang terhad terhadap sampel yang terlibat (Levy & Ellis, 2011). Seramai 40 orang responden yang terdiri daripada pelajar atlet sepaktakraw Politeknik Sultan Azlan Shah, Behrang terlibat dalam kajian ini. Bilangan responden ini adalah mencukupi berdasarkan (Sekaran, 2003) yang menyatakan kaedah eksperimental kuasi boleh dijalankan terhadap bilangan sampel sekurang - kurangnya di antara 10 - 20 orang. Responden telah dibahagikan kepada dua kumpulan dan setiap responden dibahagikan secara persampelan rawakmudah ke dalam dua kumpulan tersebut. Setiap kumpulan akan menjalani latihan selama enam minggu di mana kumpulan rawatan akan menjalani latihan dengan menggunakan kaedah pliometrik seperti pada Rajah 1 manakala kumpulan kawalan pula akan menjalani sesi latihan secara rutin. Selepas enam minggu, kesemua sampel akan diambil ukuran bagi ukur lilit betis dan paha. Data daripada kajian ini akan dianalisis dengan menggunakan kaedah analisis *one-way* ANOVA.

3.2 Responden kajian
40 orang atlet sepaktakraw lelaki berumur 18-20 tahun Politeknik Sultan Azlan Shah adalah responden bagi kajian ini. Responden ini telah dibahagikan kepada dua kumpulan iaitu kumpulan kawalan dan kumpulan rawatan dengan menggunakan kaedah persampelan rawak mudah. Responden dipilih ke dalam setiap kumpulan berdasarkan nombor identiti yang diperolehi dan dengan merujuk kepada jadual nombor rawak responden diagihkan kepada kumpulan kawalan dan kumpulan rawatan.

3.3 Alat kajian

Minggu	Intensiti	*Latihan Pliometrik*	
Minggu 1 (2 sesi)	Pra persediaan (intensiti rendah)	*Lompatan Split* 1 set = 15 lompatan Jumlah set = 5 15 saat rehat antara setiap set	30 saat rehat antara setiap set
Minggu 2 (2 sesi)	Pra persediaan (intensiti rendah)	*Lompatan Split* *1 set = 15 lompatan* *Jumlah set = 5* *15 saat rehat antara setiap set*	30 saat rehat antara setiap set
Minggu 3 (2 sesi)	Persediaan (Intensiti rendah kepada sederhana)	*Lompatan dua kaki melepasi 4 halangan ke hadapan* *1 Set = 4 ulangan; Jumlah set = 4*	30 saat rehat antara setiap set
Minggu 4 (2 sesi)	Persediaan (Intensiti rendah kepada sederhana)	*Lompatan dua kaki melepasi 6 halangan ke hadapan* *1 Set = 4 ulangan;* *Jumlah set = 4*	35 saat rehat antara setiap set
Minggu 5 (2 sesi)	Pra pertandingan (Intensiti sederhana)	*Lompatan bounds / hops jarak 10m* *1 set = 4 ulangan; Jumlah set = 4*	40 saat rehat antara setiap set
Minggu 6 (2 sesi)	Pertandingan (Intensiti sederhana)	*Lompat bounds / hops jarak 20m* 1 set = 4 ulangan; Jumlah set = 4	45 saat rehat antara setiap set

Rajah 1: Program 6 minggu Latihan Pliometrik

4. ANALISIS DAN KEPUTUSAN

4.1 Ukur Lilit Otot Paha

Jadual 1 di bawah memaparkan hasil analisis deskriptif ukur lilit otot paha di antara kumpulan kawalan dan kumpulan rawatan. Hasil analisis, skor min / purata bagi ukur lilit paha kumpulan kawalan adalah (M = 39.95, SD = 0.76) dan kumpulan rawatan (M = 41.55, SD = 1.00).

Jadual 1 : **Analisis Deskriptif Ukuran Otot Paha (cm) di antara kumpulan kajian**

Kumpulan	Bil Responden (n)	Min	Sisihan Piawai (SD)
Kawalan	20	39.9	0.76
Rawatan	20	40.41	1.00

Jadual 2 di bawah memaparkan hasil analisis *one-way* ANOVA yang digunakan untuk menguji sama ada wujud sebarang perbezaan signifikan terhadap ukur lilit paha di antara kumpulan atlet yang menerima latihan pliometrik dan kumpulan kawalan. Sebelum itu, syarat-syarat taburan normal dan kesetaraan varians telah dipastikan dipenuhi bagi memastikan data yang

diperoleh boleh digunakan dalam kajian ini. Setiap kumpulan juga telah dipastikan setara dari segi saiz ukur lilit paha sebelum ujian dilaksanakan. Rumusan dapatan analisis menunjukkan wujud perbezaan signifikan terhadap min skor ukuran lilit paha di antara kumpulan atlet yang menerima latihan pliometrik, F (1,38) =32.54, p=0.00, iaitu p<0.05 dan *partial eta squared* = 0.46, iaitu *effect size* sederhana mengikut Cohen (1988). Oleh itu, dapat dirumuskan bahawa ukuran lilit paha kumpulan rawatan yang menerima latihan pliometrik berbeza secara signifikan berbanding kumpulan kawalan.

Jadual 2: Keputusan Ujian *one-way* ANOVA Ukur Lilit Paha di antara kumpulan rawatan dan kumpulan kawalan.

Source	Df	F	Sig	Partial Eta Squared
Corrected model	1	32.54	0.00	0.46
Error	38			

*Nilai signifikan p < 0.05

4.2 Ukur Lilit Otot Betis

Jadual 3 memaparkan keputusan analisis deskriptif bagi ukur lilit otot betis (cm) di antara kumpulan kajian. Hasil analisis, skor min/ purata ukur lilit betis kumpulan kawalan (M = 30.58, SD = 0.28) manakala kumpulan rawatan (M = 34.18, SD = 2.10).

Jadual 3: Analisis Deskriptif Ukur Lilit Otot Betis (cm) di antara kumpulan kajian.

Kumpulan	Bil Responden (n)	Min	Sisihan Piawai (SD)
Kawalan	20	30.58	0.28
Rawatan	20	34.81	2.10

Analisis *one-way* ANOVA telah digunakan bagi menguji sama ada terdapat sebarang perbezaan signifikan pada ukuran lilit betis di antara kumpulan atlet yang menerima latihan pliometrik dan kumpulan kawalan. Sebelum itu, syarat-syarat taburan normal dan kesetaraan varians telah dipastikan dipenuhi bagi memastikan data yang diperoleh boleh digunakan dalam kajian ini. Setiap kumpulan juga telah dipastikan setara dari segi saiz ukur lilit paha sebelum ujian dilaksanakan. Rumusan dapatan analisis menunjukkan wujud perbezaan signifikan terhadap min skor ukuran lilit paha di antara kumpulan atlet yang menerima latihan pliometrik, F (1,38) =118.97, p=0.00, iaitu p<0.05 dan *partial eta squared* = 0.76, iaitu *effect size* besar mengikut Cohen (1988). Oleh itu, dapat dirumuskan bahawa ukuran lilit betis kumpulan pelajar yang menerima latihan pliometrik berbeza secara signifikan berbanding kumpulan rawatan.

Jadual 4 : Keputusan Ujian *one-way* ANOVA Ukur Lilit Otot Betis (cm) di antara kumpulan kawalan dan kumpulan rawatan

Source	Df	F	Sig	Partial Eta Squared
Corrected model	1	118.97	0.00	0.76
Error	38			

*Nilai signifikan p < 0.05

5. KESIMPULAN

Hasil kajian ini mendapati wujudnya perbezaan yang signifikan pada ukur lilit otot paha dan juga ukur lilit otot betis atlet sepaktakraw yang berada dalam kumpulan rawatan yang menerima latihan pliometrik. Hasil kajian ini dapat menjadi panduan jurulatih di dalam membentuk fizikal otot kaki atlet sepaktakraw dan faedah latihan pliometrik dalam pembentukan fizikal otot betis dan juga paha atlet. Atlet boleh menggunakan latihan pliometrik untuk meningkatkan kekuatan otot bahagian kaki serta memberikan kuasa eksplosif dalam perlakuan aktiviti. Walaupun kadangkala perbezaannya tidak besar namun di dalam sukan perbezaan kecil itu boleh memberi kesan besar terhadap prestasi dan keputusan perlawanan. Penemuan kajian ini mungkin bermanfaat bagi jurulatih sepaktakraw yang mencari kaedah latihan alternatif untuk membantu atlet sepaktakraw meningkatkan kekuatan otot betis dan juga otot paha mereka. Dapatan kajian ini selari dengan hasil tinjauan(Myer, Ford, Brent & Hewett, 2006) yang menyatakan latihan pliometrik boleh meningkatkan kekuatan otot kaki. Dapatan ini juga disokong oleh kajian (Rimmer dan Slievert, 2000) yang menyatakan latihan pliometrik merupakan latihan yang boleh diterapkan untuk meningkatkan saiz dan kekuatan otot kaki atlet.

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CABARAN PENSYARAH KOLEJ KOMUNITI DALAM MELAKSANAKAN PROSES PENGAJARAN DAN PEMBELAJARAN DALAM TALIAN

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Abstrak. Penguatkuasaan perintah kawalan pergerakan (PKP) yang dijalankan akibat wabak Covid-19 menyebabkan proses pengajaran dan pembelajaran di kolej komuniti tergendala. Oleh itu, Kementerian Pengajian Tinggi (KPT) telah mengambil inisiatif untuk meneruskan proses pengajaran dan pembelajaran (PdP) secara atas talian. Namun begitu, terdapat beberapa cabaran yang dihadapi oleh pensyarah dalam melaksanakan PdP secara atas talian. Oleh itu kajian ini dijalankan untuk mengenalpasti cabaran pensyarah kolej komuniti dalam melaksanakan proses PdP secara atas talian, mengenalpasti medium pengajaran dominan yang digunakan oleh pensyarah untuk melaksanakan proses PdP secara atas talian dan mengenalpasti perbezaan pensyarah bandar dan luar bandar terhadap cabaran proses PdP secara atas talian. Kajian ini adalah kajian kuantitatif berbentuk deskriptif yang menggunakan soal selidik sebagai instrumen kajian. Analisis yang dijalankan berbentuk frekuensi, ranking mean dan t-test. Soal selidik telah diedarkan secara dalam talian menggunakan *Google Form*. Populasi dalam kajian ini adalah terdiri daripada pensyarah subjek Mata Pelajaran Umum (MPU) dari 96 kolej komuniti Semenanjung Malaysia. Bilangan populasi ini adalah seramai 134 orang. Jadual Penentuan Saiz Sampel Krejcie dan Morgan 97 orang telah dipilih secara rawak sebagai sampel kajian. Namun begitu hanya 60 responden menjawab soal selidik tersebut iaitu 61.86%. Hasil dapatan kajian ini mendapati terdapat tiga cabaran paling besar dihadapi pensyarah semasa melaksanakan PdP secara atas talian. Medium PdP yang paling banyak digunakan oleh pensyarah ialah aplikasi telegram diikuti oleh *Google Classroom* dan *Whatsapp*. Uji kaji t-test mendapati tiada perbezaan signifikan di antara cabaran yang dihadapi pensyarah dengan pensyarah yang mengajar di bandar dan luar bandar.

Kata Kunci: Pembelajaran atas talian, Cabaran, Medium Pembelajaran, Covid-19

1. PENGENALAN

Penularan wabak Covid-19 telah memberi impak besar kepada seluruh dunia dan menggugat keadaan sosioekonomi global. Pandemik covid-19 ini telah membawa Malaysia ke arah penguatkuasaan perintah kawalan pergerakan (PKP) yang menyebabkan pelbagai sektor terjejas termasuklah sektor pendidikan. Sehingga 5 Mac 2020 seramai 300 juta murid dan pelajar tidak ke sekolah di seluruh dunia dan melibatkan 13 buah negara (UNESCO, 2020). Perlaksanaan perintah kawalan pergerakan yang dikuatkuasakan di Malaysia telah menyebabkan semua sekolah dan institusi pendidikan diarahkan tutup bermula 18 Mac 2020. Walaupun sekolah dan institusi pendidikan ditutup, ini tidak bermaksud proses pengajaran dan pembelajaran turut dihentikan. Guru dan pendidik mengambil inisiatif untuk meneruskan proses pengajaran dan pembelajaran dengan menggunakan pendekatan yang lain agar pelajar tidak ketinggalan dalam pelajaran mereka. China merupakan negara yang pertama terjejas akibat pandemic covid 19 ini telah melaksanakan proses pengajaran dan pembelajaran (PdP) secara atas talian sewaktu tempoh kuarantin yang dikenakan

kepada mereka. Menurut Wu (2020) wabak Covid 19 menguji kecekapan organisasi dalam melaksanakan pengajaran secara alternatif.

Dalam tempoh sekatan pergerakan akibat Covid-19 telah membawa norma baru kepada proses pengajaran dan pembelajaran di Malaysia yang sebelum ini lebih tertumpu dengan kaedah bersemuka kepada pembelajaran secara atas talian. Norma baru ini telah menyebabkan pembelajaran secara atas talian bukan lagi satu pilihan tetapi keperluan. Ini membawa cabaran kepada pengajar dan pelajar untuk mengubah method pengajaran dan pembelajaran agar proses PdP dapat diteruskan. Kehadiran teknologi yang canggih membenarkan aktiviti pengajaran dan pembelajaran boleh berlaku di mana-mana tempat dan bila-bila masa. Penggunaan teknologi maklumat dan komunikasi (ICT) seperti komputer riba dan telefon bimbit serta rangkaian internet telah digunakan dalam proses pembelajaran dalam talian selaras dengan agenda membentuk ruang pembelajaran yang berteraskan teknologi kepada generasi pelajar sekarang (Yasmin Saw, 2020).

Penggunaan teknologi di peringkat sekolah dan pengajian tinggi telah digunapakai dalam proses pengajaran dan pembelajaran seperti *e-learning, blend learning* dan *mobile learning.* Teknologi yang sentiasa berkembang dari semasa ke semasa memudahkan sesuatu proses PdP serta menarik minat pelajar dan menjimatkan masa. Namun begitu, terdapat beberapa halangan dalam menyokong pelaksanaan proses pengajaran dan pembelajaran secara atas talian seperti kekurangan kemudahan peralatan dan sambungan rangkaian internet (Noriyani, 2017). Menurut Zhong (2020) wabak covid-19 telah menwujudkan jurang digital pendidikan di antara pelajar bandar dan luar bandar di negara China. Kekurangan peralatan teknologi menyebabkan hampir separuh pelajar di luar bandar tidak mengambil bahagian dalam pelajaran secara atas talian. Dapatan kajian Pandemik Pasca Penjarakan Sosial Pasca COVID-19 yang dibuat oleh Kesatuan Perkhidmatan Perguruan Kebangsaan Malaysia (NUTP) mendapati sebanyak 93% guru memilih proses pengajaran dan pembelajaran secara bersemuka di dalam kelas berbanding kaedah pengajaran dan pembelajaran yang lain. Justeru, kajian ini dijalankan bagi mengenalpasti cabaran yang dihadapi pensyarah kolej komuniti, medium yang digunakan dalam PdP dan perbezaaan PdP antara pensyarah bandar dan luar bandar.

1.1 Penyataan Masalah

Pandemik Covid 19 telah merubah corak PdP yang selama ini lebih berfokuskan kaedah bersemuka kepada pembelajaran atas talian. Peningkatan mendadak penggunaan pembelajaran dalam talian bagi menggantikan pembelajaran dalam bilik darjah dilihat berlaku semasa perintah kawalan pergerakan dilaksanakan. Pelbagai medium telah diperkenalkan seperti *Google Classroom, Google Meet, Zoom, Easy Class* dan pelbagai lagi aplikasi yang digunakan untuk melancarkan proses e-pembelajaran. Kemudahan teknologi dihujung jari memudahkan capaian maklumat diperolehi tanpa mengira tempat dan masa. Penggunaan telefon bimbit pintar dikalangan pelajar institut pengajian tinggi merupakan satu keperluan pada abad ke 21 kerana proses pembelajaran yang melibatkan *e-learning* serta pelajar terdedah dengan penggunaan media sosial. Menurut Mohd Noorhadi & Zurinah (2017) proses PdP perlu melibatkan penggunaan media sosial seiring dengan perkembangan dunia pendidikan moden pada masa kini serta menjadikan PdP lebih menarik dan produktif. Namun begitu, perubahan kaedah pembelajaran secara bersemuka di dalam kelas kepada platform pembelajaran secara atas talian memberi kesulitan dan tekanan kepada guru dan pensyarah untuk melaksanakannya dalam masa yang singkat semasa tempoh PKP (Yasmin Saw, 2020).

Masalah ini turut dihadapi oleh pensyarah kolej komuniti yang perlu melaksanakan proses pengajaran dan pembelajaran semasa PKP bagi melengkapkan silibus pelajaran dengan mengunakan pendekatan pembelajaran secara atas talian seperti *telegram, WhatsApp* dan *email.* Dalam kajian Tuan Nguyeng (2015), keberkesanan pengajaran secara dalam talian dilihat kurang berkesan iaitu 92% berbanding pengajaran secara bersemuka. Namun begitu, 3% berpendapat sebaliknya iaitu pengajaran secara online lebih berkesan berbanding tradisional dan 4% lagi adalah pendapat bercampur. Di Kolej Komuniti Gerik, PdP atas talian

sangat diperlukan khususnya mata pelajaran pengajian am dan beberapa subjek teknikal. Pensyarah yang terlibat dalam PdP secara atas talian di KKGP ialah seramai 30 orang dan melibatkan 250 orang pelajar. Namun wujudnya cabaran di kalangan pensyarah dalam melaksanakan pembelajaran dalam talian kerana capaian internet khususnya dikawasan penginapan asrama KKGP amat tidak memberangsangkan. Selain itu juga, pengetahuan pensyarah dalam bidang ICT yang terhad menyebabkan pembelajaran secara atas talian tidak berjalan dengan lancar. Menurut Noriyani (2017) amat penting seseorang pengajar mempunyai pengetahuan dalam bidang ICT sekiranya ingin diaplikasikan dalam PdP dan perlu bersesuaian dengan mata pelajaran yang diajar. Oleh itu, kajian ini dibuat untuk pengkaji mengetahui adakah wujudnya cabaran daripada pensyarah kolej komuniti dalam melaksanakan proses PdP secara atas talian semasa tempoh PKP dilaksanakan.

1.2 Objektif Kajian

i. Mengenalpasti cabaran pensyarah kolej komuniti dalam melaksanakan proses pengajaran dan pembelajaran secara atas talian
ii. Mengenalpasti medium pengajaran dominan yang digunakan oleh pensyarah untuk melaksanakan proses pengajaran dan pembelajaran secara atas talian
iii. Mengenalpasti perbezaan pensyarah bandar dan luar bandar terhadap cabaran proses pengajaran dan pembelajaran secara atas talian.

2. KAJIAN LITERATUR

Krisis global akibat penularan wabak Covid-19 bukan sahaja menyebabkan pembelajaran dan pengajaran secara konvensional tertangguh tetapi menjadikan tugasan pendidik semakin mencabar apabila mereka perlu menyesuaikan diri dengan norma kehidupan dan kebiasaan baharu yang memerlukan proses Pengajaran dan Pembelajaran (PdP) dilaksanakan secara atas talian. Dalam alaf baharu yang mengutamakan kemahiran pembelajaran sepanjang hayat, masyarakat tiada pilihan lain selain memanfaatkan teknologi dan aplikasi pendidikan dalam talian. Konteks pendidikan masa kini memerlukan pendidik menguasai dan mempunyai literasi teknologi komunikasi dan maklumat (ICT). Kajian Thulasimani (2014) menyatakan untuk ke era gelombang ketiga iaitu berasaskan teknologi maklumat, pertimbangan yang wajar harus diberi perhatian di mana teknologi maklumat tidak terhad kepada penggunaan internet dan komputer sahaja tetapi kaedah PdP boleh dipelbagaikan menggunakan medium yang lain seperti telefon mudah alih, telegram dan lain-lain. Lantaran sebaik Kerajaan Malaysia mengisytiharkan Perintah Kawalan Pergerakan (PKP) bermula 18 Mac lalu, Kementerian Pengajian Tinggi (KPT) telah mengaktifkan mod Pengajaran dan Pembelajaran (PdP) secara dalam talian kepada seluruh IPT di negara ini termasuk universiti, politeknik, kolej komuniti, institut kemahiran dan pusat latihan teknikal yang terjejas akibat wabak ini (Kementerian Pengajian Tinggi).

2.1 Pembelajaran Atas Talian

Mengubah kaedah pengajaran konvensional kepada medium teknologi yang lain seperti penggunaan *whatsapp, telegram* dan *google classroom* bakal mempengaruhi sistem sedia ada khususnya pelajar-pelajar Kolej Komuniti. Pelajar perlu berupaya menerima kaedah pembelajaran jarak jauh berbanding kaedah konvensional sebelum Perintah Kawalan pergerakan (PKP) dilaksanakan. Pastinya cabaran PdP atas talian akan dihadapi oleh semua pihak. Namun, kejayaannya bergantung kepada usaha sejauh mana pendidik dan pelajar menguasai medium penyebaran maklumat tersebut. Kajian Rubiah dan Jamilah (2009) menyatakan seorang ahli akdemik memerlukan arahan kendiri yang tinggi sebelum melaksanakan e-pembelajaran seperti bahan-bahan kuliah dan tutorial. Secara tidak langsung, pelajar akan turut bersedia untuk melibatkan diri dalam e-pembelajaran ini. Di samping itu, e-pembelajaran boleh menyumbang kepada perseketiran PdP yang lebih fleksibel bukan sahaja untuk menukarkan modul tradisional bahkan juga bilik darjah dalam versi atas talian. Seterusnya kajian Zahiah dan Abdul (2010) menyatakan medium PdP secara atas talian memberi banyak manfaat khususnya kepada pelajar yang pendiam dan pemalu. Ini kerana mereka boleh melibatkan diri dalam perbincangan maya tanpa perlu rasa malu

untuk mengeluarkan pendapat seterusnya boleh menjadikan mereka lebih aktif dalam forum tersebut.

2.2 Capaian Internet

Disebabkan PKP yang berlaku di negara ini secara tiba-tiba, pelbagai faktor harus diambil kira bagi memastikan PdP berjalan dengan lancar. Antara cabaran utama dalam menjalankan kaedah PdP atas talian ialah capaian internet. Menurut kajian Ting (2007), kekurangan kemudahan internet menjadi masalah utama dikalangan para pelajar. Selain itu, kajian mendapati terdapat empat halangan utama dalam e-pembelajaran di mana halangan teknologikal mencatatkan min yang tertinggi. Ini menunjukkan tidak semua pelajar mempunyai capaian internet yang baik apabila berada di kampung halaman masing-masing dan seterusnya menyukarkan mereka untuk menghantar tugasan melalui medium-medium seperti disenaraikan dalam kajian ini. Sementara itu, kajian oleh Ahmad et.al (2014) menyatakan penggunaan telefon pintar (*smart phone*) oleh semua golongan pada masa kini membolehkan PdP dijalankan di mana sahaja dengan syarat mempunyai capaian internet yang baik. Justeru, aktiviti PdP akan lebih menarik dan menyeronokkan sekiranya dijalankan atas talian.

2.3 Cabaran Pendidik

Seterusnya, kajian ini turut mengkaji dari perspektif pendidik. Ke arah pelaksanaan norma baru dalam PdP, tahap kesediaan pendidik perlu berada pada tahap yang baik kerana berlakunya perubahan pembelajaran dari persekitaran hakiki kepada persekitaran maya. Pelbagai cabaran harus ditempuhi bagi memastikan PdP tetap berlansung dengan jayanya. Berdasarkan kajian yang dijalankan oleh Mohamed, Norazah, Supyan dan Afendi (2010) mendapati mod utama latihan yang diminati oleh pensyarah ialah secara bersemuka (45.1%), diikuti oleh kaedah blended (26.5%), *fully* atas talian (13%), *CD-based* (7.6%) dan *on demand* (6.3%). Di samping itu juga kajian mendapati cabaran pensyarah dalam mengintegrasikan e-pembelajaran dalam PdP ialah menyeimbangkan pengajaran dengan tugasan sampingan yang lain selain dari kekangan masa. Namun, pensyarah tidak mempunyai masalah dalam melaksanakan PdP secara atas talian sekiranya perlu.

Di samping itu, PdP secara atas talian memerlukan kerjasama antara dua pihak iaitu pensyarah dan juga pelajar. Cabaran yang bakal dihadapi oleh pensyarah dilihat dari segi penghantaran tugasan. Kajian Faizatul dan Nor (2017) mendapati alasan utama pelajar apabila PdP atas talian ialah pemilikan komputer berinternet. Ini akan menjadi alasan kepada berlakunya kelewatan menghantar tugasan dan sebagainya. Justeru, ia akan menyukarkan pensyarah dalam pentaksiran berterusan (PB) pelajar tersebut. Oleh yang demikian, pensyarah perlu memikirkan alternatif lain sekiranya pelajar menjadikan isu ketiadaan internet dan pemilikan komputer sebagai alasan.

3. METODOLOGI

Kajian yang dijalankan adalah kajian kuantitatif berbentuk deskriptif dengan menggunakan reka bentuk kajian secara tinjauan dengan menggunakan borang soal selidik. Menurut Mohd Najib Abdul Ghafar (2003), penyelidikan deskriptif digunakan untuk mendapat maklumat mengenai sesuatu peristiwa yang sedang berlaku. Soal selidik telah diedarkan secara dalam talian menggunakan *Google Form*. Populasi dalam kajian ini adalah terdiri daripada para pensyarah subjek mata pelajaran umum Mata Pelajaran Umum (MPU) dari 96 kolej komuniti Semenanjung Malaysia. Bilangan populasi ini adalah seramai 134 orang. Jadual Penentuan Saiz Sampel Krejcie dan Morgan 97 orang telah dipilih secara rawak sebagai sampel kajian. Namun begitu hanya 60 responden menjawab soal selidik tersebut iaitu 61.86%. Pembinaan instrumen kajian dibina sendiri oleh pengkaji berdasarkan konsep dan pandangan yang dikemukan penyelidik terdahulu iaitu (Langford & Damsa, 2020) dan (Syazwani,2020). Soal selidik ini mengandungi 2 bahagian iaitu Bahagian A mengandungi maklumat demografi responden dan bahagian B mengandungi item-item cabaran yang dihadapi pensyarah semasa mengendalikan kelas secara atas talian dengan menggunakan

m-pembelajaran dan *instant messaging*. Pensyarah kolej komuniti perlu bertukar kepada medium pengajaran secara atas talian semasa minggu ke 12 daripada 14 minggu PdP. Bagi menganalisis tahap cabaran yang dihadapi oleh pensyarah semasa menjalankan kelas atas talian interpretasi skor min mengikut pandangan Pallant (2007).

Jadual 1: Tafsiran Min Tahap

Min	Tahap
0.00-1.66	Rendah / Tidak Memuaskan / Tidak Perlu
1.67 – 3.33	Sederhana / Agak memuaskan / Agak Perlu
3.34 – 5.00	Tinggi / Sangat memuaskan/Sangat Perlu

4.0 DAPATAN KAJIAN DAN PERBINCANGAN

Analisis yang dijalankan berbentuk frekuensi, ranking mean dan t-test. Objektif 1 ialah untuk mengenalpasti cabaran pensyarah kolej komuniti dalam melaksanakan PdP secara talian. Berdasarkan ranking min dalam Jadual 2 menunjukkan 3 cabaran paling besar dihadapi pensyarah ialah proses PdP secara atas talian adalah lebih mencabar berbanding pertemuan bersemuka dan diikuti oleh pelajar tidak dapat menghantar tugasan yang diberi pada masa yang ditetapkan dan ketiga paling dominan ialah pelajar tidak mempunyai capaian internet yang baik untuk proses PdP. Manakala untuk cabaran kurang dominan pula adalah soalan 6,9 dan 14. Perincian setiap cabaran mengikut ranking adalah seperti dalam Jadual 2.

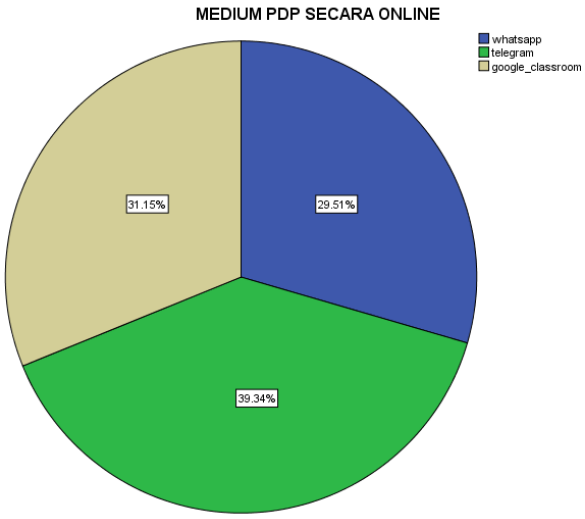
Jadual 2: Ranking min cabaran yang dihadapi pensyarah semasa menjalankan PdP atas talian

Soalan	Penyataan	Mean	Tahap	Rank
1	Proses pembelajaran secara atas talian memudahkan proses PdP	3.5082	Tinggi	8
2	Pelajar mempunyai capaian internet untuk proses PdP	2.9508	Sederhana	3
3	Pelajar memberi respons terhadap maklumat yang diberikan oleh pensyarah	3.2459	Sederhana	6
4	Pelajar dapat menghantar tugasan yang diberi pada masa yang ditetapkan	2.8852	Sederhana	2
5	Pelajar mempunyai kemahiran menggunakan medium pembelajaran atas talian	3.3607	Sederhana	7
6	Tempoh penghantaraan tugasan yang diberi oleh pensyarah bersesuaian	4.0328	Tinggi	13
7	Proses pemarkahan dapat dijalankan dengan lancar	3.5246	Tinggi	9
8	Hasil tugasan pelajar secara atas talian adalah baik	3.1311	Sederhana	4
9	Pensyarah mampu melaksanakan PdP secara atas talian	3.7213	Tinggi	12
10	Tiada tekanan dalam melaksanakan PdP secara atas talian	3.1475	Sederhana	5
11	Proses PdP secara atas talian adalah lebih mudah berbanding pertemuan bersemuka	2.7869	Sederhana	1
12	Pembelajaran secara atas talian memberi masa yang fleksible kepada pensyarah untuk melengkapkan modul pembelajaran	3.6721	Tinggi	10
13	Pembelajaran secara atas talian sesuai dijalankan secara berkumpulan	3.1475	Sederhana	5
14	Pensyarah kreatif dalam memberi tugasan	3.7049	Tinggi	11

Pengkaji melihat fenomena ini timbul kerana kebanyakan pelajar datang dari kawasan terpencil yang tidak dapat menampung semua liputan komunikasi. Selain itu pelajar dari jurusan Teknik & Vokasional lebih cenderung menggunakan pensyarah sebagai fasilatator untuk membantu mereka menggunakan teknologi dalam proses PdP. Oleh itu, tanpa kehadiran pensyarah semasa sesi PdP sedikit sebanyak mempengaruhi prestasi mereka. Ini diakui oleh (Zarina,Sanisah, Zuriawahida, Juliyana, Mohamad Hisyam 2016) dimana akses ke peralatan komputer dan teknologi dan juga internet menjadi masalah kepada pelajar terutamanya mereka yang tinggal di luar bandar. Disiplin pelajar yang lemah juga turut mempengaruhi PdP atas talian.

Ini dipersetujui (Langford, 2020) dalam kajiannya di Norway mendapati pandemik Covid-19 memberi cabaran kepada para guru. Antara cabaran yang dihadapi ialah maklum balas pelajar terhadap penghantaran tugasan yang mengecewakan, pembelajaran atas talian yang memerlukan masa yang banyak, kekurangan fasiliti yang menyukarkan aktiviti praktikal dan kajian di dalam makmal. Masalah isyarat internet yang lemah memainkan menyukarkan guru semasa mengajar kerana aplikasi Zoom yang digunakan menyebabkan bunyi itu pecah, video yang tersangkut, atau terdapat jeda antara keduanya. Oleh kerana itu, kelas tidak dapat dijalankan dengan lancar. Jan (2020) juga menegaskan sekolah menganggap setiap pelajar dan guru mempunyai Internet berkelajuan tinggi walhal sebaliknya. Negara China yang menghadapi Covid-19 memperkenalkan polisi "*Suspending Classes Without Stopping Learning*" dan Zhang, Y.Wang, Yang & C. Wang (2020) mendapati beberapa masalah timbul seperti liputan rangkaian di kawasan terpencil yang masih belum berkelajuan tinggi, kemahiran penggunaan dan pengetahuan guru mengenai teknologi pendidikan atas talian dan gangguan di rumah semasa sesi Pdp berlangsung. Ini turut disokong oleh Raju (2020) yang mendapati di India cabaran yang dihadapi oleh pensyarah ialah telefon pintar pelajar yang tidak serasi dengan *stream 4G*, akses internet yang tidak mencukupi dan pengajaran hanya dapat difokuskan kepada teori walaupun sepatutnya secara praktikal. Menurut (Bao, 2020) beberapa cabaran lain juga muncul apabila guru mengajar semasa pandemik Covid 19 iaitu platform pendidikan yang disediakan seringkali ditutup secara mengejut kerana tidak dapat menampung bilangan pelajar yang ramai, penggunaan komunikasi intrapersonal yang tidak dapat diterapkan, pelajar sering ponteng semasa kelas atas talian dan penyertaan yang sangat terhad di kalangan pelajar semasa sesi perbincangan. Namun begitu, Pdp atas talian juga dilihat banyak membantu pensyarah seperti dapat menjana kreativiti pensyarah, memberikan durasi masa yang panjang kepada pelajar untuk meyiapkan kerja, dan memberi peluang kepada pensyarah meneroka lebih dalam tentang pengajaran secara atas talian.Ini turut disokong oleh Syazwani (2020) dalam hasil kajiannya terhadap pelajar zaman milenium yang berpendapat pengajaran dan pembelajaran menggunakan social media lebih menyeronok dan pendekatan ini dekat dengan generasi muda.

Memandangkan PdP di kolej komuniti seluruh Malaysia semasa Covid -19 menyerang Malaysia adalah semasa minggu ke 12, maka medium yang dikaji adalah berbentuk *instant messaging* dan *mobile learning (m-learning)*. Ini kerana ia lebih kepada memantau tugasan pelajar yang berbaki 2 minggu. Namun begitu, beberapa pensyarah menggunakan rakaman video untuk menerangkan kuliah berbaki 2 minggu. Rajah 1 menunjukkan medium PdP yang paling banyak digunakan oleh pensyarah ialah aplikasi *telegram* diikuti oleh *google classroom* dan *whatsapp*. Hasil kajian menunjukkan 39.3 % pensyarah menggunakan telegram, 31.1% menggunakan google classroom dan 29.5% lagi menggunakan aplikasi *whatsapp*.



Rajah 1 : Mean medium PdP yang digunakan pensyarah

Pada pendapat pengkaji, pensyarah menjadikan *telegram* sebagai medium pengajaran dalam talian kerana ahli kumpulan boleh memasukkan rakan mereka ke dalam kumpulan telegram, tidak membebankan memori telefon, sesuai digunakan di telefon pintar android mahupun desktop dan saiz pemindahan fail adalah besar. Kajian Mohammad Nizam (2016) juga menunjukkan para pelajar yang menggunakan aplikasi *telegram* dalam PdP bersetuju *telegram* mudah digunakan untuk berkongsi video, nota dan makluman. Mereka juga bersetuju kualiti nota dan video menggunakan telegram sangat baik. *Google Classroom* juga menjadi pilihan pensyarah dalam menjalankan PdP. Ini disebabkan *Google Classroom* boleh dijalinkan dengan aplikasi yang berbeza, memudahkan pensyarah memantau tugasan pelajar dan pelajar mudah mendapatkan notifikasi. Ini turut dipersetujui oleh (Basilaia, Dgebuadze, Kantaria, & Chokhonelidze, 2020) yang menyatakan *Google Classroom* mewujudkan persekitaran pembelajaran bersama dengan perkongsian bahan yang pelbagai dari aplikasi berbeza. Isna (2019) melalui kajiannya mendapati *Google Classroom* membuatkan pelajar lebih banyak berkomunikasi dengan pengajar kerana secara atas talian dan tidak bersemuka. Ia sangat sesuai dengan pelajar yang pemalu dan motivasi rendah.

Melalui uji kaji t-test didapati nilai Sig t-test 0.568 > 0.05 maka dapat disimpulkan Ho diterima iaitu tiada perbezaan signifikan di antara cabaran yang dihadapi pensyarah dengan pensyarah yang mengajar di bandar dan luar bandar. Pada pendapat pengkaji, ini disebabkan walaupun ada kolej komuniti terletak di luar bandar tetapi apabila Pergerakan Kawalan Pergerakan (PKP) dilancarkan pelajar telah pulang ke tempat asal mereka dan didapati sambungan internet adalah baik. Namun begitu, wujud juga masalah kepada kolej komuniti seperti Sabah, Sarawak, Gerik, Sungai Siput yang mempunyai pelajar Orang Asal yang sambungan internet di kampung mereka adalah lemah. Namun begitu, ia ditolak oleh (Kumar, Norasmah & Haryanti,2019) yang menjukkan terdapat perbezaan antara guru sekolah bandar dan luar bandar dari segi kemahiran teknologi maklumat. Kajian mereka turut disokong oleh (Han dan Crispina, 2014) yang mendapati terdapat perbezaan prestasi pengajaran secara atas talian di antara guru Sains di bandar dan luar bandar.

Jadual 3: Jadual Independent t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean_ cabaran	Equal varianes assumed	.129	.720	-.574	59	.568	-.10204	.17791	-.45805	.25396
	Equal varianes not assumed			-.564	50.336	.575	-.10204	.18099	-.46551	.26143

5.0 KESIMPULAN

Secara amnya, pengajaran secara atas talian semasa PKP memberi banyak cabaran kepada pensyarah subjek Am di kolej komuniti. *Telegram, Google Classroom* dan *Whatsapp* sesuai digunakan sebagai medium pengajaran secara atas talian. Namun begitu, aplikasi lain yang sesuai untuk sesi PdP perlu dikaji lebih lagi seperti media sosial, *e-learning, video streaming* dan *youtube*. Kajian ini sangat berguna kepada jabatan Pengajian Kolej Komuniti dan kolej masing-masing untuk melihat semula cabaran yang dihadapai pensyarah dalam mengendalikan kelas secara atas talian. Pengkaji mencadangkan satu pendekatan perlu diambil oleh pihak JPPKK bagi memberi ruang kepada pelajar yang tiada akses internet tetapi mempunyai akses kepada medium yang lain seperti televisyen dan sebagainya bagi memberikan seluas mungkin ruang dan peluang kepada pelajar, guru dan ibubapa dalam mendapat akses kepada pendidikan khususnya sepanjang tempoh PKP. Bengkel berkaitan PdP atas talian pelu dijalankan secara berkala memandangkan kes COVID masih ada agar pensyarah dan pelajar sentiasa peka dan tidak ketinggalan terhadap PdP secara atas talian. Selain itu, sambungan internet di kolej komuniti perlu dinaik taraf untuk memudahkan PdP antara pensyarah dan pelajar. Pegawai Pembelajaran Digital di setiap kolej komuniti perlu meneroka dan berkongsi dengan pensyarah medium pengajaran secara atas talian selain dari *Telegram, Whatsapp* dan *Google Classroom* untuk menjadikan PdP lebih menarik. Pihak Kolej Komuniti Gerik pula perlu menyediakan perkakasan yang lengkap di bilik digital yang boleh menampung kegunaan staf. Bilik digital perlu dilengkapi dengan *green screen, microphone, video recording* dan kamera. Diharapkan kajian ini dapat membantu pihak pengurusan kolej, pihak pengurusan JPPKK dan kementerian untuk tindakan lanjut dalam memastikan pembelajaran secara digital di bandar mahupun luar bandar berjalan dengan baik.

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MOOC EASY COMPLEX NUMBER SEBAGAI PLATFORM PEMBELAJARAN TERBUKA BAGI KURSUS MATEMATIK KEJURUTERAAN

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Abstrak. Aplikasi MOOC adalah medium untuk menyampaikan kandungan pembelajaran secara dalam talian kepada sesiapa sahaja yang ingin mengikuti kursus tanpa batasan kehadiran. Kajian ini mengkaji pengunaan *MOOC Easy Complex Number* sebagai satu platform pembelajaran baharu kepada pelajar di Politeknik. Tujuan kajian ini dijalankan untuk mengenal pasti potensi MOOC yang dibina dalam meningkatkan kefahaman dan menarik minat pelajar dalam kursus Matematik Kejuruteraan satu. Kajian kuantitatif ini menggunakan kaedah kajian tinjauan melalui pengedaran instrumen soal selidik secara dalam talian *google form*. Sampel kajian terdiri daripada 217 orang pelajar semester satu yang mengambil kursus Matematik Kejuruteraan satu. Data dianalisis menggunakan analisis deskriptif dan inferensi. Dapatan kajian menunjukkan terdapat perbezaan terhadap kesediaan pelajar dalam penggunaan MOOC antara pelajar lelaki dan perempuan. Kajian juga menunjukkan terdapat hubungan antara kesediaan pelajar dan halangan terhadap penggunaan MOOC.

Kata Kunci: MOOC, *Easy Complex Number*

1. PENGENALAN

Dengan kemunculan *Massive Open Online Courses* atau dikenali sebagai MOOC pada masa ini telah memberikan impak yang besar kepada dunia pendidikan. MOOC adalah satu platform pembelajaran di mana ia bersifat terbuka kepada sesiapa, percuma dan fleksibel (Md Yusoff *et al.,* 2017). Kursus – kursus yang dijalankan menggunakan MOOC boleh diakses secara dalam talian dengan lebih fleksibel dari segi waktu dan tempat.

Bermula dengan penggunaan aplikasi LMS Curriculum Information Document Online System (CIDOS) yang telah diperkenalkan pada tahun 2010 telah menampakkan hasil yang memberangsangkan. Walaupun CIDOS sudah dan sedang dilaksanakan di Politeknik Malaysia, Kementerian Pengajian Tinggi memperkenalkan pula Massive Open Online Courses (MOOC) sebagai satu platform pembelajaran secara maya yang terkini di institusi pendidikan tinggi di Malaysia (Norfadzilah, 2016). Secara asasnya , para pendidik perlu sedar bahawa mereka kini sedang berdepan dengan pelajar abad ke-21 yakni Gen-Z yang mempunyai keutamaan dan cara belajar yang berbeza. Masalahnya adalah kebanyakan pendidik masih mengajar menggunakan kaedah konvensional .Oleh yang demikinan, wajar dilihat semula konsep konvensional dan pendidik perlu mengaplikasikan kaedah yang baharu untuk membentuk semula pembelajaran agar lebih relevan pada masa akan datang.

Easy Complex Number merupakan kursus MOOC yang telah dibangunkan dan memfokuskan topik *Complex Number*. Kajian ini dijalankan untuk melihat kesediaan pelajar terhadap penggunaan MOOC dan persepsi terhadap kandungan kursus MOOC *Easy Complex Number*.

Kesediaan diri pelajar adalah keyakinan dan kecekapan diri untuk menggunakan MOOC menggantikan pembelajaran harian biasa. Terdapat empat aspek jangkaan kesediaan diri yang dikaji dalam kajian ini iaitu jangkaan prestasi, jangkaan usaha, pengaruh sosial dan keadaan kemudahan. Empat aspek ini adalah berasaskan model UTAUT yang telah dibangunkan oleh Venkatesh *et al.* (2003). Kajian ini menggunakan kesemua aspek untuk mengenalpasti tahap kesediaan pelajar menggunakan MOOC.

Halangan pula ditakrifkan sebagai rintangan yang dihadapi oleh pelajar sehingga boleh membawa kesan negatif terhadap penggunaan sistem pembelajaran dalam talian seperti MOOC. Objektif kajian ini adalah:

i. Mengenal pasti tahap kesediaan pelajar terhadap kursus MOOC *Easy Complex Number*
ii. Mengenal pasti perbezaan kesediaan pelajar terhadap penggunaan MOOC mengikut jantina
iii. Mengkaji hubungan antara kesediaan pelajar dan halangan terhadap penggunaan MOOC
iv. Mengkaji persepsi pelajar terhadap reka bentuk dan kandungan MOOC *Easy Complex Number*

2. SOROTAN KAJIAN

Kajian yang dijalankan oleh Md Yusoff Daud, Farah Nurshahira Zulkifli, Mohd Jasmy & Fariza Khalid (2017) menyatakan pelajar mempunyai tahap kesediaan yang tinggi terhadap pembelajaran menggunakan MOOC manakala kajian oleh Nurul Ain dan Razzatul Iza Zurita (2015) menunjukkan kesediaan penggunaan MOOC bagi pelajar berada pada tahap yang sederhana. Hasil kajian menunjukkan penggunaan MOOC berkesan untuk sesi pengajaran dan pembelajaran yang baharu dan mudah untuk dipelajari. Penggunaan MOOC juga dapat meningkatkan daya literasi terhadap MOOC, motivasi dan minat pelajar dan ia menjadikan proses pembelajaran menjadi lebih menarik (Mohd Erfy *et al*., 2018).

Menurut Siti Fatimah dan Siti Hasmiza (2018), kebanyakan pelajar mempunyai pandangan positif terhadap penggunaan MOOC. Pelajar sedar bahawa MOOC dapat diaplikasikan dan mereka mempunyai tahap pengetahuan MOOC yang sederhana serta mengetahui kelebihan yang diperolehi dari penggunaan tersebut. Pelajar bersedia menggunakan MOOC pada bila-bila masa dan mendapatkan bahan pembelajaran melalui MOOC.

Kajian ini disokong oleh kajian Siti Feirusz dan Sazilah (2016) yang mengkaji tentang kesediaan pelajar dari segi aspek sikap terhadap pembelajaran fleksibel, pembelajaran dalam talian, pengurusan masa belajar, teknologi dan interaksi dalam talian dan pembelajaran di dalam kelas menunjukkan keputusan yang positif terhadap kesemua aspek.

Nurul Ain dan Razzatul Iza Zurita (2015) menyatakan sumber liputan wifi yang rendah adalah antara halangan yang dominan bagi penggunaan MOOC. Langkah-langkah untuk mengatasi masalah ini perlu diatasi dengan segera bagi memastikan penggunaan MOOC dapat dijalankan dengan berkesan.

3. METODOLOGI KAJIAN

Kajian kuantitatif ini menggunakan reka bentuk kajian tinjauan yang melibatkan 217 sampel pelajar semester satu Politeknik Sultan Azlan Shah. Kursus ini berlangsung selama tiga minggu. Kaedah pensampelan rawak mudah digunakan bagi pemilihan sampel.

Instrumen tersebut terdiri daripada empat bahagian iaitu maklumat latar belakang pelajar, konstruk kesediaan, konstruk halangan dan konstruk kandungan MOOC bagi Easy Complex

Number yang dibangunkan. Setiap konstruk mengandungi 15 item dan jumlah keseluruhan item soal selidik adalah sebanyak 45 item. Soal selidik diagihkan kepada responden melalui aplikasi *Google Form*. Soal selidik telah diadaptasi daripada kajian Md Yusoff *et. al* (2017) dan telah diubahsuai. Soal selidik ini telah ditentukan kesahan muka dan kesahan kandungan oleh dua orang pakar. Di samping itu, satu kajian rintis telah dijalankan ke atas 30 orang pelajar bagi menguji nilai kebolehpercayaan. Secara keseluruhannya, nilai Alfa Cronbach ialah 0.947. Indeks kebolehpercayaan ini adalah sangat baik dan tahap konsistensi yang tinggi (Bond & Fox, 2015). Data dianalisis dengan menggunakan kaedah analisis statistik deskriptif dan inferensi.

4. ANALISIS DAN KEPUTUSAN

Demografi responden kajian merujuk kepada jantina dan jabatan responden.

Jadual 1: Jantina Mengikut Responden

Jantina	Kekerapan	Peratus (%)
Lelaki	120	55.3
Perempuan	97	44.7

Jadual 1 menunjukkan sebanyak 217 orang responden telah terlibat dalam kajian ini. Bilangan responden lelaki adalah lebih ramai berbanding responden perempuan. Sebanyak 97 orang (44.7 %) responden terdiri daripada responden perempuan dan 120 orang (55.3%) responden terdiri daripada responden lelaki.

Jadual 2: Responden mengikut jabatan

Jabatan	Kekerapan	Peratus (%)
Jabatan Kejuruteraan Awam	104	47.9
Jabatan Kejuruteraan Elektrik	60	27.6
Jabatan Kejuruteraan Mekanikal	53	24.5

Jadual 2 menunjukkan responden kajian terdiri daripada tiga jabatan kejuruteraan di Politeknik Sultan Azlan Shah. Bilangan responden daripada jabatan kejuruteraan awam adalah terdiri daripada 104 orang (47.9 %). Responden jabatan kejuruteraan elektrik terdiri daripada 60 orang (27.6%) manakala responden jabatan kejuruteraan mekanikal adalah seramai 53 orang (24.5 %).

Dalam kajian ini, data dianalisis dengan menggunakan analisis data deskriptif dan inferensi. Semua data diproses menggunakan perisian SPSS Versi 21. Tahap pembolehubah ini diukur berdasarkan kepada julat interpretasi skor min berpandukan Jadual 3.

Jadual 3: Tahap Kecenderungan Mengikut Skor

Skor min	Tahap kecenderungan min
1-2.33	Rendah
2.34- 3.67	Sederhana
3.68- 5	Tinggi

Sumber: Landell (1997)

Jadual 4: Tahap Kesediaan Pelajar Terhadap Penggunan MOOC

Faktor Kesediaan	Kekerapan	Peratus (%)
Jangkaan Prestasi		
Rendah	30	13.8
Sederhana	56	25.8
Tinggi	131	60.4
Jangkaan Usaha		
Rendah	45	20.7
Sederhana	50	23.1
Tinggi	122	56.2
Pengaruh Sosial		
Rendah	14	6.5
Sederhana	56	25.8
Tinggi	147	67.7
Keadaan Kemudahan		
Rendah	45	20.7
Sederhana	37	17.1
Tinggi	135	62.2

Jadual 4 menunjukkan tahap kesediaan pelajar terhadap penggunaan MOOC. Faktor kesediaan terdiri daripada jangkaan prestasi, jangkaan usaha, pengaruh sosial dan keadaan kemudahan menunjukkan hasil keputusan yang positif. Daripada segi jangkaan prestasi, pelajar-pelajar beranggapan MOOC membantu pelajar dalam pembelajaran, membolehkan tugasan diselesaikan dengan cepat, meningkatkan produktiviti dan meningkatkan pemahaman dalam pembelajaran. Purata keseluruhan menunjukkan tahap kesediaan bagi daripada segi jangkaan prestasi pada tahap yang tinggi iaitu 60.4%.

Merujuk pada jangkaan usaha,tahap kesediaan pelajar adalah tinggi di mana mereka bersetuju bahawa interaksi menggunakan MOOC adalah mudah.Secara puratanya, hasil dapatan menunjukkan jangkaan usaha pada tahap yang tinggi iaitu 56.2%.

Berkenaan pengaruh sosial, majoriti responden merasakan bahawa orang yang mempengaruhi tingkah laku mereka berpendapat bahawa mereka perlu belajar menggunakan MOOC dan merasakan bahawa orang yang penting kepada mereka berpendapat bahawa mereka perlu menggunakan MOOC. Mereka juga bersetuju pensyarah mereka berpendapat bahawa mereka perlu menggunakan MOOC dan juga merasakan pihak politeknik berpendapat bahawa mereka perlu menggunakan pentas pembelajaran MOOC. Purata keseluruhan, pengaruh sosial menunjukkan tahap yang tinggi iaitu 67.7%.

Berkenaan keadaan kemudahan lebih separuh daripada responden bersetuju mereka mempunyai sumber yang mencukupi bagi penggunaan MOOC dan mereka juga bersetuju bahawa mereka mendapat bantuan apabila menghadapi masalah menggunakan MOOC. Secara keseluruhan, keadaan kemudahan menunjukkan tahap yang tinggi iaitu 62.2 %. Ini

disokong dengan kajian Md Yusoff *et.al* (2017), kesediaan pelajar menggunakan MOOC adalah pada tahap yang tinggi.

Jadual 5: Perbezaan Kesediaan Pelajar Terhadap Penggunaan MOOC Mengikut Jantina

Jantina	N	Sisihan Piawai	t	df	Sig.
Lelaki	120	0.08	17.37	215	0.00
Perempuan	97	0.11			

Ujian Kolmogorov Smirnov digunakan untuk menentukan kenormalan data disebabkan bilangan data melebihi 100. Menurut Chua (2006) bahawa jika keputusan Kolmogorov tidak signifikan (sig. > 0.05) maka andaian data bertabur normal ditepati. Ujian kenormalan telah dijalankan terhadap data pembolehubah bersandar iaitu kesediaan pelajar menggunakan MOOC dan pemboleh ubah bebas iaitu jantina. Keputusan ujian normaliti menunjukkan taburan data adalah normal (sig. > 0.05). Ujian univariat *Levene's Test of Equality of Error Variances* bagi semua pembolehubah adalah tidak signifikan (p > 0.05). Dapatan di jadual 5 menunjukkan bahawa terdapat keseragaman varians antara kumpulan. Ujian t sampel bebas telah digunakan bagi menjawab persoalan kajian. Jadual 5 menunjukkan hasil dapatan perbezaan min terhadap kesediaan pelajar dalam penggunaan MOOC antara pelajar lelaki dan perempuan. Hasil kajian menunjukkan terdapat perbezaan yang signifikan antara pelajar lelaki dan perempuan (t=17.37; p< 0.05).

Jadual 6: **Tahap Halangan Pelajar Terhadap Penggunan MOOC**

Halangan	Kekerapan	Peratus (%)
Rendah	95	43.8
Sederhana	98	45.1
Tinggi	24	11.1

Jadual 6 menunjukkan tahap min bagi halangan pelajar terhadap penggunaan MOOC. Hasil dapatan, responden bersetuju halangan pelajar semasa menggunakan MOOC iaitu pada tahap sederhana iaitu sebanyak 45.1%. Dapatan ini disokong oleh kajian Md Yusoff *et al.* (2017) dan menyangkal kajian yang dijalankan oleh Nurul Ain & Razzatul Iza Zurita (2015) menyatakan tahap halangan adalah pada tahap tinggi.

Jadual 7: Hubungan Antara Tahap Kesediaan Dan Halangan Dalam Penggunaan MOOC

Hubungan antara pemboleh ubah	r	Sig.
Halangan- Kesediaan	- 0.37	0.02

Ujian kenormalan terhadap data pembolehubah kesediaan pelajar menggunakan MOOC dan pemboleh ubah halangan. Keputusan ujian normaliti menunjukkan taburan data adalah normal (sig > 0.05). Oleh itu ujian kolerasi Pearson digunakan utuk menjawab persoalan kajian berkaitan perhubungan halangan dan kesediaan menggunakan MOOC. Daripada jadual 7, pekali korelasi bagi pasangan pembolehubah halangan-halangan dalam penggunaan MOOC dan kesediaan menggunakan MOOC adalah rendah memandangkan nilai pekali korelasi -0.37 dan berdasarkan kepada jadual 8, ia menunjukkan anggaran kekuatan perhubungan antara dua pembolehubah adalah rendah.

Jadual 8: *Guildford's Rule of Thumb*

Pekali Kolerasi	Kekuatan Perhubungan
0.00 – 0.20	Boleh diabaikan
0.20 – 0.40	Rendah
0.40 – 0.60	Sederhana
0.60 – 0.80	Tinggi
0.80 – 1.00	Sangat tinggi

Nilai pekali korelasi yang negatif menyatakan bahawa perkaitan atau perhubungan yang wujud antara kedua pembolehubah tersebut merupakan satu hubungan yang negatif. Ini menunjukkan bahawa seseorang yang memiliki jangkaan kesediaan menggunakan MOOC yang tinggi kurang menghadapi halangan ketika menggunakan MOOC dalam sesi pengajaran dan pembelajaran. Hasil kajian menunjukkan terdapatnya satu perkaitan yang signifikan antara pembolehubah halangan-halangan dalam penggunaan MOOC dan jangkaan kesediaan terhadap MOOC yang mencatatkan nilai signifikannya (sig < 0.05) pada ujian korelasi dua arah.

Dapatan kajian menunjukkan pekali korelasi bagi pembolehubah halangan-halangan dalam penggunaan MOOC dan kesediaan pelajar terhadap MOOC adalah rendah yang mencatatkan nilai pekali korelasi sebanyak -0.37. Ini menunjukkan bahawa sekiranya kesediaan pengguna terhadap MOOC adalah tinggi maka halangan-halangan yang dihadapi dalam penggunaan MOOC sebagai platform pembelajaran maya masa kini adalah kurang. Hasil kajian disokong oleh Md Yusoff *et.al* (2017) menyatakan terdapat hubungan kolerasi yang rendah antara kesediaan dan halangan.

Jadual 9: **Tahap Persepsi Pelajar Terhadap Reka Bentuk MOOC *Easy Complex Number***

Reka bentuk MOOC	Kekerapan	Peratus (%)
Rendah	20	9.3
Sederhana	107	49.5
Tinggi	90	41.2

Jadual 9 menunjukkan tahap persepsi pelajar terhadap reka bentuk MOOC *Easy Complex Number.* Majoriti responden (49.5%) bersetuju bahawa reka bentuk MOOC *Easy Complex Number* pada tahap yang sederhana diikuti responden memilih (41.2) % pada tahap tinggi. Justeru reka bentuk dari segi susun atur, pemilihan *font* dan warna serta reka bentuk paparan antara muka perlu ditambahbaik.

Jadual 10: Tahap Persepsi Pelajar Terhadap Kandungan MOOC *Easy Complex Number*

Kandungan MOOC	Kekerapan	Peratus (%)
Rendah	15	6.9
Sederhana	76	35.2
Tinggi	126	57.9

Jadual 10 menunjukkan tahap persepsi pelajar terhadap kandungan MOOC *Easy Complex Number* yang telah dibangunkan. Majoriti respoden bersetuju (57.9%) bahawa kandungan MOOC yang dibangunkan mempunyai ciri- ciri kandungan dan aktiviti yang menarik. Responden juga bersetuju kandungan MOOC adalah menarik dan tidak membosankan. Secara keseluruhan persepsi pelajar terhadap kandungan MOOC *Easy Complex Number* pada tahap yang tinggi. Dapatan ini disokong oleh kajian Adlina *et.al* (2019) yang menyatakan persepsi pelajar terhadap kandungan MOOC yang digunakan adalah pada tahap yang tinggi.

5. KESIMPULAN

Bagi melahirkan graduan yang mampu berdaya saing, inovatif dan kreatif pengajaran dalam bilik kuliah tidak boleh kekal secara konvesional. Daripada dapatan kajian, tahap kesediaan pelajar terhadap penggunaan MOOC *Easy Complex Number* adalah positif dan boleh dikatakan MOOC kini dilihat amat bersesuaian dengan pembelajaran platform secara maya. Dari segi tahap persepsi pelajar terhadap reka bentuk MOOC Easy *Complex Number* adalah sederhana dan perlu ditambahbaik untuk kegunaan masa akan datang dan tahap persepsi pelajar terhadap kandungan MOOC *Easy Complex Number* adalah sangat bagus. Kajian lanjutan mengenai MOOC seharusnya diperbanyakkan lagi kerana MOOC sudah mula digunakan sebagai persekitaran pembelajaran di politeknik.

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KEBERKESANAN PENGGUNAAN APLIKASI GEOGEBRA TERHADAP PENCAPAIAN PELAJAR POLITEKNIK BAGI TOPIK PEMBEZAAN

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Abstrak. Perkembangan sistem pendidikan masa kini amat menitik beratkan pembelajaran abad ke 21 yang berpusatkan pelajar. Pengajaran dan pembelajaran (PdP) matematik melibatkan banyak rumus dan memerlukan pelajar untuk memiliki kebolehan memahami konsep matematik. Aplikasi GeoGebra mampu menvisualisasikan konsep abstrak seperti dalam topik pembezaan amat mengagumkan. Pelajar dapat memahami dengan mudah konsep pembezaan. Dalam kajian ini, penyelidik ingin melihat keberkesanaan penggunaan aplikasi GeoGebra dalam pembelajaran topik pembezaan bagi kursus Matematik Kejuruteraan 2 yang diambil oleh pelajar jurusan Diploma Kejuruteraan semester 2 di Politeknik Sultan Azlan Shah, Behrang, Perak. Seramai 63 orang responden telah terlibat dalam kajian ini. Kajian ini menggunakan pendekatan kuasi eksperimen. Responden telah dibahagikan kepada dua kumpulan rawatan dan kumpulan kawalan. Kumpulan rawatan adalah kumpulan yang diajar menggunakan aplikasi GeoGebra manakala kumpulan kawalan diajar menggunakan kaedah tradisional. Praujian diberikan kepada kedua-dua kumpulan untuk memastikan kesetaraan responden. Selepas itu, kumpulan rawatan akan diajar menggunakan aplikasi GeoGebra. Pascaujian diberikan kepada kedua-dua kumpulan untuk melihat keberkesanan aplikasi GeoGebra berbanding kaedah tradisional. Selepas eksperimen tamat, kumpulan rawatan akan diberikan soalan kaji selidik untuk mendapatkan persepsi pelajar tentang aplikasi GeoGebra yang digunakan. Data kajian dianalisis menggunakan perisian SPSS versi 21. Data yang diperoleh dianalisis menggunakan kaedah analisis inferen dan deskriptif. Hasil kajian mendapati terdapat perbezaan pencapaian yang signifikan antara kumpulan rawatan dan kumpulan kawalan. Di samping itu, responden kumpulan rawatan telah memberikan respon positif terhadap penggunaan aplikasi GeoGebra dalam pembelajaran topik pembezaan.

Kata Kunci: Aplikasi GeoGebra, topik pembezaan, pencapaian

1. PENGENALAN

Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025 kini telah berada dalam gelombang kedua mulai tahun 2016 hingga 2020 dengan memberi penekanan ke atas penambahbaikan sistem dalam pendidikan. Pelancaran PPPM 2013-2025 merupakan matlamat kerajaan pada alaf baru. Melalui transformasi pendidikan ini dengan harapan dapat melahirkan generasi baharu yang utuh dalam pelbagai aspek dan berjaya menggabungkan aplikasi *Information Technology* (IT) dalam PdP (Kementerian Pendidikan Malaysia, 2013; Misrom *et al.*, 2020).

Bagi kebanyakan pelajar, matematik adalah suatu subjek yang dianggap rumit kerana pendekatannya lebih bersifat pemahaman terhadap teori dan rumus yang menerangkan tentang sesuatu dalam dunia sebenar (Arbain & Shukor, 2015; Masri *et al.*, 2016; Spector, 2015). Banyak kajian lepas menyentuh dan mencari kaedah terbaik untuk menyampaikan matematik dalam bentuk-bentuk yang lebih menarik (Aktümen & Yıldız, 2016; Erlina & Zakaria, 2014; Hamid & Ismail, 2014). Hasil daripada kajian lepas menunjukkan penggunaan teknologi seperti perisian atau aplikasi dapat membantu pelajar melihat matematik daripada sudut visual (Aktümen & Yıldız, 2016; Arbain & Shukor, 2015; Ismail & Razib, 2010). Berdasarkan kajian lepas, aplikasi GeoGebra telah diuji dan difahami keberkesanannya dalam pelbagai peringkat pendidikan. (Arbain & Shukor, 2015; Bakar *et al.*, 2010; Erlina & Zakaria, 2014; Lim & Leong, 2016; Shadaan & Leong, 2013). Aplikasi GeoGebra juga berupaya membantu pelajar memahami konsep asas dalam matematik (Zulnaidi & Zamri, 2017). Walaupun banyak kajian telah dijalankan terhadap aplikasi GeoGebra, tetapi penggunaan aplikasi ini masih terhad digunakan dalam kalangan pelajar di Malaysia (Arbain & Shukor, 2015). Sebaliknya di peringkat pengajian tinggi seperti politeknik aplikasi ini lebih kerap digunakan tetapi kurang kajian dijalankan ke atas golongan ini (Hussin *et al.*, 2018). Di samping itu, topik pembezaan jarang diberi perhatian oleh pengkaji. Oleh itu, kajian ini ingin melihat keberkesanan aplikasi GeoGebra dalam pembelajaran topik pembezaan di Politeknik Sultan Azlan Shah dari segi pencapaian dan persepsi pelajar.

Secara umumnya, kajian ini bertujuan menguji keberkesanan penggunaan aplikasi GeoGebra dalam topik pembezaan. Bagi mencapai matlamat tersebut,beberapa objektif telah dibina iaitu:

i. Menentukan perbezaan min skor praujian antara kumpulan rawatan dan kumpulan kawalan
ii. Menentukan perbezaan min skor pascaujian antara kumpulan rawatan dan kumpulan kawalan
iii. Menentukan perbezaan min skor praujian dan pascaujian terhadap kumpulan rawatan
iv. Menentukan perbezaan min skor praujian dan pascaujian terhadap kumpulan kawalan
v. Mengenal pasti persepsi pelajar terhadap penggunaan aplikasi GeoGebra dalam topik pembezaan

Bagi mencapai objektif tersebut,beberapa persoalan kajian telah ditetapkan iaitu:

i. Adakah terdapat perbezaan min skor praujian antara kumpulan rawatan dan kumpulan kawalan?
ii. Adakah terdapat perbezaan min skor pascaujian antara kumpulan rawatan dan kumpulan kawalan?
iii. Adakah terdapat perbezaan min skor praujian dan pascaujian terhadap kumpulan rawatan?
iv. Adakah terdapat perbezaan min skor praujian dan pascaujian terhadap kumpulan kawalan?
v. Apakah persepsi pelajar terhadap penggunaan aplikasi GeoGebra dalam pembelajaran topik pembezaan?

Hasil daripada analisis data akan menentukan sama ada hipotesis nol ditolak atau diterima. Hipotesis-hipotesis untuk kajian ini akan dihubungkaitkan dengan soalan-soalan kajian.

H_{01}: Tidak terdapat perbezaan yang signifikan antara min skor praujian bagi kumpulan rawatan dan kumpulan kawalan

H_{02}: Tidak terdapat perbezaan yang signifikan antara min skor pascaujian bagi kumpulan rawatan dan kumpulan kawalan

H_{03}: Tidak terdapat perbezaan yang signifikan antara min skor praujian dan pascaujian bagi kumpulan rawatan

H_{04}: Tidak terdapat perbezaan yang signifikan antara min skor praujian dan pascaujian bagi kumpulan kawalan

Kajian ini dilaksanakan bertujuan dan berharap bahawa penemuan ini akan membawa manfaat kepada pensyarah dan pelajar yang terlibat terutamanya untuk memajukan mata pelajaran matematik dalam pendidikan Malaysia. Menurut Aktümen dan Yıldız (2016), terdapat banyak penyelidikan sekarang yang menerangkan pelbagai kaedah yang dapat membantu para pelajar untuk belajar dengan lebih berkesan. Kajian lepas telah menunjukkan bahawa menggunakan aplikasi GeoGebra dalm topik pembezaan mampu meningkatkan kefahaman pelajar (Puspita Sari *et al*., 2018) serta meningkatkan kemampuan kemahiran ICT para pensyarah (Masturah & Hajar, 2013). Oleh itu, kefahaman para pelajar dalam mata pelajaran matematik di institusi dapat direalisasikan secara terancang, bersistematik dan menyenangkan. Selain itu, antara rasional lain ialah topik pembezaan merupakan topik penting dalam matematik kejuruteraan. Bagi pelajar jurusan kejuruteraan, adalah sangat mustahak bagi mereka untuk mendapat kefahaman yang jelas daripada peringkat awal.

2. SOROTAN KAJIAN

GeoGebra merupakan singkatan daripada geometri dan algebra (Erlina & Zakaria, 2014; Syahbana, 2016). Hal ini menyebabkan banyak kajian lepas lebih tertumpu kepada bentuk-bentuk geometri dan subtopik dalam algebra berbanding topik-topik lain seperti pembezaan yang jarang diberi perhatian oleh pengkaji. Menyedari kepentingan matematik untuk perkembangan ilmu pengetahuan maka aplikasi ini telah dicipta untuk meningkatkan kemahiran penyelesaian masalah dan menyenangkan pelajar memahami masalah matematik (Hamid & Ismail, 2014; Zakaria & Lee, 2012). Dengan adanya gambar atau pergerakan animasi yang dimiliki oleh Geogebra, pelajar dapat menganalisis sendiri apa yang telah dipelajari dalam kelas (Hamid & Ismail, 2014).

Kebanyakan kajian lepas menyentuh dan mencari kaedah terbaik untuk menyampaikan matematik dalam bentuk-bentuk yang lebih menarik (Aktümen & Yıldız, 2016; Erlina & Zakaria, 2014; Hamid & Ismail, 2014). Hasil daripada kajian lepas menunjukkan penggunaan teknologi seperti perisian atau aplikasi dapat membantu pelajar melihat matematik daripada sudut visual (Aktümen & Yıldız, 2016; Arbain & Shukor, 2015; Ismail & Razib, 2010). Berdasarkan kajian lepas aplikasi GeoGebra telah diuji dan difahami keberkesanannya dalam pelbagai peringkat pendidikan (Arbain & Shukor,2015;Bakar *et al*., 2010; Erlina & Zakaria; 2014; Lim & Leoing; 2016; Shadaan & Leong, 2013). Aplikasi ini juga dapat membantu pelajar memahami konsep asas dalam matematik (Zulnaidi & Zamri, 2017).

Walaupun banyak kajian telah dijalankan terhadap aplikasi GeoGebra tetapi penggunaan aplikasi ini masih terhad digunakan dalam kalangan pelajar di Malaysia (Arbain & Shukor, 2015). Hanya baru-baru ini pada tahun 2020 buku teks baharu telah menggabungkan penggunaan GeoGebra ke dalam bahagian latihan pengukuhan pada akhir topik yang dipelajari (Bakar *et al.*, 2010; Wong *et al.*, 2019). Sebaliknya di peringkat pengajian tinggi seperti politeknik dan sebagainya aplikasi ini lebih kerap digunakan tetapi kurang kajian dijalankan ke atas golongan ini (Hussin *et al.*, 2018). Walau bagaimanapun tidak dinafikan bahawa aplikasi ini sangat berguna sebagai alat untuk membantu tenaga pengajar di Malaysia menyampaikan pengajaran dengan lebih berkesan dan menyeronokkan (Arbain & Shukor, 2015; Wah, 2015). Kerajaan juga menggalakkan penggunaan aplikasi ini bagi memudahkan proses PdP berjalan dengan lancar dan berkesan (Azizul & Din, 2016; Bakar *et al*., 2010; Ming, 2019).

Kajian oleh Puspita Sari *et al*.,(2018) terhadap pelajar Universitas Negeri Jakarta mendapati bahawa aplikasi GeoGebra mampu membantu pelajar menvisualisasikan konsep pembezaan.

Hal ini turut mengukuhkan pemahaman terhadap teori yang dipelajari. Pelajar bukan sahaja diasah berfikir secara algebra tetapi turut berfikir seacara geometri dalam menyelesaikan permasalahan pembezaan.Dengan menggunakan grafik, perubahan akan disedari dengan mudah oleh pelajar (Nellie C. *et al*., 2014). Kajian yang dilakukan oleh Masturah dan Hajar (2013) ke atas pensyarah matematik pula mendapati bahawa penggunaan teknologi ke atas topik pembezaan mampu mengembangkan dan meningkatkan pengetahuan pensyarah tentang aplikasi GeoGebra. Mereka memberikan respon positif bahawa aplikasi GeoGebra membantu dalam memahami hubungan antara pengetahuan konsep dan prosedur. Menurut Shadaan, *et.al* (2013) apabila pelajar menggunakan aplikasi GeoGebra pelajar berasa minat dan bermotivasi untuk belajar matematik.

3. METODOLOGI KAJIAN

Reka bentuk kajian yang dijalankan ini adalah berdasarkan reka bentuk kuasi eksperimen yang melibatkan dua kumpulan iaitu kumpulan rawatan dan kumpulan kawalan. Berdasarkan Jadual 3.1, O_1 dan O_3 merupakan praujian pencapaian matematik topik pembezaan yang diberikan kepada kedua-dua kumpulan sebelum dilakukan intervensi. Praujian ingin melihat tahap pencapaian pelajar dalam topik pembezaan menggunakan kaedah tradisional. O_2 dan O_4 pula merupakan pascaujian pencapaian matematik yang diberikan kepada kedua-dua kumpulan selepas intervensi. Pascaujian ini ingin melihat keberkesanan aplikasi GeoGebra dalam pembelajaran topik pembezaan. Kumpulan rawatan adalah kumpulan yang diajar dengan menggunakan aplikasi GeoGebra merujuk pada X_1 dan kumpulan kawalan adalah kumpulan yang diajar dengan menggunakan kaedah tradisional merujuk pada X_2.. Selepas tempoh eksperimen tamat, kumpulan rawatan akan diberikan satu borang soal selidik berkenaan persepsi mereka terhadap aplikasi GeoGebra dalam pembelajaran topik pembezaan.

Jadual 3.1:Reka bentuk kuasi eksperimen

Kumpulan	Praujian	Kaedah Pengajaran	Pascaujian
Kumpulan rawatan	O_1	X_1	O_2
Kumpulan kawalan	O_3	X_2	O_4

Sampel kajian ini terdiri daripada 63 orang pelajar semester dua jurusan Diploma kejuruteraan di Politeknik Sultan Azlan Shah, Behrang, Perak yang mengambil kursus Matematik Kejuruteraan 2 bagi sesi Dis 2019. Kumpulan rawatan terdiri daripada 31 orang pelajar kelas DKA2B dan kumpulan kawalan terdiri daripada 32 orang pelajar dari kelas DTP 2 . Sampel ini dipilih berdasarkan pensampelan tidak rawak dengan mengambil sampel kelas sedia ada . Lokasi kajian ini dipilih kerana pengkaji menggunakan tempat bekerja sebagai lokasi kajian kerana ia lebih mudah dijalankan dan menjimatkan kos.

Kajian ini menggunakan instrumen ujian dam soal selidik sebagai medium pengumpulan maklumat kerana ia bersesuaian dengan objektif kajian bagi mendapatkan maklumat yang tepat dan lengkap. Bagi instrumen ujian, dua set instrumen yang digunakan adalah praujian dan pascaujian untuk menguji kefahaman kumpulan rawatan dan kumpulan kawalan. Praujian dan pascaujian mengandungi 10 soalan subjektif dengan berjumlahkan markah sebanyak 20 markah yang menguji topik pembezaan. Selain itu, soal selidik digunakan untuk mengetahui persepsi

pelajar terhadap penggunaan aplikasi GeoGebra dalam topik pembezaan. Soal selidik yang digunakan adalah diadaptasi daripada kajian Shadaan dan Leong (2013) yang mengkaji tentang keberkesanan penggunaan aplikasi GeoGebra dalam topik Bulatan. Soal selidik terdiri daripada dua bahagian iaitu demografi responden dan konstruk persepsi pelajar terhadap penggunaan aplikasi Geogebra. Pemboleh ubah ini dinilai berdasarkan lima mata skala likert bermula daripada (1) Sangat Tidak Setuju sehingga kepada (5) Sangat Setuju.

4. ANALISIS DAN KEPUTUSAN

Setiap keputusan kajian dibincangkan mengikut aturan daripada segi bilangan responden, analisis min skor praujian antara kumpulan rawatan dan kumpulan kawalan, analisis min skor pascaujian antara kumpulan rawatan dan kumpulan kawalan, analisis min skor praujian dan pascaujian kumpulan rawatan dan kawalan serta analisis tahap persepsi pelajar terhadap penggunaan aplikasi GeoGebra.

4.1 Responden
Jadual 4.1 menunjukkan bilangan responden mengikut kumpulan. Kumpulan rawatan terdiri daripada 31 (49%) responden dan kumpulan kawalan terdiri daripada 32 (51%) responden.

Jadual 4.1: Bilangan sampel mengikut kumpulan

Bilangan responden	Kumpulan	Kekerapan	Peratus (%)
63	Rawatan	31	49
	Kawalan	32	51

4.2. Analisis min skor praujian antara kumpulan rawatan dan kumpulan kawalan
Jadual 4.2 menunjukkan perbezan min skor praujian bagi kumpulan kawalan dan kumpulan rawatan. Ujian t sampel bebas telah dijalankan untuk membandingkan min skor praujian bagi kumpulan rawatan dan kumpulan kawalan. Hasil keputusan menunjukkan tiada perbezaan yang signifikan antara min skor praujian bagi kumpulan rawatan [M=7.23. SP= 4.72] dan kumpulan kawalan [M=7.19, SP=4.65; t (30) =0.03, p=0.097]. Ini menunjukkan keupayaan pelajar adalah lebih kurang sama sebelum kajian dijalankan.

Jadual 4.2: Perbezaan min skor praujian mengikut kumpulan

Kumpulan	Bilangan	Min	Sisihan Piawai	Nilai t	Signifikan
Rawatan	31	7.23	4.72	0.03	0.097
Kawalan	32	7.19	4.65		

4.3 Analisis min skor pascaujian antara kumpulan rawatan dan kumpulan kawalan
Jadual 4.3 menunjukkan perbezan min skor pascaujian bagi kumpulan kawalan dan kumpulan rawatan. Ujian t sampel bebas telah dijalankan untuk membandingkan min skor pascaujian bagi kumpulan rawatan dan kumpulan kawalan. Hasil keputusan menunjukkan terdapat perbezaan yang signifikan antara min skor pascaujian bagi kumpulan rawatan [M=17.06. SP= 1.75] dan kumpulan kawalan. [M=9.97, SP=3.18; t (31) =11.02, p=0.000]. Ini disokong oleh kajian yang dijalankan oleh Erlina *et al.* (2014) dan Puspita Sari *et al.*(2018) bahawa penggunaan aplikasi

GeoGebra dapat meningkatkan pencapaian prestasi pelajar. Daripada keputusan ini menunjukkan penggunaan apikasi GeoGebra dapat meningkatkan pencapaian prestasi pelajar dalam topik pembezaan dengan min yang tinggi terhadap kumpulan rawatan.

Jadual 4.3: Perbezaan min skor pascaujian mengikut kumpulan

Kumpulan	Bilangan	Min	Sisihan Piawai	Nilai t	Signifikan
Rawatan	31	17.06	1.75	11.02	0.000
Kawalan	32	9.97	3.18		

4.4 Analisis min skor praujian dan pascaujian bagi kumpulan rawatan

Jadual 4.4 menunjukkan perbezan min skor pascaujian bagi kumpulan rawatan. Ujian t berpasangan telah dijalankan untuk melihat perbezaan min skor praujian dan pascaujian bagi kumpulan rawatan. Hasil keputusan menunjukkan terdapat kenaikan min skor praujian [M=7.23 SP= 4.72] dan pascaujian [M=17.06, SP=1.75; t (30) =12.44, p=0.000] bagi kumpulan rawatan.

Jadual 4.4: Perbezaan min skor praujian dan pascaujian bagi kumpuan rawatan

Kumpulan	Ujian	Min	Sisihan Piawai	Nilai t	Signifikan
Rawatan	Praujian	7.23	4.72	-12.44	0.000
	Pascaujian	17.06	1.75		

4.5 Analisis min skor praujian dan pascaujian bagi kumpulan kawalan

Jadual 4.5 menunjukkan perbezan min skor pascaujian bagi kumpulan rawatan. Ujian t berpasangan telah dijalankan untuk melihat perbezaan min skor praujian dan pascaujian bagi kumpulan kawalan. Hasil keputusan menunjukkan terdapat kenaikan min skor praujian [M=7.19 SP= 4.65] dan pascaujian [M=9.97, SP=3.18; t (31) =5.78, p=0.000] bagi kumpulan kawalan. Namun min skor pascaujian menunjukkan min skor yang agak rendah.

Jadual 4.5: Perbezaan min skor praujian dan pascaujian bagi kumpuan kawalan

Kumpulan	Ujian	Min	Sisihan Piawai	Nilai t	Signifikan
Kawalan	Praujian	7.19	4.65	-5.78	0.000
	Pascaujian	9.97	3.18		

4.6 Analisis tahap persepsi pelajar terhadap penggunaan aplikasi GeoGebra

Analisis soal selidik berkaitan persepsi pelajar yang menggunakan aplikasi GeoGebra untuk mengetahui tahap persetujuan responden terhadap persepsi mereka bagi setiap item yang dikemukakan. Jadual 4.6 adalah ringkasan daripada dapatan kajian. Hasil keputusan menunjukkan secara puratanya responden memberi maklumbalas yang sangat positif terhadap penggunaan aplikasi GeoGebra. Ini menyokong kajian yang dijalankan oleh Shadaan, *et al.* (2013) persepsi pelajar menggunakan aplikasi GeoGebra dapat meningkatkan minat dan motivasi untuk belajar matematik.

Jadual 4.6: Hasil soal selidik

No	Item	STS (%)	TS (%)	TP (%)	S (%)	SS (%)
1.	Saya seronok menggunakan aplikasi Geogebra	-	-	2 (6.5)	13 (41.9)	16 (51.6)
2.	Saya banyak belajar menggunakan aplikasi Geogebra	-	-	3 (9.7)	15 (48.4)	13 (41.9)
3.	Saya berasa yakin menggunakan aplikasi GeoGebra ketika melakukan aktiviti	-	-	-	30 (96.8)	1 (3.2)
4.	Saya sangat aktif ketika proses pembelajaran	-	-	6 (19.4)	23 (74.2)	2 (6.5)
5.	Saya dapat banyak manfaat melalui interaksi guru dan pelajar	-	-	2 (6.5	13 (41.9)	16 (51.6)
6.	Saya mampu memberi gambaran dan jawapan pada setiap aktiviti	-	-	6 (19.4)	23 (74.2)	2 (6.5)
7.	Saya dapat berfikir secara kreatif dan kritis dalam perbincangan dan semasa sesi soal jawab	-	-	2 (6.5)	13 (41.9)	16 (51.6)
8.	Saya dapat membuat andaian logik ketika cuba membuat hipotesis	-	-	3 (9.7)	15 (48.4)	13 (41.9)
9.	Saya lebih gemar belajar matematik dengan menggunakan GeoGebra	-	-	3 (9.7)	15 (48.4)	13 (41.9)
10.	Saya dapat membentuk hubungan yang lebih baik antara pembelajaran sebelumnya dan pembelajaran baharu.	-	-	2 (6.5)	13 (41.9)	16 (51.6)

Secara umumnya, didapati penggunaan aplikasi GeoGebra memberi kesan yang lebih baik terhadap pencapaian prestasi pelajar dalam topik pembezaan. Ini dibuktikan dengan pencapaian prestasi yang baik dalam pascaujian dalam kumpulan rawatan. Pelajar juga menunjukkan minat dan motivasi yang positif terhadap pengunaan GeoGebra.

5. KESIMPULAN

Melalui kajian yang telah dijalankan, dapat dirumuskan bahawa penggunaan aplikasi GeoGebra mampu membantu pelajar peningkatkan pencapaian mereka dalam topik pembezaan disamping meningkatkan minat dan motivasi untuk belajar matematik. Pembelajaran matematik

amat penting bagi pelajar terutama dalam bidang kejuruteraan. Penggunaan teknologi amat penting bagi memudahkan pelajar menguasai sesuatu topik yang diajar. Disebabkan kurangnya kajian di Malaysia terhadap pelajar politeknik dalam topik pembezaan, diharap kajian masa hadapan dapat dilakukan terhadap golongan ini. Di samping itu, golongan pensyarah yang terlibat juga boleh diberikan penekanan. Pandangan mereka terhadap aplikasi GeoGebra juga penting agar proses pembelajaran dan pengajaran dapat berlaku dengan berkesan. Selain itu, pengambilan sampel yang lebih ramai mampu untuk meningkatkan tahap kesahan kajian apabila perawakan sepenuhnya dapat dijalankan serta tempoh kajian yang lebih panjang diperlukan bagi melihat keberkesanan aplikasi ini.

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ACTIVE LEARNING IN THE CLASSROOM PROMOTES POSITIVE BEHAVIOR AMONG STUDENTS IN LEARNING MATHEMATICS

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Abstract. The main purpose of the present study is to screen out the influence of active learning approach in order to transform students' passive to active behavior in mathematics class. This is crucial in order to boost up students' interest in learning mathematics, to involve dynamically in activities so they were able to gain knowledge and skill through new learning environment and experiences. The sample consisted of 55 students who were 18 first semester students and 37 third semester students from two departments which are Electrical and Surveyor Engineering in Politeknik Ungku Omar which taking different courses; Engineering Mathematics I and Engineering Mathematics III. Series of active learning activities were planned through 7 weeks of lesson and feedback from interview sessions with students will be used as a supported data for the qualitative study. The active learning approach not only expected to transform their behavior in learning mathematics, but it gives the opportunity for students to refine their positive character and enhance their self-esteem in ensure they become more competent to be in market after graduation.

Keywords: Active learning, qualitative, behavior, participation, interview

1. INTRODUCTION

Mathematics is a subject that often divides people into two groups. There are those who say that they are skilled at mathematics and who loved the mathematics lessons at school and there are those who say that they hated it and "blocked" at the first drop of a symbol (Ernest, 1996; Skemp, 1986). It is common when most of the students feel bored and dislike mathematics without realizing that mathematics is used in daily life decisions. For example, mathematics is used in measuring ingredients for baking and cooking; in planning events and managing financial; in training athletes for sports; and so much more. Moreover, mathematics offers solutions in engineering field such as formulating, estimating, analyzing and solving in wide range of practical problems. Hence, it is crucial for engineering students to well adapt to mathematics role in their future career. Although mathematics seems to be the fundamental in engineering subjects, most students are more enjoying learning engineering subjects compare to mathematics. Basically, students feel mathematics subject is difficult because of the concept in mathematics are abstract and difficult to understand (Haliza Othman et al., 2011). Today's challenge for educators is to seek an alternative ways to create and enhance the excitement in class in order to catch the attention of students in learning mathematics. Changing the way we teach and what we teach in science and mathematics is continuing professional concern. Efforts should be taken now to direct presentation of science and mathematics lessons away from traditional methods to a more students centered approach (Effendi Zakaria, 2006). Parallel with the objective of National Key Result Areas (NKRA's) to improve on student outcomes, active learning approach is potential as a useful tool to promote academic achievement and positive interrelationships. Active learning refers to "experience in which students are thinking about the subject matter" as they interact with instructor and each other (McKeachie,1999, p.44; Gamson,1991). Active learning is described a process in which students engage in "doing things and thinking about what they are doing" in a classroom (Bonwell & Eison, 1991, p.2) and it has a several of techniques such as experiential learning (Kolb, 1984), problem based learning (Miller, 2004),

participative learning (Kolb, 1984), and cooperative learning (Johnson, Johnson & Smith, 1991). In addition, active learning is promising to change students learning behaviors, stimulated their cognitive activity and improved the relationships among them (Haliza Othman et al., 2011).

The main purpose of the present study is to screen out the influence of active learning approach in order to transform students' passive behavior to active behavior in mathematics class. Our research is guided by the question, "How active learning able to increase positive behavior among students in mathematics class?". Since this is a qualitative study, we are focusing on students' response and comment through an open interview approach to scrutinize how possible these class activity able to reshape their behavior and further more to examine whether this process will able to improve their self- esteem and perception on mathematic learning. There are many studies have been conducted relatively to active learning influence on students' performance in various aspects. Michel, Cater and Varela (2009) has conducted an empirical study on active learning versus passive learning and based on quantitative evidence they found out that active learning shows a greater positive influence on students learning compare to passive learning in some contexts. However, benefits of active learning are not automatically earned in a short duration. According to Haliza Othman et al. (2011), after experience two semester of cooperative learning in Engineering Mathematics courses, students began to show some changes in their perception of what they have earned from cooperative learning activities. They are more matured in decision making, give full commitment to the work and comfortable work in group. As both studies were performed on well education background students, we are examining this approach on average education background students and expecting this approach will boost up their interest in not only mathematics subject, but will positively improve their confident level by adapting among other students during activity as well as their communication skill and commitment in work.

2. METHODOLOGY

2.1 Participants

The sample consisted of 55 students who were 18 first semester students and 37 third semester students. All the respondents were obtained from two departments which are Electrical and Surveyor Engineering in Politeknik Ungku Omar. First and third semester students are taking different courses which is Engineering Mathematics I and Engineering Mathematics III. Therefore, there two types of active learning activities will be applied on both groups. Even though there is a seniority gap between both groups, but active learning still considered as new approach for both groups.

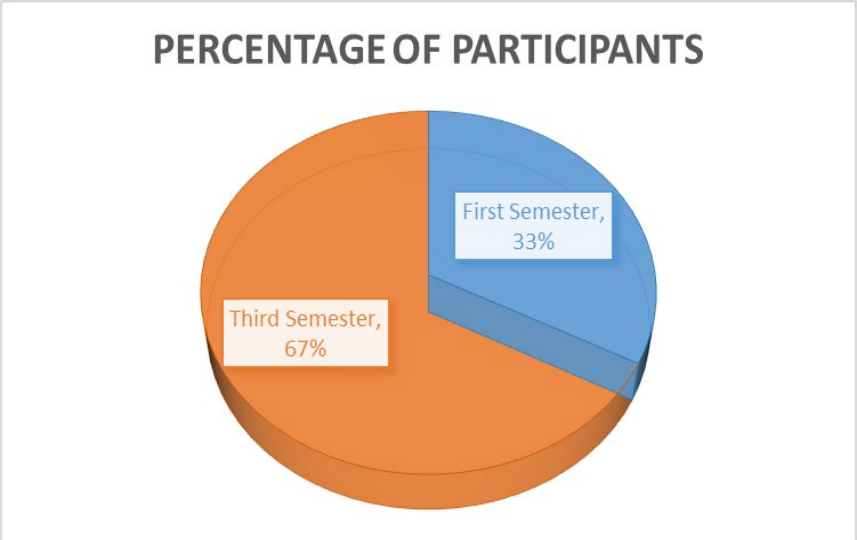


Figure 1: Percentage of respondents

2.2 Instrument

For second week of semester, active learning activity were planned for students and various type of activities were performed to boost up interest and increase their curiosity of what they are going to explore in class. This process is not only cover the subject area, it also will be included a motivational videos for students.

Table 1: Activity Plan for BA301 – Engineering Mathematics III

BA301 - Engineering Mathematics III

Week	Subtopics	Activity
Week 2	Basic Charts	Work in Pair: By referring to notes, students working in pairs to answer final year question as a drill exercise yet the answer will be cross-checked by other pairs in class.
Week 3	Statistical Charts ; Histogram and Ogive	Gallery Walk: Groups were formed in 4-5 students, and there are total of 10 groups. They were given 45min to solve different sets of final year question on subtopics, then to visualize it on majong paper. All groups will display their solution, then groups will do tour to see and understand what group has done in rotation. After tour completed, they will do the entire question in exercise book.
Week 4	Statistical Formula	Watch and Do: This activity is to capture students' focus by using video audio aid. An example video was prepared to show how to use a central tendency formula. The same previous group with the same set of question, they will discuss solution among them.
Week 5	Assessment	Pop Quiz Championship: This activity was to recapture all they have learned in topic 1, where it was performed in group form. Each group was supplied marker and paper, then they solve question in duration of time given by lecturer. The winner group will be rewarded.
Week 6	Trapezoidal and Simpson Rule	Aim and Shoot: This activity was done for topic 2 where students will master their calculator application and get familiar with formulas. 10 new subgroups were formed consist 3-4 persons. 10 final year question were given to each subgroup and they will come out with visual on majong paper on discussed solution. Later, 5subgroups will be merged into 1 side group so there were side A (1-5subgroups) and side B (6-10subgroups). The aimed groups will need to present their solution then they will aim other subgroups on the other side. After all presented, 2subgroups from side A & side B will be voted by students as the best presented group.

Table 2: Activity Plan for BA101 – Engineering Mathematics I
BA101 - Engineering Mathematics I

Week	Subtopics	Activity
Week 2	Basic Algebra	RTD (Revise, Teach, Do): This covers on Simultaneous Eqn, Quadratic Eqn and Simply Algebra. Students were divided into 3 groups and given different sets of question. Each of team members will revise one subtopic and answer selected question. After 20-30min, they will communicate to teach others their part later on everyone will complete all subtopics.
Week 3		Pop Quiz Championship: This activity was to recapture and enhance their cognitive level. Students were divided into 4groups and supplied paper n markers. Simple to high level question were given to them and after certain duration they will display solution and point will be given to correct group.
Week 4		Revise and Drill: Demo video were prepared for students, they will try to solve the exercise as an individual.
Week 5	Standard form, Indices and Log	Gallery Walk: Groups were formed in 3 students, and there are total of 6 groups. They were given 45min to solve different sets of final year question on subtopics, then to visualize it on majong paper. All groups will display their solution, then groups will do tour to see and understand what group has done in rotation. After tour completed, they will do all the question in exercise book.
Week 6	Trigonometry	Work in Pair: By referring to notes, students working in pairs to answer final year question as a drill exercise yet the answer will be cross-checked by other pairs in class.

2.3 Assessment
Since this study is based on a qualitative approach, we are applying observations, open interviews, short videos, and supporting pictures in order to understand students' views and emotions on how active learning in mathematics class able to improve their behavior indirectly to enhance their positive perception in the learning process.

3. RESULTS AND ANALYSIS

As we know, the majority of students enrolled in Politeknik Ungku Omar are within 18-24 years old and most of them are fresh from a high school basis. Based on interviews done on 6 students, all of them claimed in the high school mathematics were taught by using the conventional methods by teachers that teach and exercise methods. These are some methods used in the pedagogy approach as what we called it as the conventional or teacher-centered approach. Due to this method, students have observed became passive

in class, and from the first observation majority of students were only paid attention to the lesson for only half an hour of class before some of them were going out to the restroom, texting on phone, looking out the window and other non-benefit activity. They did not even ask any questions because they have lost interest to learn a lesson during that time. In some cases, carry or repeat students are facing a more challenging time when they feel isolated in class they enrolled in.

These signs are leading to negative behavior in class which can be worse when a student skipping class and failed in the subject. By changing the way, we teach in mathematics class, we able to capture their attention by preparing activities where students can move around and adapting one to another, communicating to each other, writing and referring to notes, debating and asking the question, presenting their work, explaining things they have understood of, competing in short time competition and others. These activities were able to offer new experiences to students in learning mathematics since we are implementing from one-way communication to multi ways of communication during class. In active learning, we are encouraging students to talk and discuss among them in class but correctly to achieve a better understanding of mathematics learning. Nevertheless, active learning is a special tool for us to conquer students heart and interest to come to class because once students feel the excitement of participation in activities, for example, they able to have fun with classmates, able to argue over mathematics solution, competing in quiz championship, and many more they will feel they want for more and they keep wondering what kind of activities they going to do on that next particular lesson. This is a very positive change where lecturer brings the excitement to class and students commit the lecturer. This is a crucial step for the lecturer to build a positive relationship with students by offering them a new perception of learning mathematics in a fun and effective way.

Since students are teenagers and teenagers are obsessing on Information Technology (IT), social networking can be used as one of the active learning tools where all the pictures and teaching videos can be uploaded for their reference and most students feel delightful to see their picture in every activity they involved during the lesson. As the lecturer has prepared all teaching material in video forms, and online notes, these could save the lectures time and students able to do self-learning before attending the class which this ability to train them to be prepared and briefly capture the idea on a topic that will be discovered later in class. The delightful feeling is a way to keep encouraging them not only to attend class but to involve and being part of the learning process itself. Another benefit of the active learning approach is, lecturer, as well as students, may assess their cognitive level on the topic instantaneously. This can be observed during activity, students may interact with each other and some would face concept mislead so the lecturer able to notice who needs the help, and most of the times student appreciate a helping hand from other students during discussion.

Therefore, we able to create a new environment in class where students are voluntarily helping each other by explaining verbally what they understand help them to increase their comprehension of the topic. In some cases, carry or repeat students who enrolled in other classes, active learning has its way to help them to feel comfortable adapting with others and increase their confidence level to idea contribution in group work. Through assimilation and mobility during activity subsequently communicating among them lead to more comfort and relief feeling in them rather they were sitting at a corner in the class, trying to isolate themselves from other students because they feel down and low compare to others probably because of their previous failure. Gradually, they able to function well as a group member in every activity and they initiate themselves to present during the particular activity which triggers a sign that they building up their self-esteem and they believe they are as good as everyone else in the class which this could reshape to positive behavior. These creative activities create possibilities for us to encourage students in exploring knowledge in a fun way to prepare them for becoming adult learners in the future. From the lecturer observation, first-year students like to work as an individual compared to the second-year student which they are comfortable to work in a group. Meanwhile, the study shows that second-year students are more matured in decision making and give full commitment to the work regardless of try

to adapt to the environment unlikely with the first-year students. It seems the first-year students need more guidance and support from the lecturer during activity and they also too cautious in performing discussion in the group at the early stage but as time passed by, they soon comfortable with this practice.

From open interviews' result, students were getting used to the conventional approach since high school led them to be a listener and audience compare to be a learner on subject matters. From a students' view, the conventional approach led them to be lazy or less productive due to there is one communication that happened in the class where students just sit, watch, and jot down in a notebook then do the exercise given. Contradict to conventional learning, they may have culture shock at the beginning of active learning but sooner they were enjoying the process because there was the number of activities applied and those activities helped them to keep the focus on topics as well as offered them a pleasant experience and recognition at the end of the day. By feeding different learning activity experiences over time, students able to record or capture the topic contents in a longer period because they are mainly involved in the learning process. Respondent agrees that active learning able to promote their positive perception towards mathematics since activities helped them to achieve a better understanding by doing it in group or pair work.

Table 1: Observation on activity for BA301 – Engineering Mathematics III

BA301 - Engineering Mathematis III

Week	Subtopics	Activity	Observation
Week 2	Basic Charts	Work in Pair : By referring to notes, students working in pairs to answer final year question as a drill exercise yet the answer will be cross-checked by other pairs in class.	Students were feel average satisfaction on this activity. They feel it is a normal practise for mathematics learning.
Week 3	Statistical Charts ; Histogram and Ogive	Gallery Walk: Groups were formed in 4-5 students, and there are total of 10 groups. They were given 45min to solve different sets of final year question on subtopics, then to visualize it on majong paper. All groups will display their solution, then groups will do tour to see and understand what group has done in rotation. After tour completed, they will do all the question in exercise book.	They were so enjoyed and having fun during activity and they really performed well on question solution on visual display. A lots of discussion occurred among them and informal communication happened among students.
Week 4	Statistical Formula	Watch and Do: This activity is to capture students' focus by using video audio aid. An example video was prepared to show how to use a central tendancy formula . The same previous group with the same set of question, they will discuss solution among them.	Students really paid attention on the video as they were practise on their past year question in group form. Questions asked when they have doubts during process.
Week 5	Assessment	Pop Quiz Championship: This activity was to recapture all they have learned in topic 1, where it was performed in group form. Each group were supplied marker and paper, then they solve question in duration of time given by lecturer. The winner group will be rewarded.	This activity was a great thing to boost up students confidence level when they were competing themselves based on their knowledge on topic in a very short duration of time.
Week 6	Trapezoidal and Simpson Rule	Aim and Shoot: This activity was done for topic 2 where students will master their calculator application and get familiar with formulas. 10 new subgroups were formed consist 3-4 persons. 10 final year question were given to each subgroup and they will come out with visual on majong paper on discussed solution. Later, 5subgroups will be merged into 1 side group so there were side A (1-5subgroups) and side B (6-10subgroups). The aimed groups will need to present their solution then they will aim another subgroups on the other side. After all presented, 2subgroups from side A & side B will be voted by students as the best prensented group.	This had given a good experience for students to work in group and presenting their work and open for Q&A session among class members. There were some groups committed mistakes in their solution but it helped others to be aware of those mistakes in calculation. What matters are they have learn from mistake they did and they able to notice it.

Table 2: Observation on activity for BA101 – Engineering Mathematics I

BA101 - Engineering Mathematis I

Week	Subtopics	Activity	Observation
Week 2	Basic Algebra	RTD (Revise, Teach, Do): This covers on Simulteneous Eqn, Quadratic Eqn and Simply Algebra. Students were divided into 3 groups and given different sets of question. Each of team member will revise one subtopic and answer selected question. After 20-30min, they will communicate to teach others their part later on everyone will complete all subtopics.	At the beginning, students feel quite boring when they need to learn by themselves, but after 30min and they became expert in their part, they really enjoy talking and explaining to others on what they had comprehend of. They also ask many question among themselves regarding subtopics to have a better understanding on what they learn.
Week 3		Pop Quiz Championship: This activity was to recapture and enhance their cognitive level. Students were divided into 4groups and supplied paper n markers. Simple to high level question were given to them and after certain duration they will display solution and point will be given to correct group.	Actively participation by students. Most students are enjoying themselves competing other groups and feel proud when they got the right answer and point. They love to repeat this activity in other chapter.
Week 4	Standard form, Indeces and Log	Revise and Drill: Demo video were prepared for students, they will try to solve the exercise as an individual.	They pleasure to watch solution demo then practise in their past year question.
Week 5		Gallery Walk: Groups were formed in 3 students, and there are total of 6 groups. They were given 45min to solve different sets of final year question on subtopics, then to visualize it on majong paper. All groups will display their solution, then groups will do tour to see and understand what group has done in rotation. After tour completed, they will do all the question in exercise book.	Student really love this activity where they able to work in group and move around touring other works. They able to question and discuss among themselves at the same time cover various solution of past year question.
Week 6	Trigonometry	Work in Pair: By referring to notes, students working in pairs to answer final year question as a drill exercise yet the answer will be cross-checked by other pairs in class.	This activity allows them to focus on small discussion between pairs and encourage them to seek and refer to reference books from library.

However, some recommendations should be noted by lecturers in conducting effective active learning in class. Firstly, we must be able to identify our target group is, for example how many students in a class, which gender dominant in class, how were their educational background, and what type of group we dealing with whether a hyperactive or hyper passive group. This will help us in planning an activity in the next step. In planning activity, we must not drastically implement an aggressive thing in class however we may try work in pairs for the first time just to observe how communication flows during the learning process. It helps us to have better class control by conducting a working pair rather than group work activity. It also helps the students to start adapting to the basic active learning approach.

Steadily, we start introducing to more challenging activities such as jigsaw, gallery walk, or others that need them to move around and do the talking among them in an appropriate control manner guidance so students were able to perform, complete and deliver the learning within timeframe with optimum effectiveness. Also, we must cautiously prepare better various lesson materials to attract their interest such as Ipad technology usage, audiovisual lesson aid, and stationeries to avoid any disturbance during conducting activity in class. At some other time, probably during competitive activity, this may lead to disappointment for a loose group so we must alert how to counter back by sharing motivational video material to them and let them share their thoughts in class. Based on the interview, students love short motivational videos because they feel driven by those videos to improve themselves and this exercise was proven to build their sense of self-development that may lead them to be a passion or self-learner in a long run. Also, feedback after every activity helps us to screen out what kind of activity that portrays their interest in and to assess activity effectiveness

4. CONCLUSION

As this study may be a basic action research study purposely to improve students' behavior in learning mathematics, it was expected to produce the desired result within 7 weeks of class. Based on the result achieved, active learning really capable to transform a boring learning environment into a better, lively, and fun learning process.

This study revealed that active learning is beneficial for the students especially for individual involvement and team dynamics. The active learning approach is not only expected to transform their behavior in learning mathematics but it allows students to refine their positive character and enhance their self-esteem to ensure they become more competent to be in the market after graduation.

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KAJIAN TAHAP KEBOLEHCAPAIAN SUMBER PEMBELAJARAN DIGITAL BAGI PELAKSANAAN PDP NORMA BAHARU DALAM KALANGAN PELAJAR POLITEKNIK

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Abstrak. Penularan jangkitan wabak pandemik COVID-19 yang menggugat rutin pendidikan telah memaksa Institusi Pendidikan Tinggi (IPT) untuk memperkasakan sistem sedia ada dan mengaktifkan mod Pengajaran dan Pembelajaran (PdP) secara dalam talian kepada seluruh IPT di negara ini. Pelbagai sumber pembelajaran digital seperti *Skype, Zoom, Webex, Schoology, Google Classroom, Google Meet, Microsoft Teams, Cidos e-learning* portal dan lain-lain boleh diakses. Jurang kesaksamaan akses kepada sumber pembelajaran digital bagi pelajar tertentu yang tidak mempunyai akses kepada teknologi pastinya akan wujud. Oleh itu, politeknik perlu memperhalusi inisiatif yang akan diambil bagi memantapkan kaedah PdP dalam talian agar semua pihak mampu mendepani cabaran era norma baharu. Pengalaman pembelajaran secara bersemuka yang dipraktikkan sebelum ini telah beralih kepada kaedah pembelajaran digital. Hal ini menyebabkan kemudahan infrastruktur seperti internet akses dan pemilikan komputer bagi setiap pelajar antara rungutan yang kedengaran daripada warga politeknik. Rentetan itu, kajian tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik telah dijalankan. Kajian ini menggunakan statistik deskriptif secara kuantitatif. Data ini dianalisis dengan menggunakan perisian *Statistical Package for Social Science* (SPSS) dan hasil dapatan yang diperolehi menunjukkan purata skor min kajian mencatat nilai yang tinggi. Kajian ini membuktikan tahap kebolehcapaian sumber digital adalah berstatus baik. Dengan kebolehcapaian sumber pembelajaran digital, pelajar berpeluang untuk terlibat secara aktif dalam perbincangan serta aktiviti yang diadakan. Konklusinya, pelajar politeknik yang melalui segala perubahan ini akan sentiasa siapsiaga menghadapi sebarang cabaran dan berupaya mengikuti proses pengajaran dan pembelajaran norma baharu.

Kata kunci: PdP, politeknik, sumber pembelajaran digital, norma baharu.

1. PENGENALAN

Pandemik COVID-19 memberi impak besar kepada pelbagai sektor di Malaysia termasuklah bidang pendidikan. Bidang pendidikan yang merangkumi semua peringkat iaitu peringkat rendah, menengah serta institusi pengajian tinggi juga tidak terlepas daripada menerima tempiasnya. Pandemik ini telah mendorong kerajaan melaksanakan Perintah Kawalan Pergerakan (PKP) (KPM, 2020). Antara pelaksanaannya ialah penutupan semua taska, sekolah kerajaan dan swasta termasuk sekolah harian, berasrama penuh, antarabangsa dan pusat tahfiz, institusi pendidikan rendah, menengah dan pra-universiti serta penutupan semua universiti awam (UA) dan swasta serta institut latihan kemahiran di seluruh negara (Abdullah, A. H, 2020). Menurut Kementerian Kesihatan Malaysia, penularan wabak Coronavirus yang ditemui di China iaitu Novel Coronavirus 2019 (COVID-19) di seluruh dunia boleh menyebabkan jangkitan pada saluran pernafasan yang boleh meragut nyawa. Pertubuhan Kesihatan Sedunia (WHO) mengkategorikan situasi penularan COVID-19 sebagai pandemik kerana ianya merupakan penyakit berjangkit yang merebak melalui populasi manusia dan boleh merebak ke seluruh dunia (Cucinotta, D., & Vanelli, M., 2020). Pandemik COVID-19 ini memberikan kesan yang sangat buruk kepada kesihatan, pendidikan dan ekonomi sehingga mengakibatkan beberapa negara termasuk Malaysia mengambil langkah drastik dan

menjalankan Perintah Kawalan Pergerakan (PKP). Semasa PKP dilaksanakan, rakyat dinasihatkan untuk berada di rumah, bekerja dari rumah (Work From Home), pergerakan di luar rumah dihadkan, memakai pelitup hidung dan mulut, kerap cuci tangan, menjaga penjarakan sosial dan pelbagai langkah pencegahan lain turut diambil berlandaskan saranan Kementerian Kesihatan Malaysia (Shah et al., 2020).

Penutupan institusi pendidikan tinggi dan sekolah yang disebabkan oleh pandemik COVID-19 ini telah memberi impak besar terhadap kaedah Pembelajaran dan Pengajaran (PdP) iaitu daripada kaedah PdP secara bersemuka di institusi kepada PdP secara atas talian atau dikenali sebagai PdPDigital. Mesyuarat Khas menteri-menteri mengenai Pelaksanaan Perintah Kawalan Pergerakan (PKP) Majlis Keselamatan Negara (MKN) pada 16 Mei 2020 telah meluluskan cadangan Kementerian Pengajian Tinggi (KPT) berkenaan pengendalian aktiviti akademik di kampus Institusi Pengajian Tinggi (IPT) semasa dan pasca PKP. KPT menerusi kenyataan media bertarikh 27 Mei 2020 memaklumkan bahawa semua aktiviti PdP hendaklah dilaksanakan secara atas talian sehingga 31 Disember 2020. Semua aktiviti PdP secara bersemuka adalah tidak dibenarkan kecuali beberapa kategori pelajar yang berkeperluan dibenarkan untuk pulang ke kampus secara berperingkat bagi melaksanakan PdP secara bersemuka dengan mematuhi sepenuhnya Prosedur Operasi Standard (SOP) yang ditetapkan dan mengutamakan langkah keselamatan serta penjarakan sosial (mohe.gov.my, 2020). Pelbagai aplikasi atau platform digital yang bersesuaian seperti Whatsapp, Google Classroom, Zoom, Webex, YouTube, Google Meet, Microsoft Teams dan pelbagai aplikasi lain boleh digunakan secara percuma untuk meneruskan aktiviti PdP. Kaedah PdP secara atas talian ini menuntut komitmen dan kerjasama daripada semua pihak terutamanya dari segi pengetahuan dan kemahiran berkaitan teknologi maklumat, penyediaan peranti digital dan akses capaian internet yang berkualiti serta penyediaan kaedah penilaian yang bersesuaian bagi mengukur pencapaian pelajar. Justeru itu, semua pihak sama ada pendidik mahupon pelajar haruslah mempersiapkan diri bagi menghadapi norma baharu iaitu kaedah PdP secara atas talian secara menyeluruh semasa tempoh PKP ini demi kelangsungan proses PdP pelajar (Mohd Salleh, 2020).

2. PERNYATAAN MASALAH

Kementerian Pengajian Tinggi menyedari hakikat bahawa kemudahan sistem pendidikan masih belum berada di tahap yang baik untuk menawarkan pembelajaran dalam talian kepada semua pelajar dalam skala yang besar. Politeknik yang berada di bawah tadbir Kementerian Pengajian Tinggi juga mungkin sedang berdepan dengan masalah yang sama dengan mana-mana institusi pendidikan terutamanya daripada segi kebolehcapaian sumber digital untuk pelajar khususnya. Menggunakan aplikasi dalam talian bukanlah satu perubahan besar bagi kebanyakan pelajar kerana tindak balas pelajar terhadap item berkaitan teknologi menunjukkan bahawa sebahagian besar daripada mereka sudah terbiasa dengan teknologi (Kuh et al., 2004). Walau bagaimanapun, kesediaan dan akses pelajar untuk alat teknologi perlu dipertimbangkan setiap masa. Selain mempunyai akses ke persekitaran pembelajaran secara atas talian, pelajar dan pendidik memerlukan peranti seperti komputer riba, tablet dan telefon pintar dan juga capaian akses yang baik kepada internet yang boleh digunakan untuk mengakses pembelajaran dalam talian (CoSN, 2020). Menjadi tanggungjawab institusi untu memastikan semua pelajar mempunyai peranti yang mencukupi untuk menyokong proses PdP secara atas talian. Sekiranya pihak institusi mengharapkan pelajar untuk menyediakan peranti mereka sendiri, hal ini boleh memberi kesan yang besar kepada pelajar. Kajian ini dibuat untuk menentukan sama ada pelajar di Politeknik Besut Terengganu bersedia untuk menghadapi proses PdP Digital norma baharu atau tidak dan sejauh mana tahap kebolehcapaian terhadap sumber digital sepanjang sesi kuliah berlangsung untuk semester Jun2020.

3. OBJEKTIF KAJIAN

Kajian dijalankan berpandukan beberapa objektif seperti yang berikut:
1) Tahap kesediaan pelajar kepada PdPDigital
2) Tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik.

4. SKOP DAN FOKUS KAJIAN

PdP secara atas talian berupaya mempercepatkan proses pembelajaran dan penyampaian mungkin berlaku dengan lebih efektif. Fokus kajian ini adalah untuk mengenalpasti tahap kesediaan pelajar kepada PdPDigital dan juga tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik memandangkan PdP berlaku secara atas talian di kediaman masing-masing dan pelajar juga tidak kembali ke kampus politeknik sehingga dibenarkan oleh pihak kerajaan. Kajian ini dijalankan ke atas pelajar semester 2 dan semester 3 Politeknik Besut Terengganu yang melaksanakan proses PdP secara atas talian bagi sesi pengajian semasa.

5. SOROTAN KAJIAN

Dalam era digital, penggunaan teknologi maklumat dan komunikasi atau *Information and Communications Technology (ICT)* memberikan peluang kepada pelajar untuk belajar dan mengaplikasi kemahiran-kemahiran yang diperlukan di alaf 21 (Ratheeswari, 2018). Pada masa kini, pelbagai peranti ICT ditawarkan dengan harga yang berpatutan. Dengan adanya telefon pintar, komputer, komputer riba, tablet dan sebagainya yang semakin mudah diakses dan paparan antara muka yang mesra pengguna, ianya dapat menarik pelbagai lapisan masyarakat untuk menggunakan kemudahan ICT. Warga pendidik terutamanya, perlu mempersiapkan diri dan meningkatkan penguasaan dan kemahiran dalam bidang ICT ini supaya kaedah PdP dapat dijalankan secara berkesan dan efektif (Robinson & Kay, 2010). Kemudahan dan fasiliti yang disediakan oleh institusi dan ibu bapa juga memainkan peranan penting untuk memastikan kelestarian PdP secara atas talian ini. Kebanyakan institusi pendidikan mempunyai platform pembelajaran atas talian yang tersendiri yang mudah diakses oleh pelajar institusi masing-masing. Sebagai contoh, CIDOS LMS merupakan platform asas bagi pembelajaran, perbincangan dan penilaian yang disediakan oleh pihak JPPKK khusus untuk kegunaan warga politeknik. CIDOS LMS kini menyediakan BigBlueButton sebagai ruang untuk pensyarah melaksanakan PdP secara atas talian. Aplikasi lain seperti *Google Classroom, Whatsapp, Telegram, Zoom, YouTube, Webex, Google Meet, Microsoft Teams* dan lain-lain juga boleh diakses dan digunakan sebagai medium PdP secara atas talian. PdP digital ini membenarkan pelajar untuk mengulangkaji pelajaran dengan menonton semula video rakaman kelas yang dihadiri dan mendapatkan maklumat daripada buku atau internet bagi memperkukuhkan pengetahuan mereka. Komunikasi dua hala di antara pendidik dan pelajar juga wujud melalui respon yang diterima secara langsung semasa sesi kuliah atau melalui perbincangan di ruangan chat, aplikasi Whatsapp, Telegram, panggilan video atau panggilan telefon (Mohd Salleh, 2020). Penilaian untuk mengukur tahap pencapaian pelajar juga boleh dilaksanakan. Contohnya, pelajar membuat rakaman video untuk membentangkan tugasan yang diberikan secara individu. Markah akan diberikan oleh pendidik berdasarkan rubrik pemarkahan yang telah disediakan. Tugasan juga boleh dihantar melalui medium yang bersesuaian mengikut kehendak pendidik. Soalan-soalan juga boleh dibangunkan menggunakan aplikasi CIDOS, Kahoot, Google Form dan sebagainya untuk melancarkan proses penilaian pelajar dan seterusnya meningkatkan keseronokan PdP secara atas talian sekali gus menghasilkan PdPD yang berkualiti.

Syarikat-syarikat telekomunikasi seperti Maxis, Celcom, Digi, TM dan sebagainya sentiasa menawarkan pelbagai pelan telefon bimbit dan pakej data yang menarik dengan harga yang berpatutan untuk kegunaan individu. Selain itu, syarikat-syarikat korporat juga menawarkan diskaun, pakej menarik serta pemberian peranti secara percuma kepada

pelajar dan guru melalui program tanggungjawab sosial. Walaubagaimanapun, bagi pelajar-pelajar yang berada di kawasan yang tiada liputan internet atau tidak mempunyai kemudahan ICT di rumah, antara alternatif lain yang diambil oleh para pendidik ialah bagi dengan menghantar nota-nota kuliah dan tugasan melalui pos bagi memastikan PdP terus berlangsung. Pelajar juga perlu mencari inisiatif untuk ke pusat-pusat internet atau ke institusi pengajian yang terdekat untuk menggunakan kemudahan ICT. Bagi menghadapi risiko sekiranya tempoh Perintah Kawalan Pergerakan ini berterusan akibat pandemik COVID19, kebanyakan negara telah mengambil langkah seperti menyebarkan peranti untuk meningkatkan akses pelajar untuk menyertai kelas secara atas talian (Wan, 2020). Daripada suatu sudut, penutupan institusi pendidikan dalam tempoh Perintah Kawalan Pergerakan ini akan memberikan kebebasan kepada pelajar untuk meneroka perkara di luar buku nota dan di luar kebiasaan mereka. Secara tidak langsung, perkara ini boleh meningkatkan kemahiran, membina karakter serta memastikan pembelajaran yang menyeluruh tetap berlangsung walaupun pelajar belajar secara atas talian di kediaman masing-masing.

6. METODOLOGI

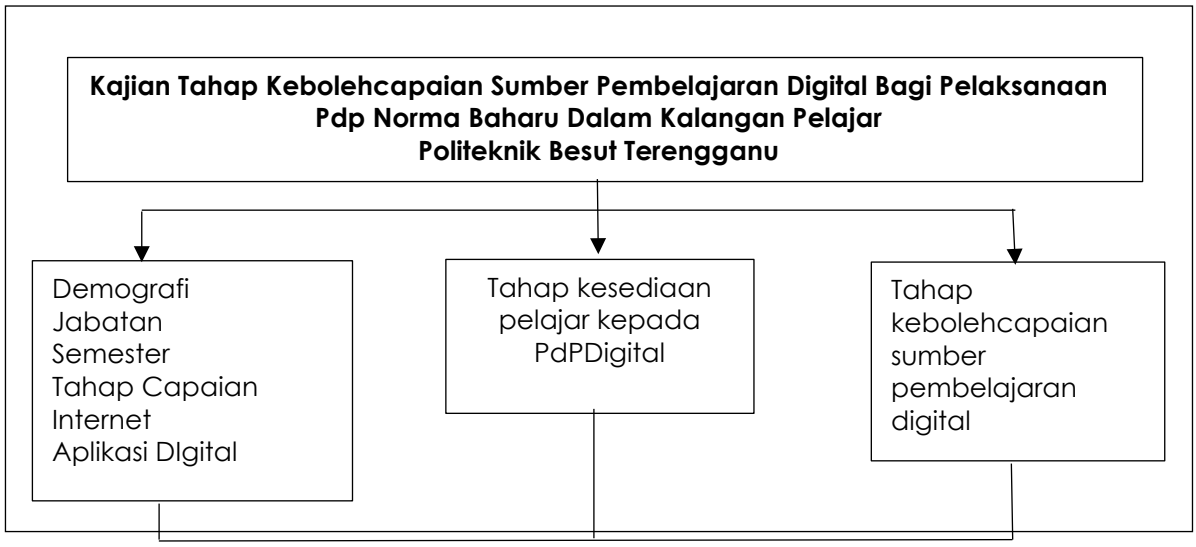
Kajian yang dilakukan ini adalah kajian deskriptif secara kuantitatif di mana soal selidik digunakan bagi memproses data yang diterima untuk menghasilkan rumusan. Soal selidik merupakan alat ukur yang digunakan di dalam penyelidikan pendidikan (K. Mohd Majid, 2005). Manakala menurut Syed Arabi (1992), beliau berpendapat bahawa pemilihan kaedah ini amat sesuai digunakan, praktikal, berkesan dan menjimatkan masa. Populasi kajian ini terdiri daripada pelajar semester 2 dan semester 3 Politeknik Besut Terengganu kerana pelajar-pelajar yang berada pada semester 2 dan 3 ini sedang melaksanakan proses PdP secara atas talian. Pengumpulan data telah dijalankan dan data dikumpul dengan menggunakan *google form* sebagai medium utama. Instrumen yang dijalankan adalah menggunakan soal selidik yang telah diubahsuai dari soalan yang telah dibangunkan oleh Universiti Malaysia Sabah. Borang soal selidik ini mengandungi dua bahagian iaitu Bahagian A (latar belakang) dan Bahagian B (tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar). Ujian kebolehpercayaan (*reliability*) telah dilakukan bagi memastikan dimensi yang diukur mempunyai kebolehpercayaan dan kesahihan yang tinggi. Analisis data dilakukan secara deskriptif dengan menggunakan perisian *Statictical Packaged for Social Science* (SPSS). Analisis kekerapan dan peratusan digunakan untuk menjelaskan demografi responden dan soalan yang melibatkan pilihan jawapan manakala purata skor dan sisihan piawai digunakan untuk mengenalpasti soalan berkaitan tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar.

Dalam menilai tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar, responden diminta memberikan maklumbalas kepada pernyataan yang diberi mengikut skala 1 (sangat tidak setuju) hingga skala 5 (sangat setuju). Skor bagi setiap pembolehubah telah diperolehi. Skor tersebut telah menggunakan formula statistik dan dikategorikan kepada tiga bahagian secara teoretikal iaitu tahap rendah, sederhana dan tinggi seperti yang ditunjukkan dalam Jadual 1. Kajian skor min 1.00 hingga 2.33 menunjukkan tahap skor yang rendah, 2.34 hingga 3.66 menunjukkan tahap sederhana, dan skor min 3.67 hingga 5.00 menunjukkan tahap tinggi (Jamil, 2002).

Jadual 1: Interpretasi Skor Min

Skor Min	Interpretasi Skor Min
1.00 hingga 2.33	Rendah
2.34 hingga 3.66	Sederhana
3.67 hingga 5.00	Tinggi

Rajah 1 menunjukkan rekabentuk kajian yang digunakan bagi mengkaji tahap kesediaan pelajar kepada PdPDigital dan tahap kebolehcapaian sumber pembelajaran digital bagi pelaksanaan PdP norma baharu dalam kalangan pelajar politeknik.



Rajah 1: Rekabentuk Kajian

6. DAPATAN KAJIAN

6.1 Analisis Bahagian A: Data Demografi Responden

Jadual 2 menunjukkan data demografi responden yang mana 100% adalah responden pelajar di bawah Jabatan Teknologi Maklumat dan Komunikasi (JTMK). Responden terdiri daripada pelajar semester 2 iaitu seramai 5 orang bersamaan dengan 13.5% dan pelajar semester 3 seramai 32 orang bersamaan dengan 86.5%. Responden ini dipilih berdasarkan faktor keberadaan pelajar untuk sesi ini adalah di kediaman masing-masing dan bukan di politeknik. Jadual 2 juga menunjukkan taburan kekerapan responden terhadap lokasi keberadaan pelajar sekarang. Data menunjukkan 0% berada di sekitar kampus politeknik. 6 daripada responden atau 16.2% berada di dalam Negeri Terengganu. Selebihnya, data menunjukkan seramai 83.8% atau seramai 31 orang responden berada di luar dari Negeri Terengganu. Pelajar telah mematuhi SOP yang ditetapkan dan kekal berada di kediaman masing-masing dan hasil daripada data yang diperolehi menunjukkan pelajar yang tidak kembali ke kampus ini berada di Terengganu, Kelantan, Pahang, Johor dan Selangor. Tahap capaian internet pula menunjukkan kebanyakan pelajar mempunyai internet akses yang baik iaitu hanya 2 orang responden sahaja yang mempunyai capaian internet 3G dan tahap capaian ini masih membolehkan mereka untuk mengakses internet. Kebanyakan daripada pelajar mempunyai tahap capaian 4G iaitu seramai 24 orang bersamaan dengan 64.9%. Seramai 7 orang responden atau 18.9% menggunakan WiFi dan 4 orang atau 10.8% responden lagi mempunyai talian tetap di kediaman masing-masing. Kekerapan yang diperolehi menunjukkan kesemua pelajar boleh mengkakses internet di kediaman masing-masing. Responden juga telah membuktikan bahawa kuliah pada semester ini telah berjalan dengan lancar dengan menggunakan aplikasi digital yang boleh digunakan secara percuma seperti CIDOS LMS sebanyak 83.8%, Webex 5.4%, Google Meet 97.3% dan Zoom 2.7%. Responden ini terdiri daripada 37 orang pelajar Diploma Teknologi Maklumat (Teknologi Digital) yang berada pada semester 2 dan semester 3 yang mengikuti kelas secara atas talian di Politeknik Besut Terengganu. Responden juga membuktikan mereka telah bersedia untuk mengikuti kuliah secara atas talian kesan daripada pandemik COVID19.

Jadual 2: Profil Demografi

Ciri Demografi		Bil	Peratusan (%)
Jabatan Teknologi Maklumat dan Komunikasi		40	100%
Semester	Semester 2	5	13.5%
	Semester 3	32	86.5%
Lokasi	Sekitar Kampus Politeknik	0	0%
	Negeri Terengganu	6	16.2%
	Luar Negeri Terengganu	31	83.8%
Tahap Capaian Internet	2G	0	0%
	3G	2	5.4%
	4G	24	64.9%
	4G+	0	0%
	WiFi	7	18.9%
	Talian tetap kediaman	4	10.8%
Aplikasi Digital	CIDOS LMS	31	83.8%
	Webex	2	5.4%
	Google Meet	36	97.3%
	Zoom	1	2.7%

6.2 Analisis Bahagian B: Tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik

Dalam langkah analisis data, data yang telah dikumpulkan dianalisis secara statistik. Maklumbalas soal selidik dalam bahagian ini akan menggunakan Skala Pemeringkatan Likert yang mengandungi lima nilai skor seperti yang ditunjukkan di dalam Jadual 3 berikut.

Jadual 3: Skala Pemeringkatan Likert

Tafsiran	Skala
Sangat Tidak Setuju	1
Tidak Setuju	2
Tidak Pasti	3
Setuju	4
Sangat Setuju	5

Analisa kebolehpercayaan telah dilakukan terhadap kesemua item 5 item. Ketekalan dalaman (*internal consistency*) bagi semua item dianggarkan oleh pekali kebolehpercayaan *Cronbach's Alpha*. Nilai *alpha* yang diperolehi adalah melebihi 0.858. Oleh itu, kesemua item yang dikaji dianggap boleh diterima. Dimensi pengukuran terhadap tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik menunjukkan diterima (α=0.858). Tiada batasan kepada nilai kebolehpercayaan sesuatu instrumen kajian, tetapi nilai 0.60 dan ke atas sering digunapakai dalam kajian pendidikan (Mohd Majid, 2005).

Data di dalam Jadual 4 menunjukkan taburan purata skor atau min untuk setiap persoalan di Bahagian B soal selidik responden. Secara keseluruhannya, tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar diinterpretasikan pada tahap tinggi. Untuk soalan 1, min yang diperolehi adalah sebanyak 3.54 dan jika dirujuk kepada Jadual 1, purata skor berada pada kategori tinggi. Ini menunjukkan pengakuan responden menyatakan

bahawa mereka tidak mempunyai masalah untuk mengakses internet bagi tujuan proses PdP secara digital. Pernyataan ini disokong dengan hasil soal selidik yang menunjukkan responden mempunyai tahap capaian internet yang baik iaitu sekurang-kurangnya pelajar mempunyai tahap capaian 3G. Mereka juga mempunyai tahap capaian 4G, WiFi dan talian tetap di kediaman masing-masing seperti Streamyx dan Unifi yang lebih stabil dan boleh melayari internet tanpa gangguan. Responden juga turut menyatakan bahawa mereka boleh memuatnaik dan memuatturun maklumat daripada internet dengan purata skor sebanyak 3.81 iaitu kategori tinggi. Kebanyakan maklumat atau dokumen yang dikongsikan oleh pensyarah kepada pelajar di politeknik adalah melalui aplikasi CIDOS LMS. Melalui CIDOS LMS, sebarang perkongsian dokumen boleh dilaksanakan dengan baik dan pelajar juga tidak ketinggalan untuk menerima perkongsian tersebut kerana semua pelajar sudah mempunyai akaun CIDOS LMS sebaik sahaja mendaftar di politeknik. Semua penilaian berterusan dan tugasan juga boleh diberikan melalui aplikasi ini. Bagi item penilaian 3, min yang diperolehi adalah sebanyak 4.68. Berdasarkan pernyataan ini, pelajar menyatakan bahawa mereka mempunyai peranti seperti komputer dan telefon pintar untuk digunakan sebagai medium kepada proses PdP secara digital. Hasil daripada soal selidik ini mendapati bahawa keseluruhan pelajar mempunyai komputer desktop, komputer riba dan telefon pintar untuk digunakan dan tidak mempunyai kekangan pemilikan peranti. Memandangkan kursus yang ditawarkan di Politeknik Besut Terengganu adalah Diploma Teknologi Maklumat (Teknologi Digital), kebanyakan pelajar sudah mempunyai peranti sendiri sejak semester pertama. Namun, untuk item seterusnya menunjukkan segelintir pelajar menghadapi kekangan kewangan untuk mendapatkan capaian internet dengan purata skor 3.27. Hal ini tidak boleh dinafikan dan langkah-langkah alternatif perlu diambil bagi membantu mereka. Item terakhir pula membuktikan tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar berada pada tahap yang baik apabila kuliah telah berjaya dilaksanakan kerana kebanyakan pelajar tinggal di kawasan yang mempunyai liputan internet yang baik dan boleh mengikuti semua kuliah yang dilaksanakan oleh politeknik dengan purata skor 3.70.

Jadual 4: Tahap kebolehcapaian sumber pembelajaran digital dalam kalangan pelajar

Bil	Item	Purata Skor	Sisihan Piawai	Interpretasi Min
1	Saya tidak menghadapi sebarang masalah untuk mengakses internet bagi tujuan proses PdP secara digital	3.54	0.931	Tinggi
2	Saya boleh muatnaik dan muatturun sebarang maklumat berkaitan PdP daripada internet.	3.81	0.877	Tinggi
3	Saya mempunyai peranti seperti komputer dan telefon pintar untuk digunakan sebagai medium kepada proses PdP secara digital	4.68	0.669	Tinggi
4	Saya tidak menghadapi masalah kewangan untuk mendapatkan capaian internet	3.27	1.146	Tinggi
5	Saya tinggal di kawasan yang mempunyai liputan internet yang baik dan boleh mengikuti semua kuliah yang dilaksanakan oleh politeknik	3.70	0.968	Tinggi

7. KESIMPULAN

Persediaan untuk menukarkan kaedah pendidikan bersifat tradisional sebagai tindak balas terhadap COVID19 memerlukan pemikiran, koordinasi dan keputusan yang dibuat dengan sangat teliti. Kuliah terpaksa ditangguhkan dalam tempoh yang agak lama manakala pensyarah diminta untuk melaksanakan proses PdP secara atas talian sepenuhnya. Oleh itu, disarankan agar institusi perlu menyediakan kemudahan ICT asas seperti komputer dan internet akses berkelajuan tinggi untuk melancarkan PdP secara atas talian dengan lebih

berkesan, memastikan pendidik mempunyai akses ke aplikasi dan platform pembelajaran digital, kesediaan pendidik dan pelajar perlu difahami dan disokong dengan sewajarnya dan tahap kebolehcapaian sumber pembelajaran digital bagi melaksanakan pdp norma baharu dalam kalangan pelajar politeknik sentiasa dipastikan berada pada tahap yang baik.

Kepatuhan kepada SOP rentetan daripada pandemik COVID-19 telah menimbulkan cabaran yang hebat kepada semua. Pembelajaran secara atas talian bukan hanya melibatkan masalah teknikal. Ia juga memberikan cabaran kepada pendidik dari segi pedagogi dan instruksional. Oleh itu, persediaan terperinci untuk bahan pengajaran dan kurikulum perlu dilakukan dan pengetahuan tentang penilaian adalah sangat penting. Tindakan melaksanakan PdP secara atas talian di peringkat pengajian tinggi adalah transformasi pedagogi yang memerlukan komitmen dan kesanggupan daripada seluruh warga pendidik dan pelajar. Revolusi digital ini dapat mensinergikan cita-cita sistem pendidikan untuk menerapkan unsur digital bagi mendatangkan impak yang lebih positif kerana umum mengetahui minat pelajar terhadap aplikasi digital. Pada hakikatnya, COVID-19 telah memberi peluang untuk menggunakan pembelajaran secara atas talian dalam skala yang besar dan tempoh yang panjang kerana sistem pendidikan sebenarnya antara teraju utama yang perlu mengikuti perkembangan teknologi, sehingga membudayakan pembelajaran secara atas talian sebagai satu satu norma baharu di peringkat pengajian tinggi bukan hanya di Malaysia tetapi juga seluruh dunia.

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STUDENTS' SATISFACTION WITH THE ONLINE ZAKAT SYSTEM IN POLITEKNIK SULTAN AZLAN SHAH

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Abstract. In line with the desire of the Malaysia Polytechnic to transform PSAS into the smart campus, several system were developed towards achieving the dreams. The online zakat system also being one of the effort parallel with that requirement. The objective of this study was to examine students' satisfaction with the online zakat system in Politeknik Sultan Azlan Shah (PSAS). Therefore, it is appropriate to review the measures of information system component of online zakat system towards the students' satisfaction. This study used quantitative method using self-structured questionnaire. There were 142 students who were applied for zakat fund by using the online zakat system involved in the questionnaire survey. Data was analysed using descriptive and inferential statistics. This study indicated that system quality ($\beta = 0.362$) and technological factor ($\beta = 0.070$) and were significantly ($P < 0.05$, 0.01 and 0.001) influenced students' satisfaction of the online zakat system. Both information quality ($\beta = 0.245$) and service quality ($\beta = 0.021$) were insignificantly influence the students' satisfaction. The study recommends the need for the institution to maintain the implementation of the system quality, improve the technological infrastructure and enhance the IT policy in order to ensure the efficient management on online zakat system by the zakat committee. Besides, the higher level management of PSAS could also see the need to provide large scale investment in developing the information system to maximize students' satisfaction.

Keywords: Information quality, system quality, service quality, technological factor, user satisfaction.

1. INTRODUCTION

In a speech by Director General of Malaysia Polytechnic, Ts Dr Muhammad Naim b Yaakub during the New Year ceremony held at Ungku Omar Polytechnic on 21st January 2020 announced that Politeknik Sultan Azlan Shah (PSAS) has been listed in FOUR (4) campuses that need to be upgraded as Smart Campus (Muhammad Naim Yaakub, 2020). It is one of the 10 flagships in the Twelfth Malaysia Plan that need to be achieved. This aim is in line with the Twelfth Malaysia Plan which starts from 2021 until 2025. As the Technical and Vocational Education and Training (TVET), PSAS needs to move together with the development plan of the Twelfth Malaysia Plan to produce students who are competitive and balanced with the needs of the industry.

One of the effort parallel with the requirement is the development of online zakat system. The online zakat application system was designed by the Zakat Community in Politeknik Sultan Azlan Shah (PSAS) since year 2015. The system was designed to provide the online services, specifically to Muslim students in the campus. The system operations include the online application zakat (input), processing the application (process), view the result of the application status and the statistic of recipient data (output). By looking to the increasing numbers of online zakat application system, there was an essential for PSAS to measure the students' satisfaction. The success of the online zakat system could be measured through a

feedback from students. Students' satisfaction on the online zakat system could provide an indication for stakeholders to justify their investment in enhancing the system developed.

User satisfaction is the important area in the Information System (IS) research. The researcher normally discussed on the importance of understanding the feedback from the user or consumer. This is described as the fulfilment of the need, that something will be effective if it satisfies the expectation of the user. According to Mkoba and Marnewick (2016), satisfaction can be defined as the judgement from the consumers of the product or services provided by an entity. The level of satisfaction from the consumers will describe the fulfilment of their pleasurable level. Besides, most organizations agreed that the information systems must meet the customer's need and this become the important expect for measuring their performance (Mkoba & Marnewick, 2016). This statement is support by Dalle et al., (2020) that the information systems also represent as the sources of information and data for the decision-making process which contributed to the realisation of short-term and long-term organizational goals.

Amongst the researcher in information system (IS) area, one of the commonly cited is the Delone and McLean model (Nwone, 2014). The revolution of DeLone and McLean IS success model (DeLone & McLean, 2003) was started from the earlier model of DeLone and McLean (DeLone & McLean, 1992). This model provides the IS success factors which quality components regarding the system, information, service, use, user satisfaction, and net benefit. As an enhancement from the Delone and McLean model, Nwone (2014) was determined that the technological factor also became another component in the IS successfulness. The finding from this research established that technological factor may significantly delivered to the IS success in the viewpoint of the user satisfaction. Accordingly, the finding from Nwone (2014) was lead to the improvement of the Delone and McLean model.

This study was conducted by adapting the three main IS quality components (system, information and service) proposed by McLean and Deleon (DeLone & McLean, 1992; DeLone & McLean, 2003), and complemented with suggestions by Nwone (2014) to include the quality of technological component in evaluating the students' satisfaction. Therefore, the objective of this study is to investigate the influence of the stated IS quality components towards the students' satisfaction on the online zakat system in PSAS.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This section discussed all variables used in reaching the research objectives.

2.1 Delone and Mclean IS Model

The DeLone and McLean models were found to be the appropriate framework for realizing IS's success. The model has been widely used by IS researchers for understanding and measuring IS success. Figure 1 below presents the updated DeLone and McLean IS Success Model.

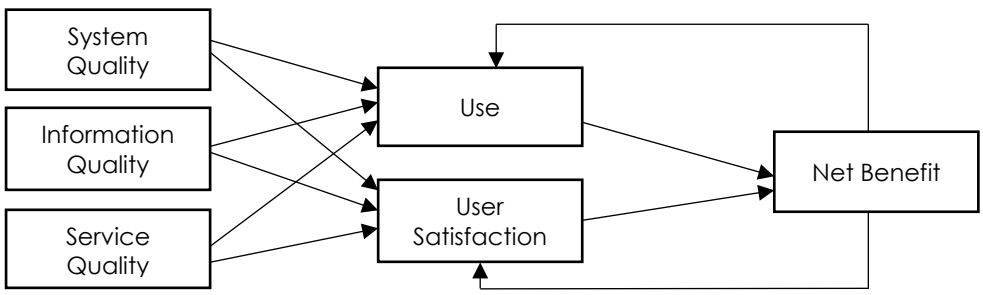


Figure 2: DeLone and McLean IS Success Model (DeLone & McLean, 2003)

The components of DeLone and McLean (DeLone & McLean, 2003) model are described in Table 1 below:

Table 1: Components of DeLone and McLean

Component	Characteristics	Example
System	The system quality.	Simplicity, reliable system, flexible and ease to use, and quick response times.
Information	The information outputs quality.	Understandable, relevance, accurate, complete, timeliness, and usable.
Service	The support service personnel quality.	Quick response, accurate, reliable, competence (technical aspect).
Use	The degree of staff and user utilize the information system capabilities.	Frequency of use, nature of use, appropriateness of use, extent and purpose of use.
Net Benefit	The system value for users or to the entire organizations.	Nil
User satisfaction	User's level of satisfaction	Nil

Source: Adapted from DeLone & McLean (2003)

2.2 System Quality and User Satisfaction

The research by Dalle et al. (2020) evaluated that the functionality of a management support in IS was primarily measured by the system quality, and it was been found to be significantly related to user satisfaction. This statement was agreed by Livari (2005) who determined that there was strong association between system quality and user satisfaction. These findings are further strengthened through the studies by Hussein (2009) and Kulkarni et al. (2007) discovered that the knowledge management systems in system quality was also found to be strongly related to user satisfaction. Other study on the web sites system quality which measured the reliability and download time, also found to be significantly relation towards the user satisfaction (Petter et al., 2008). Nevertheless, Mkoba and Marnewick (2016) examined further strengthens the argument that the strong relationship between system quality and user satisfaction could also discover by using a variety of measurement.

2.3 Information Quality and User Satisfaction

The association between information quality and user satisfaction were found by many literature (Yel & Anugrah, 2020; Gozali & Supranto, 2020; Wu & Wang, 2006; Livari, 2005). Several findings also evaluated the consistent relationship between quality information aspect and user satisfaction at the individual unit of analysis (Benbasat & Barki, 2007; Chiu et al., 2007). Previous researcher was determined that the information quality construct of Web sites, such as layout, interface, view and content had found significantly associated with the user satisfaction (Palmer, 2002). However, there was a finding by Marble (2003) that did not find any significant relationship between measures of information quality and user satisfaction in two organizational IS examined by him. Those different results discussed above were showed that difference users could provide variety of fulfilment level.

2.4 Service quality and User Satisfaction

Previous research by Gozali and Supranto (2020) found that the technical performance of the IS developers was directly positive associated to user satisfaction. This finding was supported by Hidayatullah et al. (2020) who studied on the IS success during the Pandemic of Covid-19 was discovered a similar result, that the developer skill had a significant effect on user satisfaction of expert systems. However, the studied by Seliana et al. (2020) argued that the staff experience did not found any significant relationship towards user satisfaction of e-learning. By looking to this trend of research, it could be concluded that the researchers who were evaluated the service quality by examining the features of the support personnel; also examining the relationship between personnel characteristics and user satisfaction had produced different results. Until now, most researchers (Angelina et al., 2019; Leclercq, 2007)

supported the associations between the IS components which to be found that the quality of support and services had provided an impact on user satisfaction.

2.5 Technological Factor and User Satisfaction
The definition of technological or information technology (IT) infrastructure in an organization could be explained as the shared information services delivery base that is constructed around information technologies. This IT infrastructure must developed as a specific unit which have knowledge such as skills and experience Abuzyarova et al. (2019). In other word, the technological factor can be recognized as the IS abilities refer to the availability of the IS resources and infrastructure within an organization. Technology shows that organizational nature tends to influence how information systems are developed and used (Youssef & Meriouhb, 2015). The use of technology may require various ways for system development and to develop a system capable of performing the desired process. Recent research shows that modern enterprises preferred to outsource information systems to achieve timely goals and within organizational budgets (Nwankpa & Roumani, 2014; Lee & Yu, 2012).

2.6 Based on discussion above, the research hypotheses were developed as below:

- *$H0_1$: There is no significant relationship between system quality and students' satisfaction of online zakat system.*
- *$H0_2$: There is no significant relationship between the information quality and students' satisfaction of online zakat system.*
- *$H0_3$: There is no significant relationship between the service quality and students' satisfaction of online zakat system.*
- *$H0_4$: There is no significant relationship between technical and infrastructural factors and students' satisfaction of online zakat system.*

3. METHODOLOGY

A descriptive survey was used to examine the online zakat system user' satisfaction, among the students in Politeknik Sultan Azlan Shah (PSAS). The population of this study comprises from by the students from all academic department in PSAS who applied zakat through online zakat system. A self-structured questionnaire using the information system's constructs by DeLone and McLean (DeLone & McLean, 2003) were adapted from previous researchers. This study used survey method as data collecting tool. The response was collected via Google form survey tool and 142 applicants fulfilled the survey. The data gathered were analyzed by using descriptive and inferential statistics.

4. RESULTS AND DISCUSSION

4.1 Demographic Result
By referring Table 2, it shows the respondent's demographic characteristics. The table presents that males were accounted for (29.6%) of the respondents, while (70.4%) were females. Respondents from Civil Department accounted for the highest percentage (41.5%), followed by those from Commerce Department (31.7%). Those from Mechanical Engineering were (17.6%), while those from Electrical Engineering Department accounted for (9.2%). There were (16.2%) of the respondents used the system for ">2 times", (46.5%) for "2nd times" and (37.3%) for the "1st time". The table shows that (77.5%) respondents gathered the information about zakat application advertisement form academic advisor, (11.3%) were both from the "PSAS website" and "Others" respectively.

The analysis of this study was conducted by using Statistical Package for the Social Sciences (SPSS). The Cronbach's Alfa coefficient was used to examine the reliability of the survey. Next, the factor analyse has been applied to the items to reveal significant and valid factors. The multiple regression analyse was conducted in order to examine the effect between independent variables toward dependent variable. Cronbach's alpha coefficient is used for reliability analyse. The determination of the reliability could be determined by the coefficient

alpha. Coefficient alpha in the interval of 0.00≤a<0.40 is considered as not reliable, 0.40≤a<0.60 indicates low level of reliable. If, the interval of 0.60≤a<0.80 is considered accepted as fairly reliable and 0.80≤a<1.00 is highly reliable (Cortina, 1993). This study found that, the Cronbach's alpha coefficient is 0.931, therefore it is accepted as highly reliable.

Table 2: Demographic Characteristics of the Respondents

Variable	Measurement	Frequency	Percent
Gender	Male	42	59.6
	Female	100	70.4
Department	Mechanical Engineering	25	17.6
	Civil Engineering	59	41.5
	Electrical Engineering	13	9.2
	Commerce	45	31.7
No. of used	1st Time	53	37.3
	2nd Times	66	46.5
	>2 Times	23	16.2
Information Source	PSAS Website	16	11.3
	Academic Advisor	110	77.5
	Others	16	11.3

4.2 Descriptive Analysis and Factor Loadings

The summary in Table 3 presents the principal component extracted variables that explains students' satisfaction, factor loadings, corresponding mean and standard deviation. A Kaiser-Meyer-Olkin (KMO) test by Kaiser (1974) was used in this research. This test could determine the sampling adequacy of data that are to be used for Factor Analysis. Factor Analysis used to ensure that the variables measure a particular concept are measuring the concept intended. The statistic computed in a measure of 0 to 1 (Kaiser, 1974). The results show that KMO values (0.936) was found between 0.8 and 1, indicated that the sampling is adequate for the analysis.

In the *system quality* segment, "The information displayed is easy for you to understand" presents the highest mean score (4.42) and the standard deviation (0.656) as compared to other factors within the group. "The desired attachment is easy to upload" show a mean of (4.30) with a standard deviation of (0.734). "The information required is easy to complete" present a mean of (4.39) with a deviation from the mean (0.683). "Graphics, colours and layouts of the system appeal to you" indicate the least mean and the least deviation from the mean (4.26).

Under the information quality section, "The terms placed in the system are easy for you to understand and comply with" show the highest mean score (4.39) with a standard deviation of (0.617), while "The information is known and the online system address is easily obtained by you" present mean (4.28) and the standard deviation (0.698). "The information presented is in clear and understandable way" determine the mean by (4.30) and the standard deviation (0.593). "The steps that need to be implemented in the system are easy for you to understand" present the mean score (4.36) together with the standard deviation (0.623). "Approval of whether an application is accepted or rejected is quickly notified to you" show the least mean (4.15) and highest standard deviation (0.718).

Table 3: Descriptive Analysis of Components Extraction and Factor Loadings

Component	Mean	Std. Dev	F1	F2
System Quality				
Graphics, colours and layouts of the system appeal to you.	4.26	0.592	0.803	0.133
The information displayed is easy for you to understand.	4.42	0.656	0.780	0.454
The information required is easy to complete.	4.39	0.683	0.746	0.456
The desired attachment is easy to upload.	4.30	0.734	0.800	0.069
Information Quality				
The information is known and the online system address is easily obtained by you.	4.28	0.698	0.856	0.102
The steps that need to be implemented in the system are easy for you to understand.	4.36	0.623	0.830	0.082
The terms placed in the system are easy for you to understand and comply with.	4.39	0.617	0.838	0.236
Approval of whether an application is accepted or rejected is quickly notified to you.	4.15	0.718	0.808	-0.124
The information presented is in clear and understandable way.	4.30	0.593	0.860	0.076
Service Quality				
The support staff can easily be contacted by you to ask questions.	4.18	0.687	0.805	-0.329
The support staff are technically competent (competence).	4.20	0.690	0.815	-0.433
The support staff are very reliable (reliability).	4.25	0.632	0.842	-0.384
The information of the support staff is easily obtained and displayed in the system for your convenience.	4.23	0.638	0.895	-0.174
Technological/ infrastructural Factor				
The system has sufficient internet facilities around PSAS.	4.13	0.697	0.772	-0.390
This system can be accessed via your mobile phone.	4.06	0.966	0.688	-0.088
Students' Satisfaction				
I am satisfied with the online system quality compared to manual system.	4.33	0.692	0.757	0.260
I am satisfied with the overall system quality of online zakat system.	4.47	0.615	0.778	0.113

In the *service quality* section, "The support staff can easily be contacted by you to ask questions" show the least mean score (4.18) and present a deviation from the mean (0.632). "The support staff are technically competent (competence)" discover a mean score of (4.20) and standard deviation (0.690). "The support staff are very reliable (reliability)" show a highest mean score of (4.25) and standard deviation (0.632), while "The information of the support

staff is easily obtained and displayed in the system for your convenience" present the least mean score (4.23) and also standard deviation (0.638).

On the other hand, i*n technological factor* segment, "This system can be accessed via your mobile phone" show the mean score (4.06) and the standard deviation (0.966) and "The system has sufficient internet facilities around PSAS" indicate the mean (4.13) with a standard deviation of (0.697). Under the user satisfaction section, "I am satisfied with the online system quality compared to manual system" present the highest mean score (4.33) with the highest standard deviation (0.692), while "I am satisfied with the overall system quality of online zakat system." show the same mean score of (4.47) and a deviation from the mean (0.615).

4.3 Test of Hypotheses

The result in Table 4 shows the result of the relationship between IS constructs and user satisfaction on the online zakat system. The table presents that a positive correlation ($\beta = 0.362$, $t = 3.520$) [$F(8,223) = 60.16$], between system quality and student satisfaction. The table shows that this construct has the highest 't' value, this implies that system quality has more impact on students' satisfaction than other measures. At $p<0.001$, we reject the null hypothesis, and conclude that system quality significantly influences students' satisfaction of online zakat system.

The findings determined that there was unrelated result ($\beta = 0.245$, $t= 1.830$) [$F(8,223) = 60.16$], $p = .069$ between information quality and students' satisfaction. Therefore, the information quality of online zakat system is insignificant predictor of students' satisfaction of the information system web portal. Since, $p<0.05$, we accept the null hypothesis.

By referring to Table 4, the interaction between service quality and users satisfaction show insignificant result with $p = .833$. This finding indicate that service quality insignificantly influences the students' satisfaction of online zakat system.

The interaction between technological and infrastructural factors and students' satisfaction show significant result with $p = .001$. At $p<0.001$, therefore, the result indicate to reject the null hypothesis and state that technological and infrastructural factors has a positive association with the students' satisfaction of online zakat system (see Table 4).

Table 4: Regression Analysis

Dependent Variable: Students' Satisfaction	Beta (β)	t	Sig
Independent Variable:			
System Quality	.362	3.520	.001***
Information Quality	.245	1.830	.069
Service Quality	-.021	-.211	.833
Technological Factor	.286	3.301	.001***

*** Extremely Significant at 0.001 ** Very Significant at 0.01 * Significant at 0.05

Figure 2 presents the significant association between system quality and technological factor towards students' satisfaction on the online zakat system.

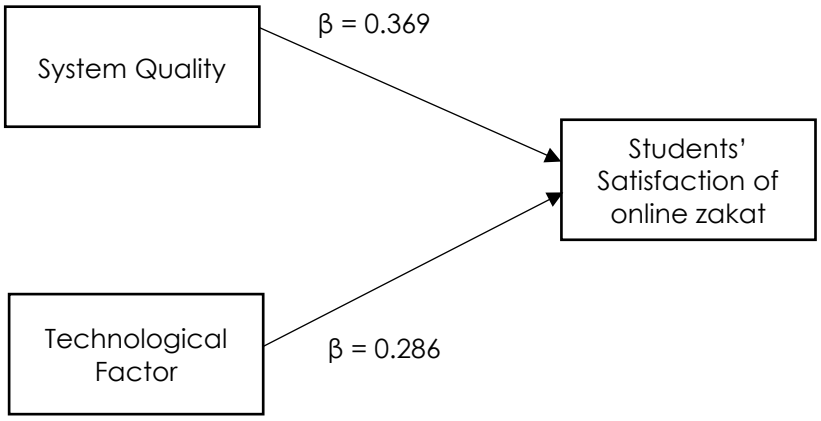


Figure 2: The result of information system measures on students' satisfaction of online zakat

4.4 Discussion

4.4.1 System Quality and Students' Satisfaction

The result from this study, clearly determined that the good System Quality could lead to a higher users satisfaction of the system. This study conclude that the students will use the zakat online system more if it is easy to complete the online zakat application form and easy to upload the desired attachment. It is also discovered that, most of the students found the zakat online system is system easy to use and the graphics, colors and layouts are found appeal to them.

4.4.2 Information Quality and Students' Satisfaction

This study found that the Information Quality was insignificantly related with the students' satisfaction. The result indicates that, the information presented in the online zakat system is in clear and understandable way. However, this construct was not effect student's satisfaction.

4.4.3 Service Quality and Students' Satisfaction

The result indicates that service quality is to be insignificantly effect in measuring students' satisfaction of online zakat system. Service quality is measured in terms of the online zakat application system performance in response to the student's complaint and issues arising from system abnormalities problems. This indicates that the responsiveness of support staff goes a long way in addressing difficulties encountered by students. In addition, this show that the zakat system support staff must ready with the technical skill and competence addressing the complexities regarding the system problems and issues.

4.4.4 Technological Factor and Students' Satisfaction

The result from this study discovered the significant effect of technological issues on students' satisfaction of online zakat system. The study found that, the technological factor (internet access) has sufficient internet facilities around PSAS and the system easily can be accessed via mobile phone and personal computer. These factors were lead to the students' satisfaction on the zakat online system.

5. RECOMMENDATION AND CONCLUSION

The successfulness of the zakat online system is only judged by the students' assessment on the online zakat system. The system quality and technological factor of online zakat system is significantly affecting the students' satisfaction. Since these two constructs are the main determinants of student's satisfaction on the online zakat system, therefore, the investment in improving the quality of the system should be seen as a requirement. Politeknik Sultan Azlan Shah should implement and enforce IT policies that will ensure efficient management of IS. The findings of this study can be a signal on the need for institutions to increase efficiency in

maintaining and improving the online zakat system in a timely manner. In addition, the improvement of the online zakat system and also other online system in the campus can provide the students with the benefits, besides the aspirations of PSAS to become a smart campus can be achieved.

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A STUDY OF DATA DISSEMINATION IN OPPORTUNISTIC NETWORK: PUBLISH/SUBSCRIBE APPROACH vs EPIDEMIC APPROACH

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Abstract. Opportunistic Network is a sort of correspondence innovation that works on quick changes in the network topology. The primary test in the Opportunistic Network is to recognize the best way to convey information to the destination. There are no proper ways that exist among source and destination. The communication between nodes is discontinuous and can cause a high data drop. In this circumstance, the flooding approach will be the ideal of data dissemination. However, it produces more resources and data overhead. As a solution, a few researchers had proposed efficient forwarding techniques on data dissemination, for example, history-based routing, social-based routing, probabilistic-based routing, and context-based routing. Each of these routings has its constraint. All previously mentioned directing classifications require an active node to push data with the goal that a legitimate choice can develop to deliver an efficient routing mechanism. In this paper, had proposed the Publish/Subscribe approach as a way of disseminating information in an opportunistic network. To monitor the spread of data, enforce the comparison attribute in this approach. Therefore, by introducing this attribute during the exchanging of data, the overhead and transmission latency of the data can be reduced while preserving the delivery time. This approach contains a crucial push element which may be more efficient in information dissemination selection in the opportunistic network. The Epidemic approach used as the benchmark to compare with the Publish/Subscribe approach for this study. As a result, the Publish/Subscribe approach performs better than the Epidemic approach in a particular situation with minimizing the data overhead and delivery delay while maintaining the data delivery.

Keywords: Opportunistic Network, Publish/Subscribe, Epidemic

1. INTRODUCTION

The improvement of computing hardware has presented another arrangement of smart hand-held gadgets, for example, a smartphone. Smartphone innovation had been utilized as one of the essential components in the communication platform. These gadgets can legitimately speak with one another utilizing remote innovation as a communication standard. Communication includes, for example, sharing, trading, and distributing data straightforwardly between smartphones become simpler, and this is probably going to improve utilizing advancements, for example, opportunistic networks. An Opportunistic Network is a not fixed infrastructure P2P network which the connection not completed between the source and destination. In a particular situation that the connection is inaccessible at present, the source node conveys the data until the next communication platform is built up. With the concept of store-carry-forward, it is the suitable ways to build up the connection between the source and destination. Each node plays a role as an interconnected node. Their task is to help establish the connection between the source and destination node.

Since opportunistic networks are not fixed infrastructure, the communication exists spontaneous and short live connectivity. Here, the challenging issue will be the forwarding information from source to destination. So, Flooding approach is the practical solution to disseminate the information (Huang, Lan, & Tsai, 2008; Lenando et al., 2016). In any case, this approach produces information duplication and expends plenty of resources. Withdrawing

from here, more analysts are examining approaches to find an efficient method to forward data in an opportunistic network. History-based routing, Social-based routing, Probabilistic based routing, and Context-based routing had been successfully developed and implemented into the opportunistic network on data dissemination. However, each of these routings has its constraints. For history-based routing, create high information overhead at data stores. In social-based routing, when constructing a distant social relationship, it delivered a delivery delay due to the time taken. In probabilistic-based routing, due to storing probability table, which comprises of the history of encounters, more memory space is required. Same as context-based routing, which to store user intrigued data, more memory space is required.

In common, all previously mentioned to create an efficient routing mechanism it depends on the nodes actively push the data in the opportunistic network environment. However, two problem statements were identified; (1) without a proper forwarding mechanism, it may cause into a data overhead, (2) without a proper information selection mechanism, it may cause more time taken on data delivery, and increases of data drop brings high delivery delay for the information reach to the destination. This study chooses to consider the Publish/Subscribe (PS) approach because it can further utilize a vital push element for efficient data dissemination in an opportunistic network. To the finest of our information, no distributed work examines particularly exploiting Publish/Subscribe approach within the Opportunistic Network.

2. LITERATURE REVIEW

Epidemic based routing protocol is an improvement of flooding technique (Vahdat & Becker, 2000). This scheme has the fastest dissemination if only contention and transfer time ignored. Compare to Flooding technique which focusing on flooding the data to any nodes, and Epidemic technique forwards the information to all known neighbours via information exchange index called a summary vector (Wang et al., 2015). Summary vector works to avoid sending the same information to the same nodes. Its contains information seen by the sender. When both nodes connected directly, each of them will exchange their summary vector, then, each of them can determine the information has not previously seen (Guan & Wu, 2019). This guide a node to request information from another. To implement the epidemic technique, besides source ID and destination ID store in a message, it is also provided with a unique ID. The purpose of using the unique ID is to determine either the message has been seen before or not. However, the weakness of this routing, it replicates all the messages contained in a node received from other nodes that come into interaction along its path. With this, it creates more overhead on a nodes buffers space but provides a high delivery probability. In this research, Epidemic approach used as the benchmark in this study. This routing also used to compare with the proposed data dissemination technique, Publish/Subscribe approach.

The History-based routing protocol (HiBOp) is a context-based routing protocol that uses the context information held by the node to identify the route that is ideally suited to transmit the message successfully in the shortest time(Mota et al., 2014). HiBOp exploits context information to any nodes that never been in the same group (Boldrini et al.,2007). HiBOp describes two tables: Table Identification and Table History. To manipulate the social patterns and relationships between nodes, HiBop remembers the present context and the historical context of each node. It then determines the probabilities of the contact based on the similarities with the background knowledge of the destination and chooses the best forwarders. HiBop only requires the sender to make several copies of messages to manage their message reproduction. Some nodes do not hold backups of the communications forwarded. However, the weaknesses of this routing, more memory space required on each node due to storing both current and historical context information.

(Yoneki et al., 2007) proposed an algorithm of Socio-Aware Overlay based on Publish/Subscribe communication in the opportunistic network. In this overlay, a node with high values of centrality been chosen as the broker node to keep up the next message delivery rate. This overlay assumes a community structure based on a nodes classification in an opportunistic network (Ciobanu & Dobre, 2012). The essential kind of node is from a comparative arrange which has a high number of contacts of long/stable duration. Another sort of node is known as a recognizable stranger and contains a high number of contacts with the current node, but the contact terms are short. There are likewise stranger nodes, where the contact duration is short, and the number of contacts is low, lastly companion nodes, with scarcely any contacts, yet high contact terms. To create an overlay for publish/subscribe frameworks, community discovery is acted in a decentralized way, since opportunistic networks don't have settled a structure. To recognize its local community, a node interacts with experiencing devices and executes the discovery calculation. The discovery calculation occurs in the information exchange stage of the collaboration between node. Every node achieves the content ID by keeping up data about the experienced nodes and contact duration, and the local community recognized up until now. At the point when two nodes completed exchanging information, every node securing the familiar setting and local community data. By following the algorithm, each node updated its local community and familiar set values. When the encountering among nodes increased, might alter the state of the local community. However, the weaknesses of this technique are causing a high delay due to the time taken to build a community overlay before can disseminate the information effectively.

CAR is a context-based routing protocol which this technique uses user information to disseminate to any potential node in the proximity area (Guan & Wu, 2019; Musolesi & Mascolo, 2009). Types of user information will be exploited to the network such as their address, location and preferences. A sender filter a potential node which has the highest probability of delivering the message in its inside cloud before reach to destination nodes that are outside the cloud. Nodes in CAR provide conveyance probabilistic proactively and scatter them within the ad hoc cloud which makes the contacts exploited to evaluate probabilities as it were for the destinations that every node knows about (Boldrini et al.,2007). Both CAR and HiBOP routing have a similarity concept of disseminating the information by using the user information. However, both of these routings delivered the same weaknesses, which requires a memory space to store information and states of other encountered nodes. It is crucial for a node to update and to recalculate the potential of its neighbours when forwarding information to other nodes.

3. METHODOLOGY

In this section, design a Publish/Subscribe approach framework and its algorithm to adapt to the opportunistic networks environment. Implement the comparison attribute applied in Publish/Subscribe approach will help in managing during the data forwarding session. Comparison attribute function as acceptance or ignoring information receive by referring their local information of interest. Here, each node will be listing their local information of interest. Take into a situation where a node can publish data at any time once encountering a nearby node. During this session, all nodes proactively forward data that carry with them when any neighbour node located in a proximity area. Nodes advertise data via Publish technique. Once the data received by the neighbour node, then it compares with its local list of interest. If there's a similarity of interest, then solely it'll Subscribe and store it in its native database. Here, can avoid the replication of data which causes a data overhead. Figure 1 shows the basic framework of the Publish/Subscribe approach and follows with the comparison attribute.

Based on Figure 1, a node publishes information whenever it encounters nearby nodes in a proximity area. Then, a potential forwarder may subscribe to the information. This potential forwarder is acting as an intermediate node that store, carry and forward the information successfully reach the destination. However, before the potential forwarder subscribes the

data, as initial must undergo the comparison session. During this session, the data compared with supported interest. As an example, node A has an interest in Film and Fashion, and node B has an interest in Film and Book. Node A publishes its data to node B, then node B makes a data interest comparison. Since node B has an equivalent interest of Film with node A, it then subscribes and updates the receiving data on its database.

In Figure 2, explaining the information exchange flow between users ranging from the connection establishment until disconnected. Each node plays both roles as a Publisher and Subscriber at an identical time. This node can produce, carry, and forward information. When two nodes encounter at a particular time, both users connected through Bluetooth technology (1). Then, user A start to publishes information to user B (2). Next step, user B received and make a comparison with its local list of interest information (3). User B will choose whether accepting or denying the receiving information (4). Let say the user B agree to accept the data, it then updates its local interest list (5). Next, subscribes to the information (6) until both users have no data exchange involves, then they decided to disconnect from the network (7). This process will keep continuing until it meets the potential destination node.

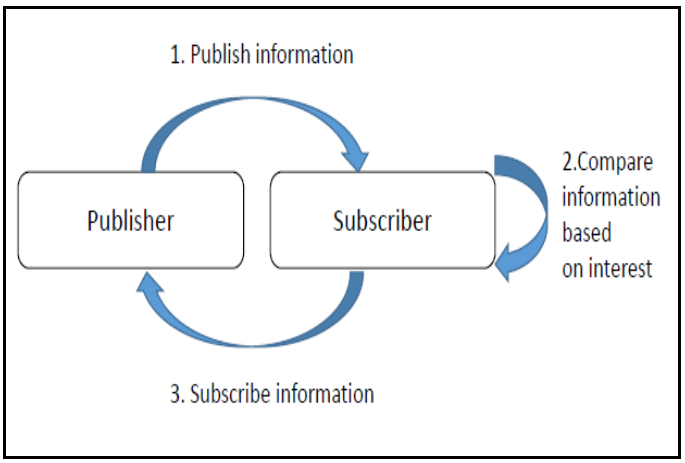


Figure 1: **Basic idea of Publish/Subscribe approach**

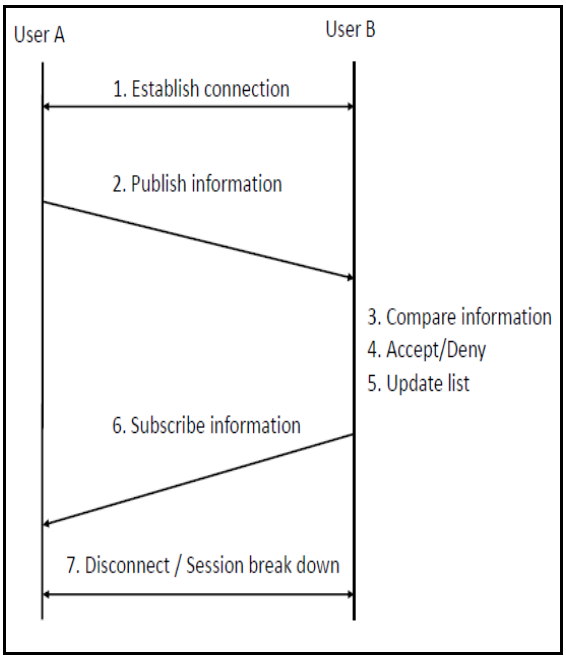


Figure 2: Information exchange flow between users

Algorithm 1 shows the Publish/Subscribe approach algorithm on forwarding the information in the opportunistic network. Implementation of the comparison attribute also explained in this algorithm.

Algorithm 1: Publish/Subscribe approach

Input : Publisher P of message PID_m, Subscriber S of message SID_m,
Output : Subscriber S updated SID_U
IF PID_m has information to advertise **THEN**
    PID_m publish to SID_m
    IF (interest (PID_m = SID_m)) **THEN**
        SID_m subscribe the information
        SID_U
    ELSE
        SID_m rejects the information
    END IF
END IF

3.1 Key Performance Indicator
Three key performance indicators to evaluate our Publish/Subscribe algorithm performance used in this research:

a) Data overhead = $\frac{R-D}{D}$, R is a number of information relay and D is a number of information that been sent out.

b) Data delivery = $\frac{D}{G}$, D is a total number of successful information delivered to destination and G is the total number of information that been sent out.

c) Delivery delay = $\sum_{i=1}^{n}\left(\frac{R_i-G_i}{n}\right)$, n is a number of messages delivered to the destination, R_i is the time when a message *i* reaches to its destination and G_i is the time when a message *i* is created.

3.2 Experiment setup
In this experiment, to analyze and generate the performance result, the ONE simulator (Keränen, A., 2009) is used. ONE simulator had used by many researchers in evaluating data dissemination in the opportunistic network (Prabha et al., 2016; Sharma et al., 2018). Table 1 shows the simulation parameters used in this experiment to evaluate the performance.

In this experiment, 5MB buffer has been set for the forwarding algorithms on Publish/Subscribe approach to permit a quantity of information exchange between nodes distributed equally. Message event generator is ready every 25 to 35 seconds, that varied from 500Kb to 1Mb. The situation conducted in 1000 seconds, with 20 nodes. Node density is the total number of nodes within the network. Since nodes are concerned within the interaction, the more nodes within the network, the faster the data disseminated. This situation is going to evaluate with a random walk as a mobility model in two areas of region size. Those

experiments aim to evaluate the Publish/Subscribe approach relates to data dissemination performances on minimizing the information overhead and delivery, whereas maintaining the delivery time.

Table 1: Simulation parameters

Simulation parameter	Values
Region area (meter2)	100 x 100, 200 X 200
Message size	500kb
Transfer rate	2 Mbps
Communication range	10 meters
Communication interface	Bluetooth
Number of nodes	20
Group	Pedestrian
Node speed	0.5 (min), 1.5 (max)
Mobility Model	Random Walk
Buffer size	5Mb
Total Simulation Time	1000seconds

4. ANALYSIS AND RESULTS

4.1 Performance result of Data Overhead

Based on Figures 3 and 4 shows that the Publish/Subscribe approach performs lower information overhead compare to Epidemic approach with 260.46 and 104.93, respectively, in both area regions (refer in Table 2). The reason is the information isn't directly held on in its database (buffer size). Data can solely be store once the node accepts the info supported its interest information as for Epidemic, the conception of flooding the info causes the high data overheads. In Epidemic approach, more replication of info occurred.

Table 2: Data overhead performance for Publish/Subscribe approach and Epidemic approach

Area Region	Routing	Nodes Density	Mean	Standard Error	Standard Deviation	Data Overhead
100x100	Epidemic	20	24.53	3.64	12.08	269.79
	Publish/Subscribe	20	23.68	3.40	11.26	260.46
200x200	Epidemic	20	9.64	1.77	5.86	106.03
	Publish/Subscribe	20	9.54	1.74	5.78	104.93

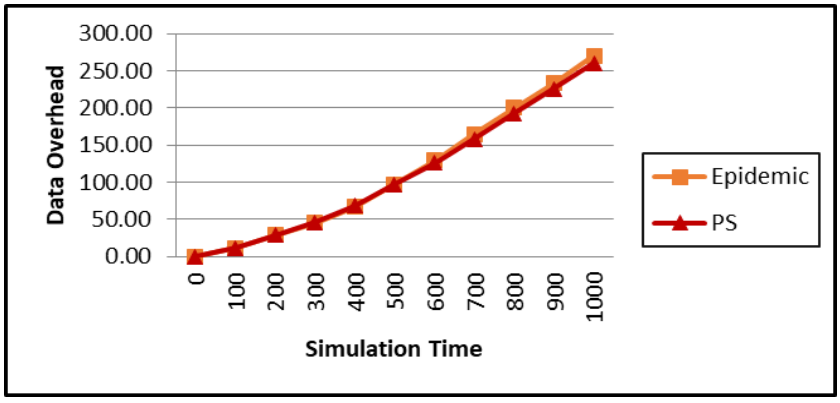


Figure 3: PS and Epidemic data overhead performance in area region 100 x 100 m²

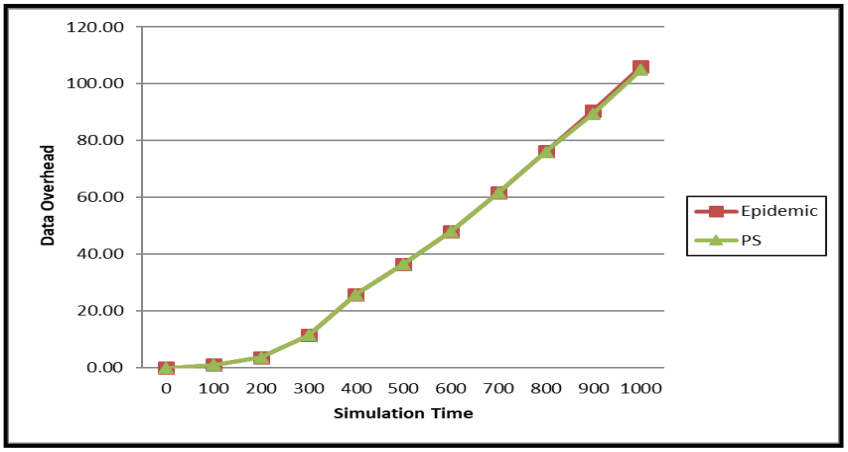


Figure 4: PS and Epidemic data overhead performance in area region 200 x 200 m²

4.2 Performance result of Data Delivery

Based on Figures 5 and 6, the Publish/Subscribe approach performs higher delivery time compare to the Epidemic approach with 6.30 and 4.61, respectively, in both area regions (refer in Table 3). The reason is the Publish/Subscribe approach encounters a potential node that has the same interest of information in a short time. It may lead the potential node to disseminate the information to reach the destination node quicker. Compare to the Epidemic approach, it sends messages to all possible encounter nodes which slower the information delivery due to the duplication happen during the information exchange process.

Table 3: Data Delivery performance for Publish/Subscribe approach and Epidemic approach

Area Region	Routing	Nodes Density	Mean	Standard Error	Standard Deviation	Data Delivery
100x100	Epidemic	20	0.60	0.02	0.16	5.93
	Publish/Subscribe	20	0.64	0.02	0.17	6.30
200x200	Epidemic	20	0.42	0.019	0.14	4.58
	Publish/Subscribe	20	0.43	0.020	0.14	4.61

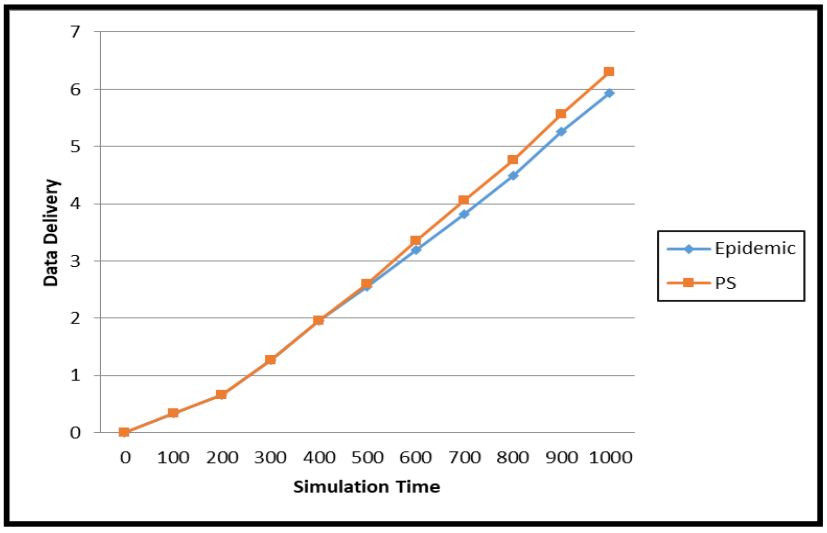


Figure 5: PS and Epidemic delivery time performance in area region 100 x 100 m²

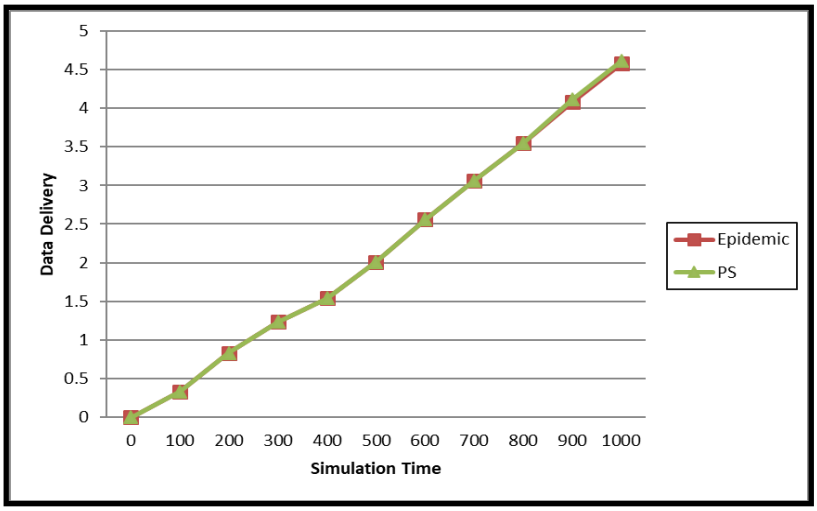


Figure 6: PS and Epidemic delivery time performance in area region 200 x 200 m²

4.3 Performance result of Delivery Delay

In Figure 7, the Publish/Subscribe approach performs lower delivery delay compare to the Epidemic approach. Here, the reduction of information drop throughout the data exchanges decreases when more nodes involve within communication range. This lead to little hop counts to reach its destination. The issue on the Epidemic, though it is spreading the data to all or any potential nodes, it causes duplication data. That's the reason for data to reach its destination slightly slow because of the long relay.

Table 4: Delivery delay performance for Publish/Subscribe approach and Epidemic approach

Area Region	Routing	Nodes Density	Mean	Standard Error	Standard Deviation	Delivery Delay
100x100	Epidemic	20	87.46	17.20	57.06	962.06
	Publish/Subscribe	20	79.13	14.69	48.71	870.43
200x200	Epidemic	20	108.39	27.27	90.44	1192.25
	Publish/Subscribe	20	111.92	28.83	95.63	1231.13

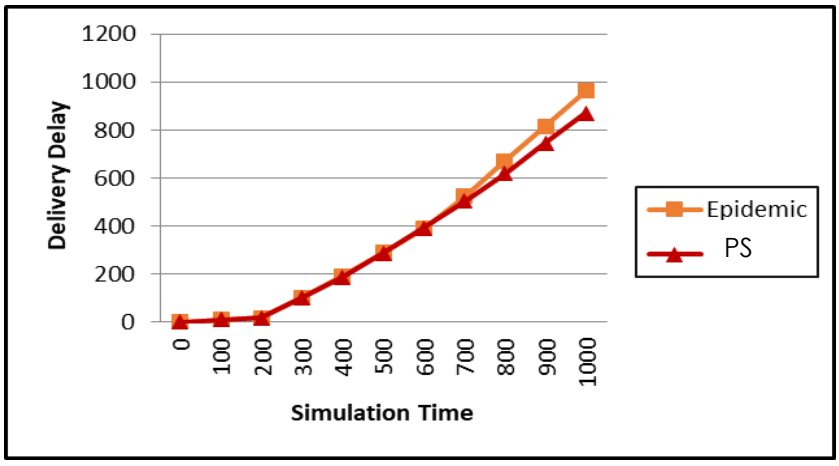


Figure 7: PS and Epidemic delivery delay performance in area region 100 x 100 m²

However, in Figure 8, Epidemic performs better delivery delay as compared to Publish/Subscribe because it fully utilizes the resources by flooding the information to the network with the high possibility that the information reaches the destination in a short time.

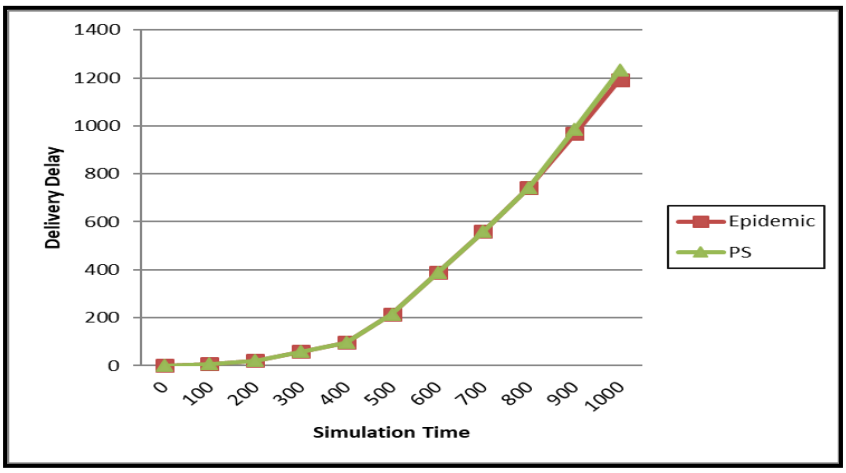


Figure 8: PS and Epidemic delivery delay performance in area region 200 x 200 m²

5. CONCLUSION

This research aims to evaluate the proposed idea of the Publish/Subscribe approach in terms of its performance based on data dissemination. Evaluation for the PS approach predicated on information overhead, delivery time, and delivery delay. The expectation with the planned algorithmic rule can accomplish efficient data dissemination is another various method of spreading data. At the tip of this analysis, overall performance the PS approach produces a shorten time taken to deliver the information and able to reduce the data overhead and delivery delay except it performs higher delivery delay when the area of the region increased. However, there is an improvement of result when implemented the comparison attribute in disseminating the information. Its helps in reducing the replication of information which avoid increases in data overhead and delivery delay. For the future work, evaluate the Publish/Subscribe approach performance with various buffer sizes and multi-protocol management scheme.

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THE DEVELOPMENT OF MEASUREMENT SUPER SMART NOTES MOBILE APP USING INTEGRATED ONLINE AND OFFLINE FEATURES

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Abstract. Measurement Super Smart Notes is a mobile application that contains compact and simple notes, with formulas and examples, also interactive exercise using Socrative and feedback features using Google Forms for students feedback. This mobile application is prepared to help students memorize important facts about fundamental measurement basics instantly and easily. This mobile application was developed using Adobe Creative Cloud Animate CC Platform Android software that has online and offline features based on the 5-phase ADDIE teaching design model which is the analysis phase, design phase, development phase, implementation phase, and evaluation phase. A stand-alone user version of the application .APK (Android application package) will be created that can be installed on any phone with an Android application. The development of this mobile application has been successfully developed and conceivably implemented in teaching and learning for Measurement Courses. To get more information about the implementation of the Measurement Super Smart Notes mobile app, the study will extend to look at the impact of m-learning on students' academic achievement. Also as a future study, an interactive quiz also will be implement via real time application platform such as Kahoot or Quiz-Bot application to enhance the variety of exercises in Measurement Super Smart Notes.

Key Word: Measurement Mobile Apps, ADDIE Model, Android, online, offline.

1. INTRODUCTION

Industrial Revolution 4.0 indicates the current Electrical Engineering syllabus in Polytechnic Malaysia enforced the implementation of Outcome-Based Learning (OBE) in the teaching and learning process where non-face-to-face hours increase. A traditional teaching and learning method alone is not pertinent anymore and mobile learning has emerged as a current well-established methodology of modern education (Park, 2011). Mobile Learning (m-learning) refers to any kind of independent learning which takes place over and above the traditional learning environment in terms of time and place via wireless mobile devices (Abu-Al-Aish, 2014). Through m-learning methods, the learning process is no longer bound to a classroom activity but is more moveable, any time, any place, and on-demand (Rajala et al., 2008).

2. LITERATURE REVIEW

M-learning is now facilitated by the availability of mobile technology enables the exchange of ideas and information, interactions, and the sharing and accessing of learning materials among teachers and students (Norliza A.Rahim, 2013). There are empirical study findings shown m-learning implementation encourages students to focus on learning and in turn improve student academic performance as studies by Atan & Shahbodin (2018), Far, Hossain, Nurunnabi, Hussain, & Swapan Kumar Saha (2019), and Klimova (2019). Contrary to studies by Hossain (2019) shown negative effects on learning achievements depending on attitude and

mobile phone usage. Consequently, the implementation of m-learning has been well planning and must consider the students' demands and how it's was implemented.

But engineering educator faces a problem where students face difficulty learning electrical subject because the theories, concepts, and calculation in the subject content are abstract that involved complex cognitive activities that rise cognitive load extraneous, so delivery method including presenting contents subject material must be alteration (Yusof, Foong, & Sern, 2016; Lee, Nursaadah, Yusoff, & Tan, 2019). Based on previous empirical study findings conducted by Yusof et al. (2016), example-based learning that applied constructivist theory is the applicable approach to dilute cognitive load extraneous in learning electrical subjects. Concurrently, a study finding by Trifonova & Ronchetti (2003) and Klimova (2019) proved that the mobile app is suitable for constructivist learning. So to overcome the cognitive load extraneous impact, and to take the capability of mobile technology, the design of the mobile app must be associated with applicable learning theories and pedagogical method and refer to the Models of Human Memory that also focuses on students' demand to improved learner achievement (Hasan, Zahrani, & Laxman, 2015; Noor Khairunnisa Othman, 2017; Elkhateeb, Shehab, & El-bakry, 2019).

Although there is plenty of research done on mobile application development in polytechnic such as Islamic Education Mobile Apps in .JAR format by Aliff Nawi, Mohd Isa Hamzah, & Surina Akmal Abd Sattai, (2014), Mobile Apps of Science, Technology, and Engineering in Islam in .APK format (M-ISTech) by Yusoff & Romli (2018), but there is still lacking in research about the development of the mobile app to help students understand the basic concepts of measurement to facilitate their learning styles.

Therefore, the objectives of this research are as follows:

a) To design Measurement Super Smart Notes for Measurement Devices Course (DEC10013).
b) To develop Measurement Super Smart Notes to access the android platform-based design (ADDIE).
c) To evaluate the user's usability and satisfaction of the Measurement Super Smart Notes for Measurement Devices Course (DEC10013).

3. RESEARCH METHODOLOGY

3.1 Analysis Phase

The development of Measurement Super Smart Notes mobile app are based on the ADDIE Model (Rossett,1987) and the first phase is the analysis phase. Based on the Continuous Quality Improvement (CQI) Report, June 2017 - Dec 2018 Session for Measurement (DEE1013) courses, Course Learning Outcome (CLO1C) that referring the cognitive level involving the theory and calculation aspects shown that teaching and learning method should be changed to be more attractive and effectual. Based on student achievement of Quiz 1, Quiz 2, Theory Test, and Final Exam results, showing that they had difficulty pertinent facts and apply the concept that causes them to fail to answer the assessment.

3.2 Design Phase

In the design phase, the process of delivering information gathering from the analysis phase occurs. Measurement Super Smart Notes mobile app design process applying the approach of Cognitive Load Theory and Models of Human Memory (Sweller, 1988; Atkinson & Shiffrin, 1971). This is because the Cognitive Load Theory and Models of Human Memory are strictly linked to raising the level of cognitive involving working memory and long-term memory. Hence, the visual information presented should be combined with the scheme in the preexisting long-term memory to complete the development of mental models in working memory and reduce the cognitive load.

By integration with minimalism learning theory and also a restriction of working memory which is 15 seconds to 30 seconds (Goldstein, 2011), the arrangement of notes and calculation examples is organized in a simple and concise so that students can better understand the concepts and apply the formula during problem-solving activities. Meanwhile, by referring to the Information Visualization Theory, multimedia elements such as choosing appropriate colors, text, images, graphics, buttons and interactivity were implemented to facilitate data in a visual and meaningful way so that can help the students better understand it (Escobar et al., 2016; Baharum et al., 2019) . The design of this mobile app also integrates the exercise activities in online quiz form to sustain the information receive into long-term memory. By referring to the Behaviorism Learning Theory, each student's feedback in the exercise activities will generate marks automatically and shuffle each time students repeat the exercise activities. This mobile app design also has a link to google forms as a communication medium between students and lecturers. This interaction process also can afford to construct information during the development of mental models (Yusoff & Romli, 2018) and to reveal objective learning using mobile app accomplish (Klimova, 2019).

3.3 Development Phase

The process of converting activities that we're justified in the analysis and design phase is applied in the development phase. Measurement Super Smart Notes mobile app was developed using Adobe Cloud Animate CC 2017 Platform Android, Socrative, and Google Form and full use offline and online capability of the mobile features. That means the developer can update the exercise assessment even though this mobile app in .apk format. Platform Android was chosen because of the most popular smartphone's operational system nowadays (Klimova & Poulava, 2015).

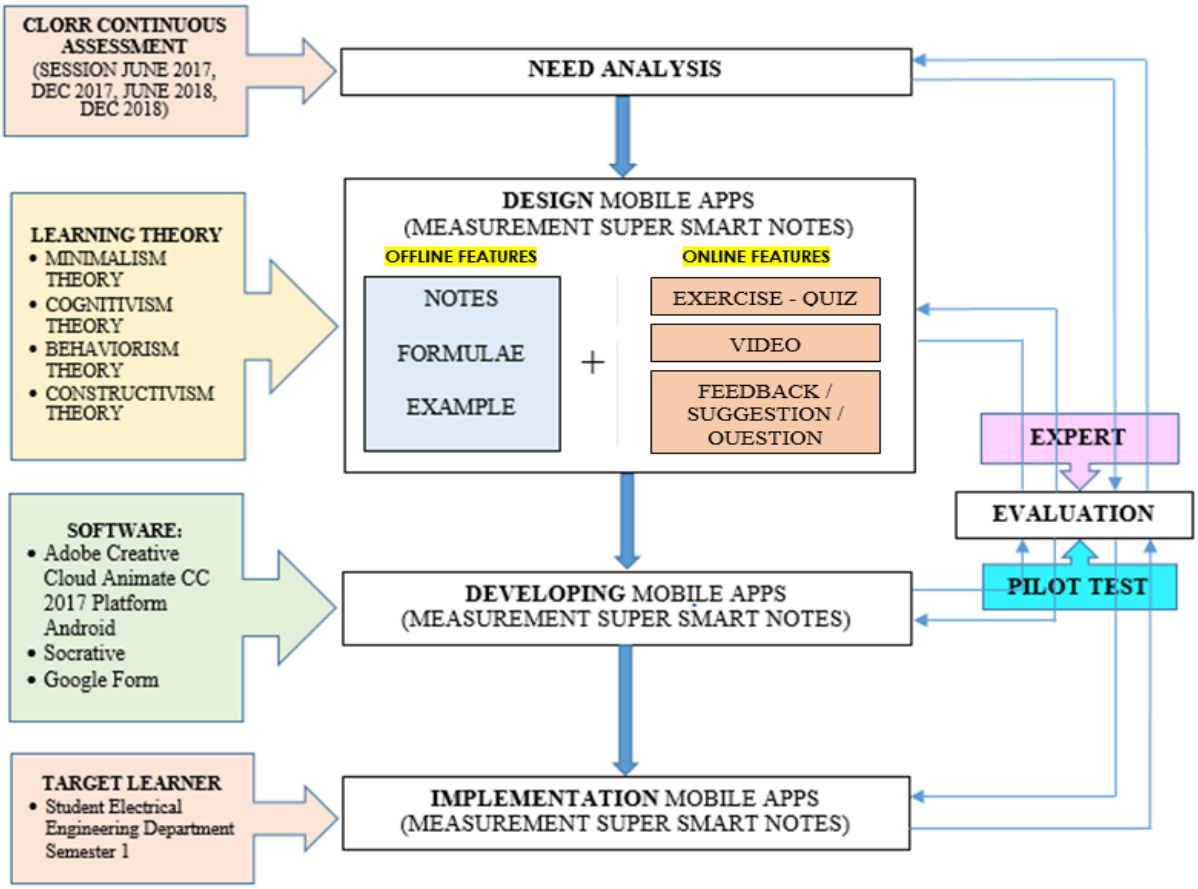


Figure 1.0: Flow chart of Measurement Super Smart Notes Based on ADDIE MODEL (Drljača et al., 2017; Normala Rahmat et al., 2019)

3.4 Implementation and Evaluation Phase

The implementation phase is the fourth phase and very important that determines whether the objective of development Measurement Super Smart Notes was achieved. The last phase in ADDIE model is the evaluation phase which involves the process of evaluation from experts as formative assessment during the design process and after the completed development process.

3.4.1 Expert Evaluation

Face and content validation was done that involving expertise in measurement as electrical engineering and education content expert and information technology regarding design and development Measurement Super Smart Notes. The first draft of Measurement Super Smart Notes is given just after the design process completely as shown in Figure 1.1. The arrangement of the contents reorganizes based on advice from a content expert.

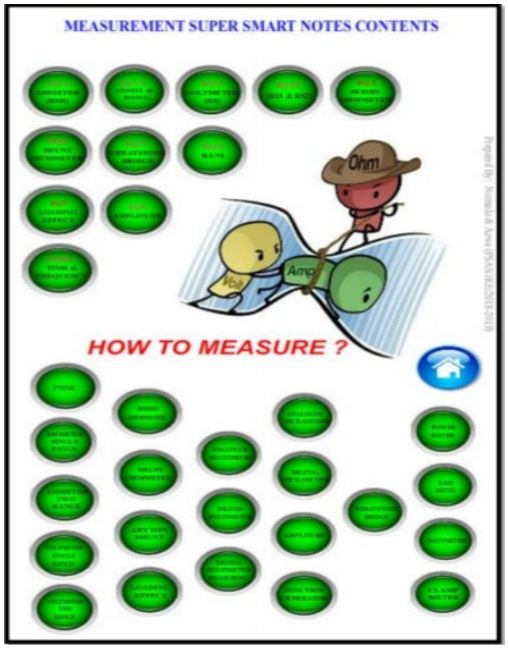


Figure 1.1: First Draft Design of Measurement Super Smart Notes

The amendments were done based on the comment given by the expert especially regarding multimedia aspects such as a chosen image or picture use, size of text, and also contrasting background color and text in the image.

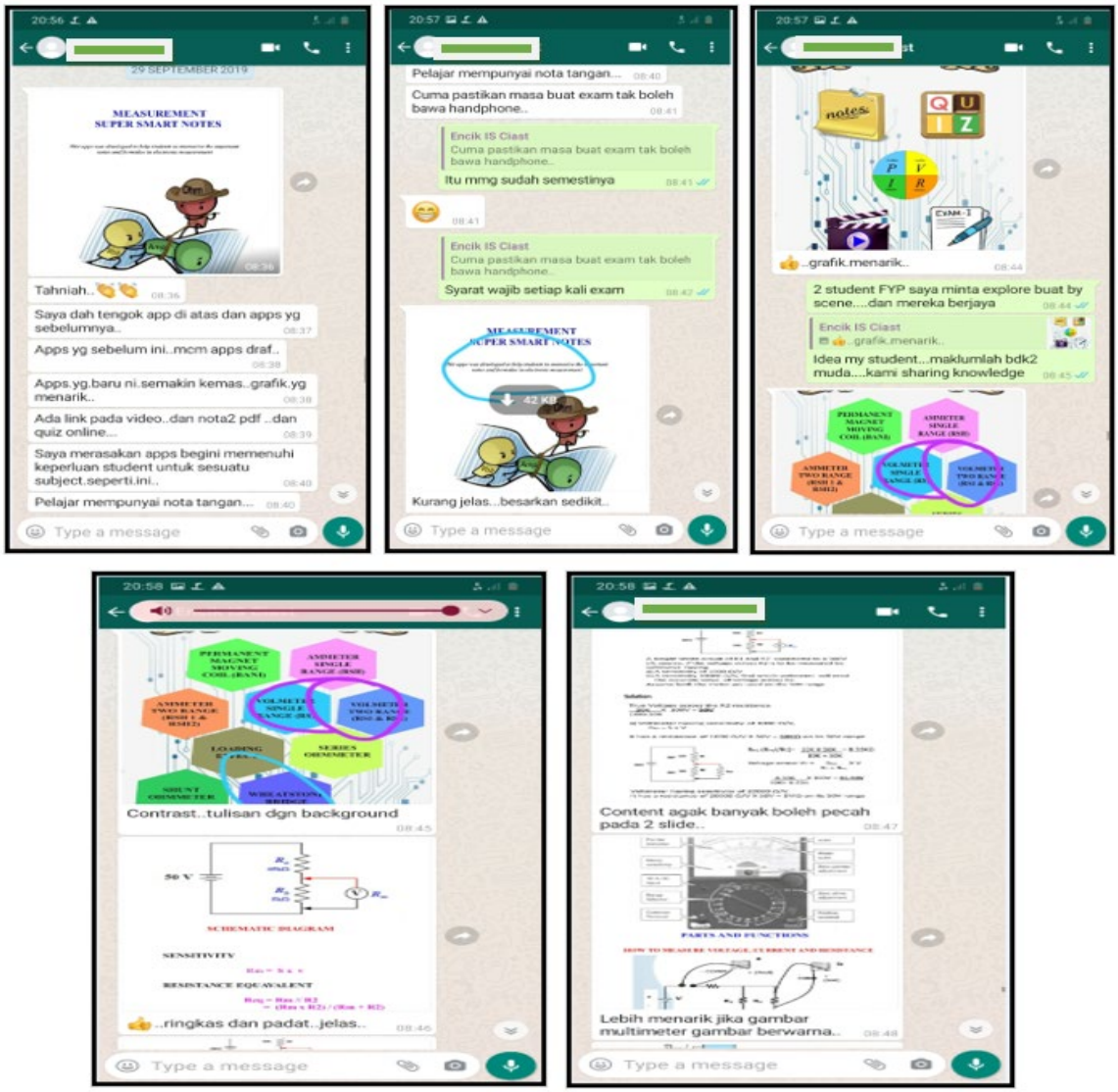


Figure 1.2: Expert Comment About Graphic Design and Text Size, Contrasting Background Color and Text in Image

4. DATA ANALYSIS AND RESULTS

4.1 User And Satisfaction Evaluation

Measurement Super Smart Notes mobile app .apk file was distributed to the target group students to install in their handphone through WhatsApp. After the install the .apk file; then they were exploring the mobile app by themself how to use it. Then the student-user evaluation was conducted as a summative assessment to obtain responses from the students by distributing the questionnaire, which was adapted from the Post-Study System Usability Questionnaire (PSSUQ). The Cronbach alpha analysis result for the altered version of the questionnaire that consists of 24 items shown .921, indicating that overall, the scales had acceptable reliability (Normala Rahmat et al., 2019). The descriptive statistical methods were used to analyze and evaluated using the means value and interpretation. The overall data show that students are satisfied with the Measurement Super Smart Notes mobile app for the six criteria evaluate with mean score values being above and beyond 3.34 in category high level mean score interpretation (Pallant, 2007).

The mean score of layout or design criteria is 4.37, this shows that overall students agree with the design and layout content contained in the Measurement Super Smart Notes mobile app. This finding aligned with the findings of Latifah Abdul Majid et al., (2012); Ibrahim et al., (2013), who stated that interactive design with appropriate text, colors, and images will interact and enabled students to pay close attention to the learning process and meet the needs of the students. Meanwhile, the data evaluation of the functionality shows that the mean score is 4.34, and ease to use is 4.37, this result shows that the interface development is following the principles of design of interface specified Norfadilah Kamaruddin, (2016).

Further, the data evaluation of the learnability shows that the mean score is 4.41, this results in line with research by Hassan et al., (2015) that stated that the use of mobile applications will reinforce the user's existing knowledge to generate and discover the new ideas. The satisfaction criteria mean score is 4.22 and the outcome or future use criteria is 4.24; the results show that the objective of Measurement Super Smart Notes mobile app to make a student become an independent learner achieved. These findings aligned with the finding of a study by Aliff Nawi et al. (2014), Yusoff & Romli (2018), and Atan & Shahbodin (2018) stated that students will be more motivated and become independent learner when the mobile app used meets their demands regarding subject content displayed interactively and easy-to-use.

4.2 Measurement Super Smart Notes Mobile App

Measurement Super Smart Notes mobile app development was successful achieve the objective using ADDIE Model with offline and online features that fulfill the Information Visualization Theory as shown in Figure 1.6. This inline with research conducted by Ahmad et al., (2020). Figure 1.7 shown the feedback and suggestion also question given by targeted group students about this mobile app. Meanwhile, the result shown in Figure 1.8 is about exercise assessment in Quiz Form using Socrative Platform. The interaction process inline with research findings by Yusoff & Romli (2018) that stated this process can contribute to constructing information during the development of mental models.

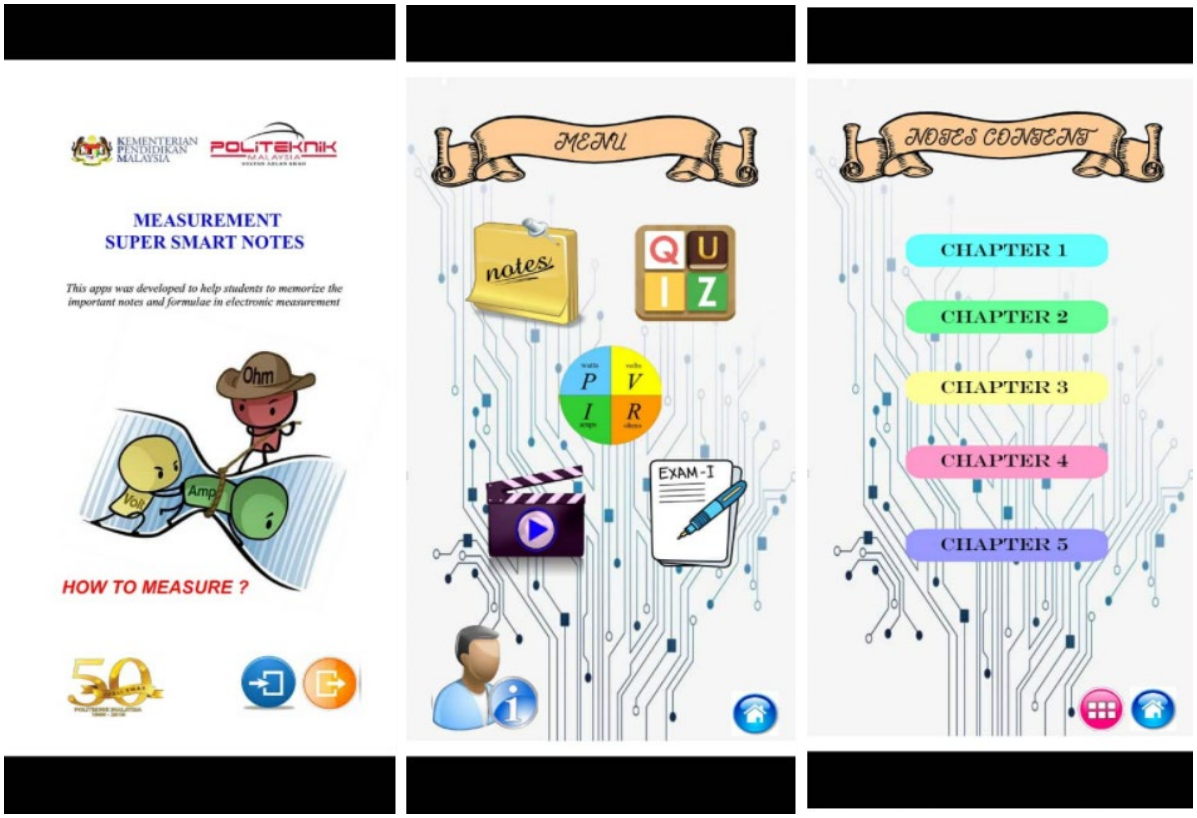
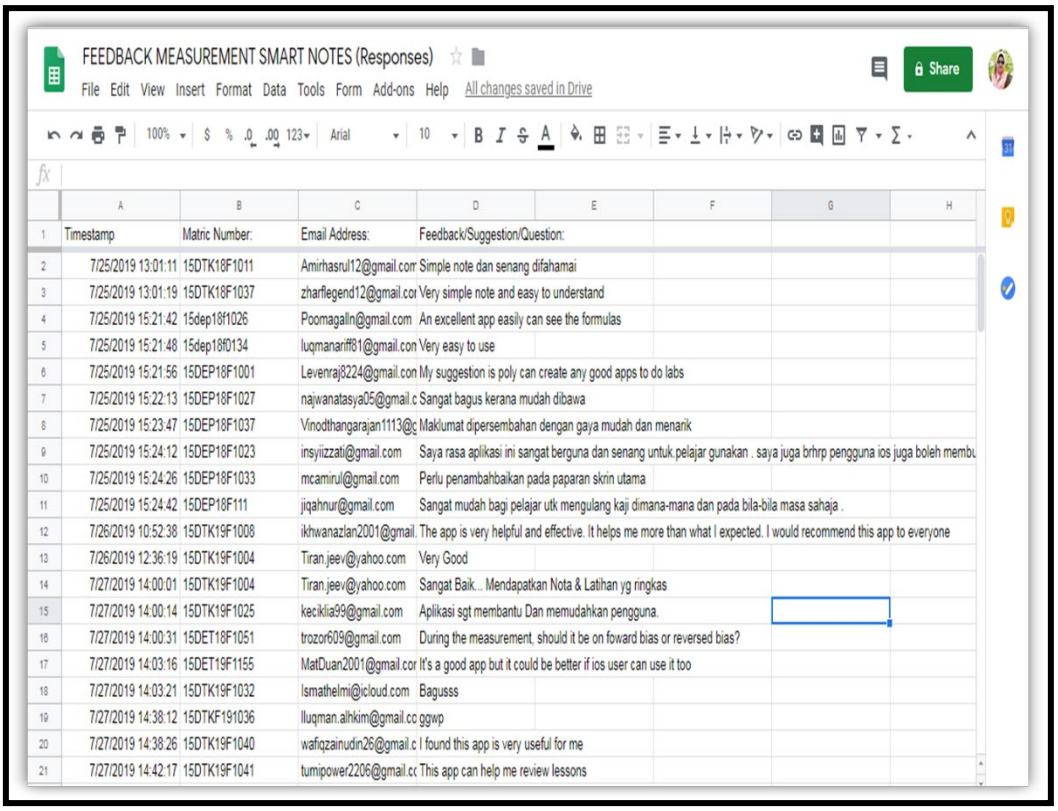


Figure 1.6: Partially Content the Measurement Super Smart Notes Mobile App



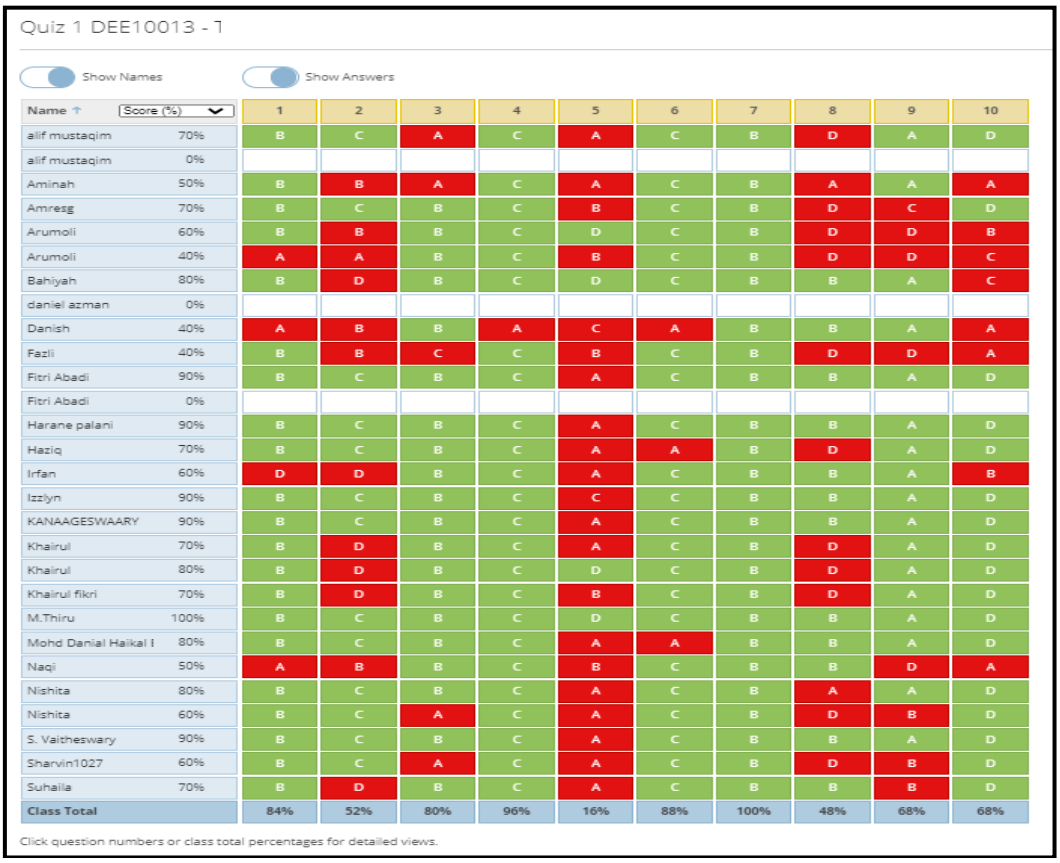
FEEDBACK MEASUREMENT SMART NOTES (Responses)

File Edit View Insert Format Data Tools Form Add-ons Help All changes saved in Drive

Share

	A	B	C	D
1	Timestamp	Matric Number:	Email Address:	Feedback/Suggestion/Question:
2	7/25/2019 13:01:11	15DTK18F1011	Amirhasrul12@gmail.com	Simple note dan senang difahamai
3	7/25/2019 13:01:19	15DTK18F1037	zharflegend12@gmail.co	Very simple note and easy to understand
4	7/25/2019 15:21:42	15dep18f1026	Poomagaln@gmail.com	An excellent app easily can see the formulas
5	7/25/2019 15:21:48	15dep18f0134	luqmanariff81@gmail.con	Very easy to use
6	7/25/2019 15:21:56	15DEP18F1001	Levenraj8224@gmail.con	My suggestion is poly can create any good apps to do labs
7	7/25/2019 15:22:13	15DEP18F1027	najwanatasya05@gmail.c	Sangat bagus kerana mudah dibawa
8	7/25/2019 15:23:47	15DEP18F1037	Vinodthangarajan1113@g	Maklumat dipersembahan dengan gaya mudah dan menarik
9	7/25/2019 15:24:12	15DEP18F1023	insyiizzati@gmail.com	Saya rasa aplikasi ini sangat berguna dan senang untuk pelajar gunakan . saya juga brhrp pengguna ios juga boleh membu
10	7/25/2019 15:24:26	15DEP18F1033	mcamirul@gmail.com	Perlu penambahbaikan pada paparan skrin utama
11	7/25/2019 15:24:42	15DEP18F111	jiqahnur@gmail.com	Sangat mudah bagi pelajar utk mengulang kaji dimana-mana dan pada bila-bila masa sahaja .
12	7/26/2019 10:52:38	15DTK19F1008	ikhwanazlan2001@gmail.	The app is very helpful and effective. It helps me more than what I expected. I would recommend this app to everyone
13	7/26/2019 12:36:19	15DTK19F1004	Tiran.jeev@yahoo.com	Very Good
14	7/27/2019 14:00:01	15DTK19F1004	Tiran.jeev@yahoo.com	Sangat Baik... Mendapatkan Nota & Latihan yg ringkas
15	7/27/2019 14:00:14	15DTK19F1025	keciklia99@gmail.com	Aplikasi sgt membantu Dan memudahkan pengguna.
16	7/27/2019 14:00:31	15DET18F1051	trozor609@gmail.com	During the measurement, should it be on foward bias or reversed bias?
17	7/27/2019 14:03:16	15DET19F1155	MatDuan2001@gmail.cor	It's a good app but it could be better if ios user can use it too
18	7/27/2019 14:03:21	15DTK19F1032	Ismathelmi@icloud.com	Bagusss
19	7/27/2019 14:38:12	15DTKF191036	lluqman.alhkim@gmail.co	ggwp
20	7/27/2019 14:38:26	15DTK19F1040	wafiqzainudin26@gmail.c	I found this app is very useful for me
21	7/27/2019 14:42:17	15DTK19F1041	tumipower2206@gmail.cc	This app can help me review lessons

Figure 1.7: Measurement Super Smart Notes Feedback/Suggestion/Question Platform



Quiz 1 DEE10013 - 1

Show Names Show Answers

Name	Score (%)	1	2	3	4	5	6	7	8	9	10
alif mustaqim	70%	B	C	A	C	A	C	B	D	A	D
alif mustaqim	0%										
Aminah	50%	B	B	A	C	A	C	B	A	A	A
Amresg	70%	B	C	B	C	B	C	B	D	C	D
Arumoli	60%	B	B	B	C	D	C	B	D	D	B
Arumoli	40%	A	A	B	C	B	C	B	D	D	C
Bahiyah	80%	B	D	B	C	D	C	B	B	A	C
daniel azman	0%										
Danish	40%	A	B	B	A	C	A	B	B	A	A
Fazli	40%	B	B	C	C	B	C	B	D	D	A
Fitri Abadi	90%	B	C	B	C	A	C	B	B	A	D
Fitri Abadi	0%										
Harane palani	90%	B	C	B	C	A	C	B	B	A	D
Haziq	70%	B	C	B	C	A	A	B	D	A	D
Irfan	60%	D	D	B	C	A	C	B	B	A	B
Izzlyn	90%	B	C	B	C	C	C	B	B	A	D
KANAAGESWAARY	90%	B	C	B	C	A	C	B	B	A	D
Khairul	70%	B	D	B	C	A	C	B	D	A	D
Khairul	80%	B	D	B	C	D	C	B	D	A	D
Khairul fikri	70%	B	D	B	C	B	C	B	D	A	D
M.Thiru	100%	B	C	B	C	D	C	B	B	A	D
Mohd Danial Haikal I	80%	B	C	B	C	A	A	B	B	A	D
Naqi	50%	A	B	B	C	B	C	B	B	D	A
Nishita	80%	B	C	B	C	A	C	B	A	A	D
Nishita	60%	B	C	A	C	A	C	B	D	B	D
S. Vaitheswary	90%	B	C	B	C	A	C	B	B	A	D
Sharvin1027	60%	B	C	A	C	A	C	B	D	B	D
Suhaila	70%	B	D	B	C	A	C	B	B	B	D
Class Total		84%	52%	80%	96%	16%	88%	100%	48%	68%	68%

Click question numbers or class total percentages for detailed views.

Figure 1.8: Result Exercise Assessment in Quiz Form Using Socrative Platform

5. CONCLUSION

In conclusion, the results showed that respondents agreed Measurement Super Smart Notes mobile app created successfully makes the teaching and learning process more interactive and independent as required in Outcome-Based Learning (OBE). The undeniable electrical subject is one of the difficult subjects because it involves complex cognitive activities faced by students in the engineering field. Integration of effective learning strategies and pedagogical approach through the mobile app will able to make learning more effective and entertaining teaching and learning process (Ahmad et al., 2020). To get more information about the implementation of the Measurement Super Smart Notes mobile app, the study will extend to look at the impact of m-learning on students' academic achievement. Also as a future study, an interactive quiz also will be implement via real time application platform such as Kahoot or Quiz-Bot application to enhance the variety of exercises in Measurement Super Smart Notes.

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EFFECT OF MICRO LIME ORGANIC AS SUSTAINABLE MATERIAL ON GEOTECHNICAL PROPERTIES OF BATU PAHAT SOFT CLAY

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Abstract. Batu Pahat soft clay which located in Johor, has experienced geotechnical properties such as low in shear strength and bearing capacity and also occur settlement when the load is charged. Therefore, studies have been conducted to study the effects of addition micro organic lime on the soil properties of Batu Pahat soft clay. The aim of this paper is to understand the effect of adding micro organic lime on some geotechnical properties of Batu Pahat soft clay. Micro organic lime is added to soil at 2%, 4%, 6% and 8% based on the weight of soil. Atterberg limit, compaction and permeability have been carried out to be analyzed. The test results show that the soft clay properties of Batu Pahat studied have increased when the use of micro organic lime is added as a stabilizer. Analysis result of X-ray fluorescence (XRF) show that the calcium oxide (CaO) contain in micro organic lime is 93.7% which has a high readability in soil stabilization.

Keywords: soft clay, micro organic lime, geotechnical properties.

1. INTRODUCTION

Soft clay is soil that is largely composed of fine particles such as silty and clayey soils, which have high moisture content, peat foundations and loose sand deposits, located near or under the water table (Kamon and Bergado, 1991). Soft clay are normally have the problem including low strength and high compressibility also can cause severe damage to civil engineering construction (Asma and Dariusz, 2013). However, Batu Pahat soft clay were low in shear strength, bearing capacity, and suffer large settlement when subjected to loading (Alvin and Izzudini, 2017). Therefore, several methods have been used to improve the properties of soft clay so that its stability can be improved. Among the methods used to stabilize soft clay, the use of various additives is recommended, as the replacement of soil that is not suitable for quality soil becomes a more economical and non-ecological practice (Aref et al., 2016). In addition, the use of cement as a stabilization nowadays is not encouraging because of rising costs and environmental concerns.

2. LITERATURE REVIEW

Lime is a material used to increase the strength, stiffness properties and to reduce the swell-shrink potential of clay soil (Aref et al., 2016 and Zhao et al., 2014). Its use depends on the condition either in the form of lime or as hydrated lime. Extensive studies have been carried out on addition of lime in soil stabilization (Aref et al., 2016, Mukherjee, 2014, Sen et al., 2011 and Roa and Shivanda, 2005). These studies reported for maximum soil modification, the optimum lime addition required is between 1% to 3% lime by weight. However, it does not bring any changes to the plastic limit but increase the strength. However, other studies reported the increase of more than 8% of lime will decrease the soil strength (Amir, 2007). Adding lime in clay soil will presence of water, a number of reaction will occur, leading to the improvement of soil properties. These reactions include cation exchange, flocculation and pozzolanic reaction.

Flocculation is primarily responsible for modification of the engineering properties of clay soil when treated with lime (Ghobadi et al., 2014).

The objective of this study is to investigate the adding micro organic lime on some properties of Batu Pahat soft clay. X-ray fluorescence, Atterberg limit, compaction and permeability have particularly been investigated. The purpose of this study is to stabilize Batu Pahat soft clay with more economical method using organic material as well as to enhance geotechnical properties.

3. MATERIALS

3.1 Batu Pahat Soft Clay

The soil sample used in the study have been obtained from a Research Centre for Soft Soil (RECESS) at UTHM Johor. Batu Pahat soft clay (BPSC) was obtained by excavating 1 m below the ground. Based on the laboratory tests that have been conducted, the basic properties of clayey soil are shown in Table 1. The liquid limit (LL) greater than 50% and plastic limit (PL) has obtained 33 %. The studied soil is classified as CH soil according to the unified soil classification system (USCS).

Table 1 : **Basic Properties Of The Studied BPSC**

Colour	Depth (m)	Specific gravity	LL (%)	PL (%)	PI (%)	Classification (USCS)	Optimum Moisture Content (%)	Maximum Dry Density (kN/m^3)
Dull grey	1	2.62	57.4	33.0	24.4	CH	34	17.92

3.2 Micro Lime Organic

Micro organic lime used is composed of organic material that is powder of cockle shell. Cockle shell used from Anadara Granosa type (Figure 1). Cockle shell through a cleaning process before being burned in the oven at 500 ° C for 24 hours. Then the cockle shell are crushed up to micro size (passing the sieve size of 63 µm).



Figure 1: **Micro Lime Organic**

4. METHODOLOGY

Some laboratory tests consisting of X-ray fluorescence (XRF) of micro lime organic, Atterberg limits, compaction and permeability test was conducted on the BPSC. The percentages of micro lime organic used in the mixtures were 2%, 4%, 6% and 8%.

4.1 X-Ray Fluorescence (XRF)

Sample preparation for the XRF test was carried out with the micro organic lime that passing the sieve size of 63 µm. Then, the sample was mixed with an additional agent binder at the ratio of 3:7 to be used as a pallet by inserting a sample into the machine with a pressure of 100 kN. After that, the pallets will be discharged using a liquefaction agent (Lithium Tetreborate) at 1100 °C up to 1200 °C before analysing the element in the sample.

4.2 Atterberg Limits Test
Atterberg Limits Test is based on BS1377: 1990. Variations in the PI of untreated and treated BPSC were then studied. The same material was used for PL and LL tests.

4.3 Compaction Test
To determine the maximum dry density (MDD) and optimum moisture content (OMC) of the sample, a standard Proctor compaction test was conducted refers to BS1377: 1990.

4.4 Permeability Test
The variable permeability test is carried out on fine sized soil such as clay to determine the coefficient of soil permeability. Experimental procedure is based on BS1377: 1990. The data obtained using the Darcy law formula to determine the coefficient of soil permeability.

5. RESULT AND ANALYSIS

5.1 X-Ray Fluorescence (XRF)
Table 2 presents the results of X-ray fluorescence to determined mineralogy of micro organic lime. CaO content in micro organic lime after crystallization process was 93.7 %. This shows that the mineral content of CaO is high and suitable for stabilizer agent (Aref et al., 2016).

Table 2 : Mineralogy Of Micro Organic Lime

Formula	Concentration	Formula	Concentration	Formula	Concentration
Orig-g	6 %	K2O (Potassium oxide)	0.31 %	Fe2O3 (Iron(III) oxide)	1.60 %
Added-g	4 %	MnO (Manganese(II) oxide)	0.31 %	A12O3 (Aluminium oxide)	0.70 %
CO2 (Carbon dioxide)	0.10 %	Na2O (Sodium oxide)	0.25 %	SrO (Strontium oxide)	0.38 %
CaO (Calcium Oxide)	93.7 %	TiO2 (Titanium dioxide)	0.23 %	S (Sulfur monoxide)	0 < LLD
SiO2 (Silicon dioxide)	2.06 %	ZnO (Zinc oxide)	0.21 %	Mg (Magnesium)	0 < LLD

5.2 Atterberg Limit
The following is the Atterberg limits test data added with micro organic lime according to different percentages, refer to Table 3. Figure 2 show the relationship between micro organic lime and PI for Batu Pahat soft clay treated with micro organic lime. The workability of the soil can be improved, it is based on the devaluation of PI. The higher the PI is the greater the quantum of water that can be imbibed by the soil is and hence the greater its swell potential would be (Roa and Shivanda, 2005). After the addition of micro-organic lime, the soil has shown a decrease in the value of PI. Workability of the soil has been increased with the addition of 4% micro organic lime. Where it can reduce the value of PI from 24.4% to 13.1%. The figure 2 showed the value of the PI against the percentage of soil mixture which obtained the value of the correlation, r is 0.7780. However, several researcher found that a regression coefficient, r of more than 0.71 indicated a strong correlation between the fitted parameter (Abdullah, 2006).

Through this polynomial equation, the corresponding percentage of micro organic lime additions is 3.7 %. Similar behaviour was found by several researchers for adding lime content beyond 4% was sufficient to enhance the workability of the soil by reducing the PI (Aref et al., 2016).

Table 3. Atterberg limits of the studies mixtures of micro organic lime

Soil mixture	LL	PL	PI
2% micro organic lime	60	43.5	16.6
4% micro organic lime	54.8	41.7	13.1
6% micro organic lime	53.3	38.2	15.1
8% micro organic lime	54.0	38.0	16.0

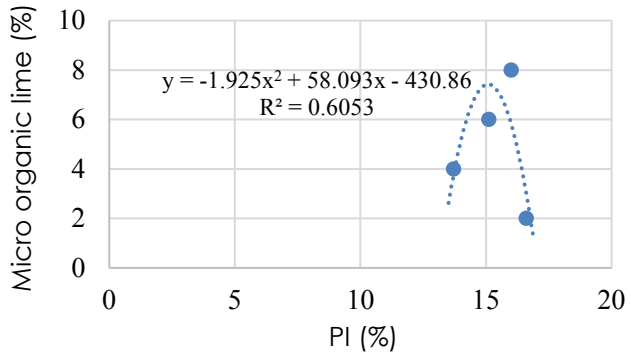


Figure 2: Relationship Between Micro Organic Lime And PI For The Batu Pahat Soft Clay.

5.3 Compaction

To determine the effect of the use of micro lime organic on optimum moisture content (OMC) and maximum dry density (MDD) of the Batu Pahat soft clay, compaction tests were performed. The effect of addition of micro lime organic in compaction test can be mentioned in Table 4. OMC values have increased and MDD has decreased by adding 2% to 6% micro organic lime. Increased OMC value from 34% to 36% and decreased MDD value from 1792 Mg/m3 to 1770 Mg/m3 when adding 4% micro organic lime compared to 0%. Similar behaviour was also observed in the literature in case of lime stabilization for clay soil (Aref et al., 2016; Harichance, 2011). The relationship between MDD and OMC on the soil compaction properties tested can be seen in Figure 3. By comparing the relationship between OMC and MDD with the polynomial equation found the value of regression coefficient, R^2 of 0.7248 and value of r is 0.85. A regression coefficient, r of more than 0.71 indicated a strong correlation between the fitted parameter.

Table 4 : Compaction Test Result Of The Studied Mixtures.

Soil mixture	OMC (%)	MDD (Mg/m^3)
2% micro organic lime	33.5	1813
4% micro organic lime	36.0	1770
6% micro organic lime	38.3	1781
8% micro organic lime	45.7	1768

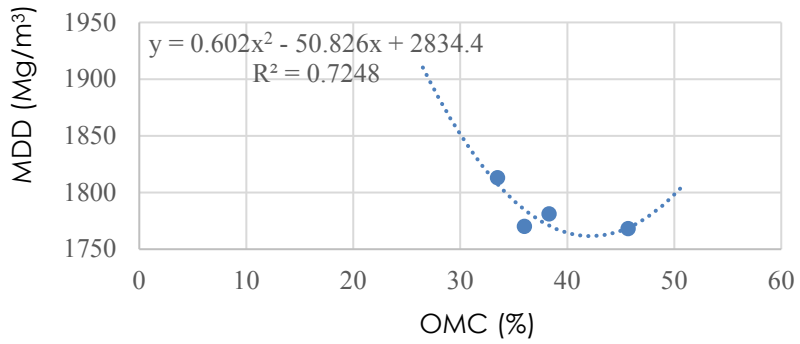


Figure 3: Relationship between MDD and OMC for the Batu Pahat soft clay

5.4 Permeability

Figure 4 shows that relationship between coefficients of soil permeability, k with micro lime organic lime content for Batu Pahat soft clay. Based on the polynomial equation, the value of regression coefficient, R^2 obtained is 0.9625. This shows that there is a strong relationship between the coefficients of soil permeability and the percentage of additive with micro organic lime. Through the polynomial equation, is found that the percentage of 4 % micro organic lime is adapted as the ratio of mixing as a stabilizer.

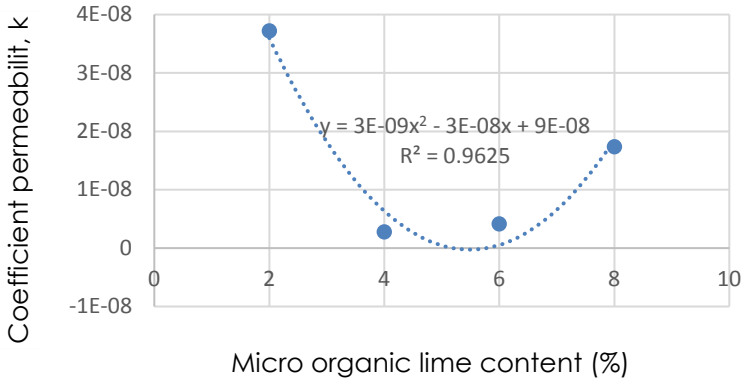


Figure 4: Relationship Between Coefficient Of Soil Permeability, K And Micro Organic Lime Content For The Batu Pahat Soft Clay

6. CONCLUSION

This study presents the effect of adding micro organic lime on Atterberg limit, compaction and permeability of Batu Pahat soft clay. On the test results, the following conclusion can be drawn:

- The PI of Batu Pahat soft clay decreased with increasing adding micro organic lime. However, adding with 4 % of micro organic lime is appropriate.
- The MDD of Batu Pahat soft clay was significantly affected by adding micro organic lime. Adding micro organic lime has increasing OMC and decreased the MDD.
- Mineralogy micro organic lime was content 93.7% of calcium oxide, where it is a high calcium oxide content compared to other lime content.

From the studies that have been done, the use of micro organic lime can increase the characteristics of soft clay and it is recommended to be used as a subgrade layer of the road. Using micro organic lime is considered to be an economic and environmental practice.

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TAHAP PELAKSANAAN AMALAN KESELAMATAN DAN KESIHATAN PEKERJAAN DALAM KALANGAN STAF TEKNIKAL

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Abstrak. Tahap kesedaran rakyat Malaysia terhadap kesihatan dan keselamatan pekerjaan menunjukkan peningkatan saban tahun. Kebanyakan majikan mahupun pekerja mula faham kepentingan dalam melaksanakan tanggungjawab dan peranan masing-masing dalam mengenal pasti, mentaksir serta pengawalan terhadap potensi sesuatu risiko atau bahaya yang mungkin terjadi di kawasan tempat kerja. Bagi melindungi kebajikan pekerja di negara ini, kerajaan Malaysia telah memperkenalkan akta-akta atau peraturan-peraturan berhubung keselamatan dan kesihatan pekerja (KKP). Kajian dilaksanakan bagi melihat tahap perlaksanaan amalan KKP dan mengenalpasti risiko dan permasalahan tentang cara kerja yang selamat dalam kalangan staf teknikal. Kajian ini dijalankan di sekitar Kuala Lumpur, Selangor dan Putrajaya yang melibatkan bahagian penyelenggaraan di JKR, JPS dan JAS. Responden kajian ini melibatkan seramai 56 orang staf teknikal. Analisis menggunakan Perisian *Statistical Packages for The Social Sciences (SPSS)* versi 20.0 bagi mempersembahkan hasil dapatan. Proses menganalisis data melibatkan analisis berkaitan taburan latar belakang responden dan tahap (skor min) bagi pelaksanaan keselamatan dan kesihatan di tempat kerja. Dapat disimpulkan bahawa pelaksanaan amalan keselamatan dan kesihatan pekerjaan dalam kalangan staf teknikal berada pada tahap yang sangat baik. Ini dapat dilihat melalui dapatan kajian yang memperoleh skor min yang tinggi pada semua bahagian seperti polisi keselamatan, panduan asas, amalan keselamatan dan kesihatan pekerjaan, audit pemeriksaan dan penilaian keselamatan, dan juga program dan latihan keselamatan.

Kata Kunci: Keselamatan dan Kesihatan Pekerjaan (KKP), staf teknikal

1. PENDAHULUAN

Kesedaran rakyat Malaysia berkaitan kesihatan dan keselamatan pekerjaan menunjukkan peningkatan yang sangat baik sejak kebelakangan ini. Kebanyakan majikan mahupun pekerja mula faham kepentingan dalam melaksanakan tanggungjawab dan peranan masing-masing dalam mengenal pasti, mentaksir serta pengawalan terhadap potensi sesuatu risiko atau bahaya yang mungkin terjadi di kawasan tempat kerja. Bagi melindungi kebajikan pekerja di negara ini, kerajaan Malaysia telah memperkenalkan akta-akta atau peraturan-peraturan berhubung keselamatan dan kesihatan pekerja seperti Akta Keselamatan dan Kesihatan Pekerjaan 1994 (OSHA), Akta Kilang dan Jentera 1967, dan Akta keselamatan sosial pekerja 1969 (AGC). Tujuan utama akta atau peraturan ini diperkenalkan adalah bagi memastikan kesihatan pekerja di negara ini bebas daripada sebarang penyakit yang wujud daripada keadaan tempat kerja itu sendiri sama ada penyakit kesihatan mental, fizikal ataupun sosial. Menurut Sirajuddin, Nor'Aishah dan Abu Hassan Shaari (2012), penyakit pekerjaan adalah merupakan penyakit yang berpunca daripada pekerjaan seseorang pekerja itu sendiri ataupun akibat terdedah kepada bahaya di kawasan tempat kerja dalam satu-satu tempoh yang lama. Ini boleh menyebabkan pekerja tersebut memperoleh penyakit

pekerjaan seperti penyakit silikosis yang disebabkan oleh pendedahan terhadap debu-debu, batu, dan pasir, penyakit kulit akibat alahan terhadap pemakaian sarung tangan getah, pekak akibat pendedahan terhadap bunyi bising yang berpanjangan dan kesakitan kepada otot serta sendi akibat pendedahan terhadap kerja yang berat dengan menggunakan tangan (Sirajuddin et al., 2012).

Bidang Keselamatan dan Kesihatan Pekerjaan (KKP) ditubuhkan atau diwujudkan adalah dengan tujuan memberi perlindungan kepada para pekerja dari segi kesihatan, keselamatan mahupun kebajikan. Setiap syarikat atau organisasi perlu memastikan serta menekankan tentang aspek keselamatan di tempat kerja sebagai komponen utama sewaktu beroperasi. Melalui Akta Keselamatan dan Kesihatan Pekerjaan (AKKP) 1994 yang dikawal selia oleh Jabatan Keselamatan dan Kesihatan Pekerja (JKKP) mewajibkan para majikan melaksanakan tanggungjawab mereka dengan mengambil berat terhadap keselamatan dan kesihatan setiap pekerja yang dilantik oleh syarikat mereka.

1.1 Pernyataan Masalah

Satu kajian oleh Ummi Nadiah dan Rosnani (2016) menyatakan bahawa kegagalan dalam pengurusan sesebuah risiko dengan baik akan menyebabkan kepada kejadian yang bahaya atau buruk. Risiko di tempat kerja sering kali dikaitkan dengan aktiviti berkaitan sesuatu pekerjaan yang dilakukan dan boleh menyebabkan kemudaratan terhadap seseorang pekerja. Menurut Wan Nadzri, Nor Syazwani dan Mohd Nasrun (2017) daripada kajian mereka menyatakan bahawa bidang teknikal seperti industri pembinaan bangunan merupakan industri yang mencatatkan kemalangan jenis maut yang paling tinggi bagi tahun 2015 iaitu sebanyak 88 kes daripada 214 kes keseluruhannya. Risiko ini juga tidak terkecuali terhadap syarikat atau organisasi yang menjalankan kerja-kerja penyelenggaraan bangunan yang mana setiap kakitangan syarikat atau organisasi ini akan terdedah kepada risiko kemalangan ataupun kemudaratan ketika melaksanakan kerja-kerja penyelenggaraan di sesuatu tapak kerja.

Berdasarkan kepada Manual Keselamatan dan Kesihatan Pekerjaan Jabatan Kerja Raya Malaysia (2018), kajian keberkesanan kepada program pengurusan KKP perlu dibuat sekurang-kurangnya sekali setahun bagi mengkaji kesesuaian dan pencapaian dasar KKP dan objektif KKP di jabatan. Oleh yang demikian, terdapat keperluan untuk melaksanakan kajian ini bagi mengenal pasti tahap perlaksanaan amalan KKP dalam kalangan kakitangan teknikal di JKR,JPS dan JAS serta melihat sejauh mana tahap pelaksanaan bekerja dalam keadaan selamat.

1.2 Objektif

Kajian yang dijalankan adalah untuk:

i. Menentukan tahap perlaksanaan amalan KKP dalam kalangan staf teknikal di JKR, JPS dan JAS.
ii. Menentukan tahap pengetahuan kepada perundangan KKP dalam kalangan staf teknikal JKR, JPS dan JAS.

1.3 Skop Kajian

Kajian ini meliputi aspek-aspek yang disenaraikan di bawah:

i. Responden bagi kajian ini melibatkan staf teknikal di JKR, JPS dan JAS.
ii. Borang kaji selidik yang berkaitan dengan amalan cara kerja selamat terhadap staf teknikal yang terlibat digunakan dalam kajian ini bagi menyokong dapatan kajian.
iii. Aplikasi SPSS 20.0 for windows akan digunakan bagi menganalisis data kajian ini.

2. SOROTAN KAJIAN

Isu-isu kemalangan di dalam sektor pekerjaan berisiko seperti sektor pembuatan adalah antara penyumbang utama kepada berlakunya kemalangan. Berdasarkan statistik yang dikeluarkan oleh Jabatan Keselamatan dan Kesihatan Pekerja (2018), sebanyak 35460 kes

kemalangan pekerjaan yang telah dicatatkan adalah terdiri daripada pelbagai sektor dengan sejumlah 611 kes yang melibatkan kematian pekerjaan telah direkodkan. Norsyazwani dan Wan (2017) menyatakan industri pembinaan banyak menyumbang dalam perkembangan ekonomi negara dan berorientasikan buruh yang melibatkan pekerja yang ramai. Kapasiti pekerja yang ramai ini banyak terdedah kepada risiko seperti bangunan tinggi, haba elektrik, objek tajam yang bergerak, lif, bahan kimia, habuk, bunyi bising dan ruang yang terhad.

Sektor pengilangan merupakan sektor pekerjaan yang merekodkan kes kemalangan yang tertinggi dibandingkan dengan sektor pekerjaan yang lain. Menurut Raudhiah, Nakiah dan Hashim (2015), setiap pekerja dan majikan perlu mempunyai tahap kesedaran yang tinggi terhadap kesihatan dan keselamatan di tempat kerja bagi mengurangkan risiko kemalangan yang sering berlaku di tempat kerja. Paringga (2010) menegaskan pendidikan dan latihan perlu disediakan untuk memberi kefahaman terhadap para pekerja mengenai amalan kerja yang selamat. Pekerja juga digalakkan untuk melaksanakan tugasan yang sama berulang kali bagi meningkatkan tahap kemahiran mereka sekaligus dapat mengurangkan kes kemalangan kerana pekerja lebih faham dan mahir untuk mengendalikan sesuatu tugasan. Lai, Liu dan Ling (2011) menyatakan bahawa latihan keselamatan merupakan medium yang paling berkesan untuk mengurangkan kes kemalangan kerana dapat membantu para pekerja mengenalpasti bahaya yang ada di tapak pembinaan.

Jonathan dan Mbogo (2016) menyatakan bahawa keselamatan dan kesihatan pekerjaan perlulah meliputi tentang keadaan tempat kerja yang selamat tanpa menimbulkan sebarang risiko dalam kalangan pekerja serta memastikan hanya pekerja yang layak dan benar-benar sihat yang melakukan pekerjaan tersebut. Para majikan seharusnya memastikan bahawa hanya pekerja yang benar-benar sihat dan cergas sahaja yang perlu datang ke tempat kerja. Menurut Garcia-Herrero (2012), amalan kesihatan dan keselamatan di tempat kerja bertujuan mewujudkan keadaan, kemampuan serta tabiat yang membolehkan pekerja melaksanakan pekerjaan mereka dengan cekap dan betul bagi mengelakkan sebarang kemalangan.

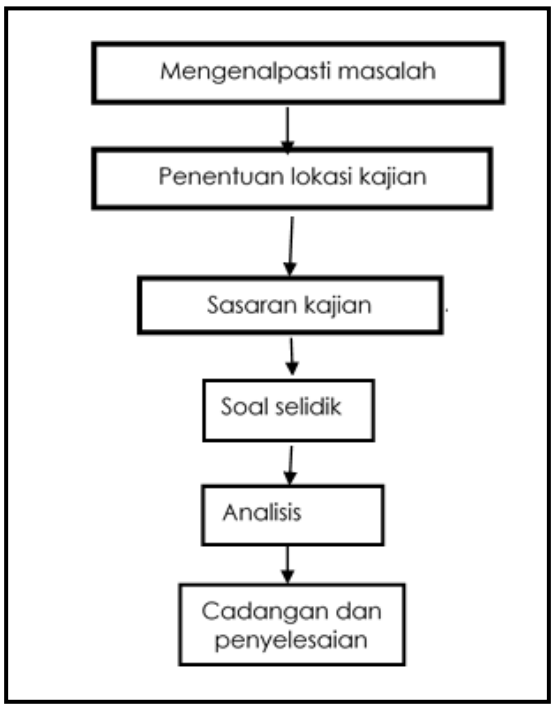
Satu kajian yang dilakukan di Pusat Penyelidikan Reka Bentuk dan Teknologi *Saxion University of Applied science* mengenai "Keselamatan di tempat kerja" menyimpulkan bahawa keselamatan diri, persekitaran yang selamat dan tingkah laku yang selamat adalah komponen penting yang diperlukan oleh majikan untuk memastikan ketersediaannya dalam organisasi mereka (Ynze Houten, 2012). Menurut penyelidikan ini, penekanan keselamatan melalui penyesuaian persekitaran harus dilakukan terhadap pekerja yang datang bekerja dan dapat mengenal pasti risiko di tempat kerja supaya pekerja dapat mengelakkan situasi berbahaya adalah kunci kepada keselamatan di tempat kerja (Ynze Houten, 2012).

Setiap pekerja perlu mempunyai kesedaran tentang kepentingan untuk menjaga keselamatan dan kesihatan di kawasan tempat kerja. Perkara ini dapat membantu mereka membantu mengurangkan risiko berlakunya kemalangan di tempat kerja. Manakala para majikan pula perlu memastikan setiap pekerja peka dan mematuhi standard operasi keselamatan semasa melaksanakan tugas atau pekerjaan mereka.

Berdasarkan peraturan yang terdapat dalam Akta Keselamatan Kesihatan Pekerja 1994 mewajibkan semua majikan sesebuah syarikat mewujudkan polisi keselamatan dengan tujuan untuk mengurangkan risiko kemalangan yang berlaku di tempat kerja. Polisi ini diwujudkan bagi memastikan setiap syarikat atau organisasi mempunyai garis panduan berkaitan keselamatan dan kesihatan di tempat kerja. Melalui polisi keselamatan dan kesihatan ini dapat memberi kesan tahap kesedaran setiap pekerja terhadap amalan kerja selamat di tempat kerja (Raudhiah, Nakiah, & Hashim, 2015). Nikolaos (2010, menegaskan pemeriksaan keselamatan tapak juga antara amalan yang harus dititikberatkan oleh majikan atau penyelia tapak bagi mengenalpasti keadaan tapak samada berada dalam keadaan selamat ataupun tidak

3. METODOLOGI KAJIAN

Metodologi kajian adalah meliputi lokasi kajian, pensampelan, kaedah pengumpulan data, instrumen kajian dan kajian rintis. Aliran metodologi kajian ditunjukkan dalam Rajah 1.



Rajah 1 : Aliran Metadologi Kajian

3.1 Lokasi Kajian

Kajian ini dijalankan di sekitar Kuala Lumpur, Selangor dan Putrajaya yang melibatkan bahagian penyelenggaraan di JKR, JPS dan JAS.

3.2 Persampelan

Populasi bagi kajian ini hanya melibatkan 150 responden daripada ketiga-tiga lokasi dan dipilih secara rawak. Soal selidik bagi kajian ini diedarkan secara atas talian menggunakan *google form* melalui email kepada kakitangan teknikal di JKR, JPS dan JAS mengikut masa yang telah ditetapkan. Namun begitu, hanya seramai 56 orang responden yang memberikan maklum balas dan menjawap kajian ini disebabkan faktor kekangan masa, kesibukan daripada beban tugas yang banyak dan lain-lain.

3.3 Kaedah Pengumpulan Data

Borang selidik secara atas talian digunakan sebagai kaedah pengumpulan data daripada responden dalam kajian ini. Pemilihan soal selidik secara atas talian menggunakan *google form* melalui email digunakan bagi memudahkan penyelidik untuk mengumpul data dan menjimatkan masa. Menurut Chua (2006), dalam penyelidikan sains sosial, instrumen kajian biasanya merupakan soal selidik yang direka untuk mengumpul data kajian kerana ianya mempunyai banyak kegunaan. Penggunaan soal selidik adalah wajar memandangkan masa yang terhad dan responden tidak dipengaruhi oleh tingkah laku pengkaji (Chua, 2006).

3.3.1 Soal Selidik

Satu set borang soal selidik secara atas talian berkaitan tahap pelaksanaan amalan KKP di dalam kalangan kakitangan teknikal telah disediakan. Borang soal selidik ini mengandungi enam bahagian yang terdiri dari bahagian A sehingga bahagian F. Bahagian A bagi soal selidik ini adalah berkaitan latar belakang responden. Bahagian B sehingga F pula berkaitan dengan persepsi terhadap pelaksanaan KKP di tempat kerja setiap responden.

3.3.2 Kajian Rintis

Tahap kebolehpercayaan kajian dapat ditentukan dengan menggunakan interprestasi nilai *Alpha Cronbach* yang mempunyai julat antara 0.00 hingga 1.0. Sekiranya nilai julat menghampiri 1.0, ia menunjukkan tahap kebolehpercayaan berada pada tahap baik, tinggi, dan berkesan. Manakala, julat menghampiri 0.00 pula, ia menggambarkan tahap kebolehpercayaan yang rendah (Yusof, 2004). Jadual 1 menunjukkan panduan dalam menganalisis kajian rintis.

Jadual 1 : Jadual Interprestasi Skor *Alpha Cronbach*

Skor *Alpha Cronbach*	Tahap Kebolehpercayaan
0.8 hingga 1.0	Sangat baik dan efektif dengan tahap konsistensi yang tinggi
0.7 hingga 0.8	Baik dan boleh diterima
0.6 hingga 0.7	Boleh diterima
<0.6	Item perlu dibaiki
<0.5	Item perlu digugurkan

Sumber : (Bond & Fox, 2015)

Set soal selidik yang telah disediakan perlu diuji terlebih dahulu kebolehpercayaannya bagi memastikan bahawa set soal selidik sesuai untuk digunakan di dalam kajian ini. Seramai 12 orang responden yang mempunyai latar belakang yang sama iaitu bidang teknikal telah dipilih dalam kajian rintis ini. Jadual 2 menunjukkan analisis kajian rintis yang telah dijalankan kepada set borang soal selidik iaitu nilai purata *Alpha Croanbach* sebanyak 0.972 iaitu berada pada tahap yang sangat baik.

Jadual 2 : Kebolehpercayaan Item Bagi Setiap Kriteria Bagi Staf

Kriteria	Nilai Kebolehpercayaan
Polisi Keselamatan	0.917
Panduan Asas	0.902
Amalan Keselamatan Dan Kesihatan Pekerjaan	0.774
Audit, Pemeriksaan dan Penilaian Keselamatan	0.917
Program dan Latihan Keselamatan	0.951
Purata	0.972

3.4 Kaedah Penganalisaan Data

Data yang diperolehi melalui soal selidik secara atas talian dianalisis berdasarkan objektif dan secara kuantitatif. Dapatan ini kemudiannya disusun, diringkaskan dan dipersembahkan dalam bentuk yang mudah difahami. Analisis ini menggunakan Perisian *Statistical Packages for The Social Sciences (SPSS)* versi 20.0 bagi mempersembahkan hasil dapatan. Proses menganalisis data hanya melibatkan analisis berkaitan taburan latar belakang responden dan tahap skor min pelaksanaan amalan KKP dan pengetahuan kepada perundangan KKP dalam kalangan staf teknikal.

4. ANALISIS DAN KEPUTUSAN

Dapatan kajian adalah berkaitan dengan objektif yang dirancang dan ingin dicapai dalam kajian ini. Dapatan kajian dibahagikan kepada dua objektif iaitu tahap perlaksaan amalan KKP dan pengetahuan kepada perundangan KKP dalam kalangan staf teknikal JKR, JPS dan JAS. Data yang diperolehi melalui soal selidik dianalisis menggunakan statistik deskriptif seperti peratusan, min dan sisihan piawai digunakan untuk menghuraikan tahap perlaksanaan amalan KKP, dan pengetahuan kepada perundangan KKP . Skema penskoran adalah bersifat konservatif supaya selari dengan skala yang dipilih dan ditunjukkan dalam Jadual 3 di bawah.

Jadual 3: Tafsiran Julat Nilai Min

Skor Min	Tafsiran Min	Tahap
1.00 hingga 2.33	Rendah	Lemah
2.34 hingga 3.66	Sederhana	Sederhana
3.67 hingga 5.00	Tinggi	Baik

Sumber : Abdul Ghafar, M.M., (2003)

4.1 Analisis Demografik Responden

Jadual 4 menunjukkan maklumat responden berkenaan jawatan di organisasi. Sebanyak 62.5% adalah staf profesional dan 37.5% adalah daripada staf sokongan teknikal yang berkhidmat di JKR, JPS dan JAS.

Jadual 4: Jawatan, organisasi dan pengalaman responden

		Bilangan responden	Peratusan(%)
Jawatan	Profesional	35	62.5
	Staf sokongan teknikal	21	37.5
Organisasi	JPS	22	39.3
	JKR	19	33.9
	JAS	15	26.8
Pengalaman	1hingga 5 tahun	14	25.0
	6 hingga 10 tahun	10	17.9
	10 tahun ke atas	32	57.1
	Jumlah Purata	56	100

Jadual 4 juga menunjukkan organisasi tempat responden berkhidmat iaitu JPS, JKR atau JAS. Maklumat ini perlu bagi memudahkan pengkaji untuk melihat perbandingan pelaksanaan KKP di organisasi teknikal yang berbeza. Responden terdiri daripada 39.3% staf JPS, 33.9% daripada JKR dan 26.8% adalah daripada JAS. Seterusnya, maklumat berkaitan tempoh pengalaman kerja responden dalam bidang teknikal menunjukkan sebanyak 57.1% responden berpengalaman lebih dari 10 tahun bekerja, sebanyak 17.9% adalah pengalaman 6 hingga 10 tahun dan 25% adalah berpengalaman 1 hingga 5 tahun.

4.2 Analisis Deskriptif Responden

Analisis data dan ulasan data tertumpu kepada aspek polisi keselamatan, panduan asas, amalan keselamatan dan kesihatan pekerjaan, audit pemeriksaan dan penilaian keselamatan serta program dan latihan keselamatan.

4.2.1 Menentukan Tahap Perlaksanaan Amalan KKP dalam Kalangan Staf Teknikal.

Faktor-faktor yang menentukan tahap perlaksanaan amalan KKP dalam kalangan staf teknikal di JKR, JPS dan JAS dapat dikenalpasti dalam bahagian ini. Analisis soal selidik pada Bahagian B,C,D dan F adalah bagi menjawab kepada objektif pertama kajian.

a. Bahagian B: Polisi Keselamatan

Jadual 5 menunjukkan majoriti responden sangat setuju dengan soalan-soalan yang di kemukakan. Item yang tertinggi nilai min adalah item pertama iaitu "Di setiap bahagian di tempat kerja terdapat polisi keselamatan yang disediakan oleh JKKP" dengan nilai min 4.14 dan diikuti item ke-12 serta ke-13 iaitu "Kemudahan dan peralatan keselamatan disediakan kepada semua pekerja organisasi ini" dan "Saya sedar dan sensitif kepada perilaku dan suasana yang boleh mengakibatkan kemalangan dan kecederaan" masing-masing dengan nilai min yang sama iaitu 4.0. Ini jelas menunjukkan majoriti responden mempunyai pengetahuan mengenai Polisi Keselamatan di organisasi mereka dan pekerja teknikal perihatin terhadap suasana tempat kerja yang boleh mengakibatkan kemalangan. Purata min keseluruhan bagi pengetahuan terhadap polisis keselamatan adalah 3.80 iaitu pada tahap baik.

Jadual 5: Taburan Kekerapan dan Persepsi Responden Terhadap Polisi Keselamatan

No item	Pernyataan	Min	Sisihan Piawai	Tafsiran Min	Tahap
1	Di setiap bahagian di tempat kerja terdapat polisi keselamatan yang disediakan oleh JKKP	4.14	0.796	Tinggi	Baik
2	Tahap perlaksanaan polisi keselamatan yang dilaksanakan di tempat kerja adalah baik.	3.93	0.710	Tinggi	Baik
3	Tugas dan tanggungjawab setiap staf dinyatakan dengan jelas dalam polisi tersebut	3.93	0.892	Tinggi	Baik
4	Objektif keselamatan dinyatakan dalam polisi tersebut	4.04	0.830	Tinggi	Baik
5	Latihan keselamatan untuk semua staf dinyatakan dalam polisi tersebut	3.93	0.850	Tinggi	Baik
6	Terdapat pemeriksaan keselamatan harian, mingguan dan juga bulanan bersama dengan pegawai keselamatan	3.39	0.947	Sederhana	Sederhana
7	Terdapat khidmat pembantu perubatan jika berlaku kecemasan	2.96	0.990	Sederhana	Sederhana
8	Prosedur dan pelan kecemasan disediakan di tempat kerja anda	3.82	0.716	Tinggi	Baik
9	Laporan tahap keselamatan bagi sesuatu tempoh tertentu disediakan oleh setiap pegawai KKP jabatan	3.71	0.847	Tinggi	Baik
10	Semua kemalangan, penyakit, keracunan dan kejadian berbahaya di laporkan serta langkah-langkah pencegahan diambil bagi mencapai kemalangan sifar.	3.93	0.657	Tinggi	Baik
11	Pegawai KKP menjalankan siasatan perkara yang berisikodi dalam dan luar tempat kerja secara berkala	3.64	0.819	Sederhana	Sederhana
12	Kemudahan dan peralatan keselamatan disediakan kepada semua pekerja organisasi ini	4.00	0.809	Tinggi	Baik
13	Saya sedar dan sensitif kepada perilaku dan suasana yang boleh mengakibatkan kemalangandan kecederaan.	4.00	0.853	Tinggi	Baik
	Purata Keseluruhan	3.80	0.824	Tinggi	Baik

b. Bahagian C: Panduan Asas

Jadual 6 menunjukkan taburan kekerapan dan persepsi responden terhadap panduan asas yang disediakan oleh organisasi. Keseluruhan responden bersetuju dengan item soalan yang dikemukakan dengan nilai min adalah 3.91 iaitu pada tahap baik. Hasil dapatan menunjukkan responden didedahkan dengan panduan asas KKP seperti pendedahan bekerja dalam suasana selamat, penerapan amalan 5S di tempat kerja, panduan KKP disediakan kepada pekerja sebelum, semasa dan selepas melakukan kerja dan JKKP sentiasa memantau keadaan tempat kerja dengan menggunakan senarai semak secara berkala. Panduan asas ini telah mendorong pekerja untuk bekerja dalam keadaan selamat dan selesa.

Jadual 6: Taburan Kekerapan dan Persepsi Responden Terhadap Panduan Asas

No item	Pernyataan	Min	Sisihan Piawai	Tafsiran Min	Tahap
1	Pekerja dilatih dalam aspek keselamatan dan kesihatan pekerja seperti melatih bagaimana untuk mengangkat beban secara manual dengan betul	3.64	0.724	Sederhana	Sederhana

2	Panduan keselamatan dan kesihatan pekerjaan disediakan untuk kakitangan sebagai panduan sebelum, semasa dan selepas melakukan aktiviti kerja	3.82	0.664	Tinggi	Baik
3	JKKP sentiasa memantau keadaan tempat kerja dengan menggunakan senarai semak secara berkala	3.68	0.811	Tinggi	Baik
4	Ruang khas di sediakan untuk menyimpan bahan merbahaya serta melabelkan setiap bekas bahan tersebut	3.71	0.803	Tinggi	Baik
5	Pencahayaan adalah memenuhi keperluan bagi meningkatkan kualiti dan prestasi kerja	3.96	0.687	Tinggi	Baik
6	Peti pertolongan cemas disediakan di dalam pejabat untuk kemudahan semasa kecemasan	4.29	0.653	Tinggi	Baik
7	Alat pemadam api diperiksa secara berkala supaya boleh berfungsi dengan baik	4.25	0.694	Tinggi	Baik
8	Amalan 5S (Sisih, Susun, Sapu, Seragam dan sentiasa amalkan dipraktikkan di tempat kerja anda	3.96	0.738	Tinggi	Baik
	Purata Keseluruhan	3.91	0.722	Tinggi	Baik

c. Bahagian D: Amalan Keselamatan dan Kesihatan Pekerjaan

Dapatan hasil analisis bagi item amalan keselamatan dan kesihatan pekerjaan dalam jadual 7 menunjukkan nilai min purata keseluruhan pada tahap yang baik iaitu 3.93. Pekerja teknikal di organisasi ini rata-rata tahu sekurang-kurangnya satu undang-undang KKP dan bersedia jika berlaku sebarang kemungkinan atau kecemasan di tempat kerja. Nilai min bagi kedua-dua item ini adalah 4.32 dan 4.25. Mereka juga mengambil bahagian dalam aktiviti promosi KKP dan ini dibuktikan dengan nilai min item kedua iaitu 3.75.

Jadual 7: Taburan Kekerapan dan Persepsi Responden Terhadap Amalan Keselamatan Dan Kesihatan Pekerjaan

No item	Pernyataan	Min	Sisihan Piawai	Tafsiran Min	Tahap
1	Saya tahu sekurang-kurangnya satu undang-undang keselamatan dan kesihatan pekerjaan.	4.32	0.606	Tinggi	Baik
2	Saya telah terlibat dalam aktiviti promosi KKP	3.75	0.879	Tinggi	Baik
3	Pihak pengurusan memberi ganjaran kepada pekerja yang mengamalkan amalan pekerjaan yang selamat.	3.29	0.803	Sederhana	Sederhana
4	Saya akan melaporkan kepada pihak pengurusan tentang apa-apa bahaya yang mungkin berlaku di tempat kerja saya.	4.25	0.694	Tinggi	Baik
5	Saya tahu apa yang perlu dilakukan jika saya tercedera atau dalam keadaan kecemasan	4.04	0.687	Tinggi	Baik
	Purata Keseluruhan	3.930	0.734	Tinggi	Baik

d. Bahagian F: Program dan Latihan Keselamatan

Jadual 8 di bawah menunjukkan taburan kekerapan dan persepsi responden terhadap program dan latihan keselamatan yang dianjurkan di organisasi.

Jadual 8: Program dan Latihan Keselamatan

No item	Pernyataan	Min	Sisihan Piawai	Tafsiran Min	Tahap
1	Saya mempunyai pengetahuan mengenai KKP di organisasi	4.11	0.679	Tinggi	Baik
2	Saya telah diberi pendedahan awal kepada undang-undang KKP	3.93	0.657	Tinggi	Baik
3	Saya telah diberi pendedahan terhadap hazard-hazard yang ada di sekitar tempat kerja	4.21	0.624	Tinggi	Baik
4	Saya telah diberi pendedahan terperinci tentang prosedur kerja yang tidak selamat di tempat kerja	4.00	0.714	Tinggi	Baik
5	Saya pernah menghadiri kursus/latihan KKP di peringkat organisasi	4.04	0.914	Tinggi	Baik
6	KKP organisasi sentiasa merancang program KKP untuk staf di organisasi ini (Cth : Fire Drill,Emegerncy Respon Team)	4.00	0.603	Tinggi	Baik
7	JKKP organisasi sentiasa memberi motivasi kepada staf tentang amalan kerja selamat di tempat kerja	3.79	0.780	Tinggi	Baik
8	JKKP organisasi sentiasa memberi latihan induksi kepada pekerja baru dan latihan yang berterusan kepada pekerja yang lain	3.82	0.811	Tinggi	Baik
	Purata Keseluruhan	3.99	0.723	Tinggi	Baik

Secara keseluruhan menunjukkan dapatan min purata adalah 3.99 iaitu pada tahap baik. Hasil analisis dapat disimpulkan bahawa pekerja-pekerja teknikal telah diberi pendedahan awal kepada undang-undang KKP dan hazard-hazard yang ada di sekitar tempat kerja. Masing-masing menunjukkan nilai min bagi kedua-dua item adalah 3.93 dan 4.21. Selain itu, bagi item ketujuh "JKKP organisasi sentiasa memberi motivasi kepada staf tentang amalan kerja selamat di tempat kerja" mencatatkan nilai min 3.79. Ini menunjukkan JKKP setiap organisasi sentiasa memberi dorongan dan motivasi kepada pekerja teknikal agar bekerja dalam keadaan selamat.

4.2.2 Menentukan Tahap Pegetahuan kepada perundangan KKP dalam Kalangan Staf Teknikal.

Analisis soal selidik pada Bahagian E adalah bagi menjawab kepada objektif kedua kajian.

a. Bahagian E : Audit, Pemeriksaan dan Penilaian Keselamatan

Jadual 9 menunjukkan dapatan bagi item audit, pemeriksaan dan penilaian keselamatan di tempat kerja. Dapatan menunjukkan item yang kelima iaitu "Terdapat maklumbalas daripada kakitangan teknikal mengenai perlaksanaan amalan di organisasi" mempunyai nilai min tertinggi iaitu 4.04 dan diikuti item keempat "Terdapat pemeriksaan peralatan-peralatan pencegahan Kebakaran dan kecemasan" dengan nilai min 4.00. Secara keseluruhan min purata bagi item-item Audit, pemeriksaan dan penilaian keselamatan adalah 3.92 dan sisihan piawai 0.741 iaitu berada pada tahap baik.

Jadual 9 : Taburan Kekerapan dan Persepsi Responden Terhadap Audit, Pemeriksaan dan Penilaian Keselamatan

No item	Pernyataan	Min	Sisihan Piawai	Tafsiran Min	Tahap
1	Terdapat audit keselamatan di teknikal secara berkala oleh Pegawai Keselamatan luar	3.89	.731	Tinggi	Baik
2	Terdapat pemeriksaan yang terperinci terhadap keseluruhan Sistem operasi kerja di tempat kerja	3.75	.792	Tinggi	Baik
3	Terdapat penilaian keselamatan oleh pegawai keselamatan Organisasi berdasarkan borang semakan piawai	3.93	.759	Tinggi	Baik

4	Terdapat pemeriksaan peralatan-peralatan pencegahan Kebakaran dan kecemasan	4.00	.853	Tinggi	Baik
5	Terdapat maklumbalas daripada kakitangan teknikal mengenai Perlaksanaan amalan di organisasi	4.04	.571	Tinggi	Baik
	Purata Keseluruhan	3.92	0.741	Tinggi	Baik

4.2.2 Perbincangan

Daripada analisis didapati bahawa konstruk polisi keselamatan mencatatkan nilai min yang paling rendah berbanding dengan konstruk yang lain dengan nilai skor min sebanyak 3.80 dengan sisihan piawai 0.824. Menurut Raudhiah, Nakiah, & Hashim, (2015), polisi keselamatan dan kesihatan ini dapat memberi kesan tahap kesedaran setiap pekerja terhadap amalan kerja selamat di tempat kerja. Bagi panduan asas pula, dapatan merekodkan skor min sebanyak 3.91 dengan sisihan piawai 0.722

Dapatan kajian juga medapati bahawa konstruk bagi amalan keselamatan dan kesihatan pekerjaan merupakan konstruk yang mencatatkan nilai skor min kedua tertinggi iaitu sebanyak 3.93 dengan sisihan piawai 0.734. Dapatan ini menggambarkan pekerja teknikal sentiasa menitikberatkan amalan keselamatan dan kesihatan pekerjaan dalam setiap tugas yang diberikan. Dapatan ini di sokong oelh Garcia-Herrero (2012) yang membahaskan amalan kesihatan dan keselamatan di tempat kerja bertujuan mewujudkan keadaan, kemampuan serta tabiat yang membolehkan pekerja melaksanakan pekerjaan mereka dengan cekap dan betul bagi mengelakkan sebarang kemalangan.

Manakala program dan latihan keselamatan pula adalah merupakan konstruk yang mencatatkan nilai skor min yang paling tinggi bagi kajian ini iaitu sebanyak 3.99 dengan 0.723. Skor min yang tinggi ini menunjukkan bahawa organisasi seperti JAS, JKR dan JPS kerap menjalankan program dan latihan keselamatan di kalangan staf teknikal mereka. Dapatan ini di sokong oleh Paringga (2010) yang mengupas bahawa pendidikan dan latihan perlu disediakan untuk memberi kefahaman terhadap para pekerja mengenai amalan kerja yang selamat dan pekerja digalakkan untuk melaksanakan tugasan yang sama berulang kali bagi menambah nilai kemahiran mereka. Hal ini secara tidak langsung akan dapat mengurangkan kes kemalangan kerana pekerja lebih faham dan mahir untuk mengendalikan sesuatu tugasan.

Konstruk bagi audit, pemeriksaan dan penilaian keselamatan pula menunjukkan nilai skor min ketiga tertinggi iaitu sebanyak 3.92 dengan sisihan piawai 0.741. Kekerapan audit, pemeriksaan dan penilaian keselamatan memainkan peranan penting dalam meningkatkan kualiti amalan KKP. Dapatan ini di sokong oleh Nikolaos (2010) yang menegaskan pemeriksaan keselamatan tapak antara amalan yang harus dititikberatkan oleh majikan atau penyelia tapak agar dapat mengenalpasti keadaan tapak samada berada dalam keadaan selamat ataupun tidak.

Jadual 10 : Tahap Keseluruhan Pelaksanaan Amalan KKP dan Pegetahuan kepada Perundangan KKP dalam kalangan staf teknikal di JKR, JPS dan JAS

Bahagian	Jenis Konstruk	Skor Min	Sisihan Piawai	Aras Persetujuan	Tafsiran Min
B	Polisi Keselamatan	3.80	0.824	Setuju	Tinggi
C	Panduan Asas	3.91	0.722	Setuju	Tinggi
D	Amalan Keselamatan Dan Kesihatan Pekerjaan	3.93	0.734	Setuju	Tinggi
F	Program dan Latihan Keselamatan	3.99	0.723	Setuju	Tinggi
Objektif 1	Purata Keseluruhan	3.91	0.751	Setuju	Tinggi

E	Audit, Pemeriksaan dan Penilaian Keselamatan	3.92	0.741	Setuju	Tinggi
Objektif 2	Purata Keseluruhan	3.92	0.741	Setuju	Tinggi

Hasil analisis daripada Jadual 10 menunjukkan bahawa konstruk-konstruk bagi kajian berkaitan tahap pelaksanaan amalan KKP dan pegetahuan kepada perundangan KKP dalam kalangan staf teknikal. Nilai purata keseluruhan tahap perlaksanaan amalan KKP dalam kalangan staf teknikal mempunyai tahap skor min yang tinggi iaitu sebanyak 3.91 dengan sisihan piawai 0.751. Ini menunjukkan tahap perlaksanaan amalam KKP dalam kalangan staf adalah baik dan menjawab kepada objektif pertama kajian. Selain itu, keputusan keseluruhan pegetahuan kepada perundangan KKP dalam kalangan staf teknikal ialah skor min 3.92 dan sisihan piawai ialah 0.741. Ini juga menunjukkan bahawa semua staf teknikal memahami perundangan yang berkaitan dengan KKP di jabatan dan menjawab kepada objektif kedua kajian.

5. CADANGAN

Berdasarkan kepada hasil dapatan kajian yang diperolehi, pengkaji berpendapat kajian-kajian lanjutan perlu dijalankan dalam usaha untuk memperolehi lebih banyak maklumat berkaitan pelaksanaan amalan KKP. Antara cadangan tersebut adalah seperti berikut:

i. Melaksanakan kajian berkaitan pelaksanaan amalan keselamatan dan kesihatan secara meluas yang melibatkan semua negeri serta membandingkan tahap kesedaran terhadap keselamatan dan kesihatan mengikut zon negeri.
ii. Melaksanakan kajian berkaitan keperluan mengenal pasti faktor-faktor yang dapat menambahbaik kesedaran majikan dan pekerja dalam melaksanakan amalan keselamatan dan kesihatan di tempat pekerja.
iii. Kaedah pengumpulan data secara temubual dalam kalangan majikan dan pekerja pekerja teknikal di tempat kerja perlu di laksanakan agar dapat mengenalpasti tahap kefahaman mereka mengenai amalan keselamatan dan kesihatan pekerjaan.
iv. Mengkaji perincian Manual Keselamatan dan Kesihatan Pekerjaan JKR,JPS dan JAS bagi mengetahui prosedur yang tepat bagi mewujudkan persekitaran kerja yang selamat.

6. KESIMPULAN

Dapat disimpulkan bahawa pelaksanaan amalan keselamatan dan kesihatan pekerjaan dalam kalangan staf teknikal berada pada tahap yang sangat baik. Ini dapat dilihat melalui dapatan kajian yang memperoleh skor min yang tinggi pada semua bahagian seperti polisi keselamatan, panduan asas, amalan keselamatan dan kesihatan pekerjaan, audit pemeriksaan dan penilaian keselamatan, dan juga program dan latihan keselamatan. Selain itu, mereka juga mempunyai pengetahuan tinggi bagi mengenalpasti risiko dan juga permasalahan tentang cara kerja yang selamat di tempat kerja.

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KAJIAN PENGURANGAN KADAR PENOLAKKAN BAGI PRODUK *ARMREST* MELALUI PENGUBAHSUAIAN DAN PENAMBAHBAIKKAN LEKAPAN

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Abstrak. Kajian ini adalah mengenai bagaimana untuk menurunkan kadar penolakkan bagi produk *armrest* di sebuah kilang di Bukit Beruntung dan seterusnya meningkatkan produktivitinya melalui penambahbaikan lekapan . Konsep *Seven Lean Manufacturing Waste* telah digunapakai untuk mengenalpasti sebab dan punca kecacatan yang berlaku dalam penghasilan produk *armrest*. Kadar penolakkan yang tinggi bagi produk ini telah dikenalpasti berlaku pada stesen kerja ikatan pelekat yang menyebabkan kecacatan yang dikenali sebagai *Foam Bump*. Seterusnya kajian ini mendapati masalah *Foam Bump* berpunca daripada lekapan yang digunakan pada stesen kerja bagi proses ikatan pelekat. Maka pengubahsuaian dan penambahbaikan lekapan yang sedia ada dicadangkan serta dilaksanakan. Dapatan yang perolehi selepas penambahbaikkan lekapan menunjukkan pengurangan kadar penolakkan bagi pengeluarkan produk *armrest* adalah sebanyak lapan puluh tujuh peratus.

Kata Kunci: lekapan, *foam bump,* ikatan pelekat, proses pembalutan

1. PENGENALAN

Lean Manufacturing merupakan metodologi yang digunakan secara meluas didalam industri pembuatan terutamanya industri automotif untuk meningkatkan pengeluaran dan mengurangan sisa buangan didalam proses pengeluaran. Menurut Rachaelle (2019) L*ean Manufacturing* merujuk kepada penerapan amalan dan prinsip serta merupakan kaedah yang dibangunkan didalam pengeluran produk. Menurut Rachaelle (2019) lagi, banyak pengeluar menggunakan konsep *Lean Manufacturing* untuk mengurangkan sisa buangan, mengoptimumkan proses, mengurangkan kos, meningkatkan inovasi, dan mengurangkan masa untuk memasarkan di pasaran global.

Menurut Margaret (2000) *Lean Manufacturing* adalah pendekatan sistematik untuk mengenalpasti dan mengurangkan sisa buangan melalui penambahbaikkan berterusan saterusnya meningkatkan produktiviti. Sisa buangan dilihat sebagai apa sahaja yang tidak dipercayai dan diingini oleh pelanggan yang tidak mempunyai nilai tambah dan pelanggan tidak bersedia membayarnya. Menurut Margaret (2020) lagi, antara kelebihan *Lean Manufacturing* adalah dapat mengurangkan masa pengeluaran, pengurangan kos operasi dan peningkatan kualiti produk.

Menurut Evi (2017) *Lean Manufacturing* merupakan kaedah pengeluaran yang berasal dari *Toyota Production System* dan diperkenalkan oleh Shigeo Shingo yang berfungsi untuk mengurangkan dan menghapuskan sisa buangan. Terdapat tujuh jenis sisa buangan iaitu *overproduction, waiting, transportation, defect, unnecessary inventory, inappropriate processing dan unnecessary motion.*

Ikatan pelekat *(adhesive bonding)* adalah proses di mana dua permukaan bahan dilekatkan bersama biasanya untuk menghasilkan satu produk yang lain. Proses ini melibatkan bahan

seperti gam, epoksi atau pelbagai agen plastik yang terikat oleh penyejatan pelarut. Ini dilakukan dengan menyemburkan agen pengikat dengan tekanan atau masa tertentu. Ikatan pelekat boleh digunakan untuk melekatkan hampir semua kombinasi permukaan.

Lekapan adalah alat yang digunakan untuk meletak, menyokong dan memegang benda kerja ketika proses pemasangan produk. Lekapan dalam proses ikatan pelekat membantu operator untuk melekatkan permukaan *PU Foam Bun* dan Substrat bersama-sama untuk menghasilkan ikatan yang kuat dan kemas. Lekapan adalah peralatan yang digunakan untuk memegang produk bagi memastikan produk diletakkan pada kedudukan yang tepat dan posisi betul semasa proses ikatan pelekat. Saterusnya *PU Foam Bun* dan Substrat yang telah dilekatkan akan dihantar ke proses pembalutan dimana hasil ikatan yang kuat dan kemas semasa proses ikatan pelekat akan menghasilkan permukaan armrest yang kemas. Masalah yang dihadapi didalam proses pengeluarkan armrest adalah rekabentuk lekapan yang sedia ada bagi proses ikatan pelekat kurang sesuai kerana lekapan tersebut tidak dapat memegang produk dengan cukup baik dan kemas. Keadaan ini menyebabkan berlakunya kecacatan pada produk semasa proses ikatan pelekat menyebabkan produk ditolak dan tidak dapat dihantar ke proses seterusnya iaitu proses pembalutan.

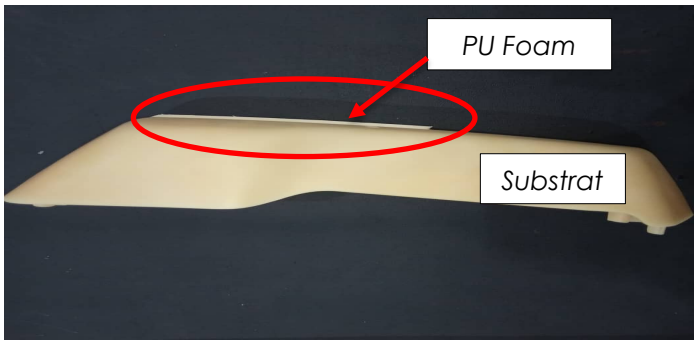
1.2 Objektif kajian

Objektif kajian ini adalah seperti berikut

i. Menganalisis kadar *penolakkan* bagi produk armrest pada stesen kerja ikatan pelekat
ii. Menambahbaik dan mengubahsuai lekapan yang sedia ada bagi proses ikatan pelekat

1.3 Penyataan masalah

Ikatan pelekat ialah proses melekatkan substract dan *PU Foam Bun* dalam pengeluaran armrest. Proses ini dilakukan dengan menggunakan lekapan untuk memegang substract dan *PU foam bun* bagi menghasilkan ikatan yang kemas dan berkualiti sebelum dihantar ke proses pembalutan . Pembalutan adalah proses akhir dalam pengeluaran armrest dimana kekemasan dan kehalusan produk bergantung sepenuhnya kepada kualiti semasa proses ikatan pelekat. Masalah yang dihadapi didalam pengeluaran armrest ialah rekabentuk lekapan yang digunakan kurang sesuai dimana ianya tidak dapat memegang atau mengepit substract dan *PU Foam Bun* dengan sempurna sehingga menyebab berlakunya kecacatan.



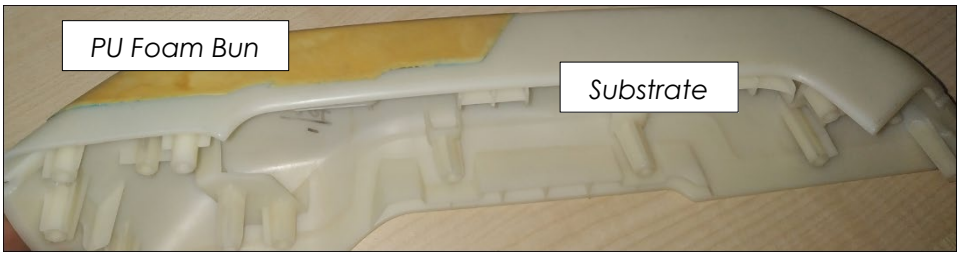
Rajah 1: *PU Foam Bun* tidak dilekat dengan sempurna pada *Substrate*

Rajah 1, menunjukkan *PU foam bun* tidak dilekatkan dengan sempurna pada *substract* sehingga menyebabkan ada lebihan, *PU foam bun* yang dapat dilihat terkeluar dari substract iaitu permukaan kedua-duanya tidak rata. Kecacatan ini akan menyebabkan produk ditolak kerana ia akan menampakkan bonjolan pada armrest selepas proses pembalutan dilakukan.



Rajah 2: Kecacatan yang dikenali sebagai Foam Bump

Rajah 2, menunjukkan kecacatan yang berlaku selepas proses pembalutan yang dipanggil sebagai *Foam Bump*. *Foam bump* merupakan bonjolan yang terjadi pada permukaan armrest yang telah dibalut. *Foam bump* ini berpunca daripada proses lekatan (bonding) yang tidak kemas dan sempurna disebabkan masalah pada lekapan yang digunakan. Kecacatan ini juga akan menyebabkan produk armrest ditolak dan tidak boleh dihantar kepada pelanggan.



Rajah 3: *Pu Foam Bun* yang telah dilekatkan pada *Substrate*

Rajah 3 menunjukkan *PU foam bun* dilekatkan dengan sempurna pada substract, dimana kedua-dua permukaan PU foam dan substract adalah rata, kemas dan tidak kelihatan sebarang bonjolan pada permukaaannya .

2. SOROTAN KAJIAN

Menurut Emilie (2018) kecacatan dalam Lean Manufacturing adalah apabila produk didapati mempunyai kekurangan padanya setelah proses pengeluaran berlaku. Bahagian produk yang terjejas mestilah diperbaiki sepenuhnya dan ianya mengakibatkan kos tambahan, kelewatan dan kemungkinan masalah dari segi keselamatan. Menurut Emilie (2018) kecacatan dalam proses pengeluran merupakan pembaziran dari segi sumber seperti kewangan, sumber manusia dan bahan serta tidak mendatang keuntungan kepada perniagaan. Ini bermakna kecacatan akan mengurangkan keuntungan dengan penggunaan sumber untuk menghasilkan produk tetapi tidak dapat digunakan dan akhirnya tidak dapat dijual

Kecacatan boleh disebabkan oleh pelbagai faktor dan sebahagian besar daripadanya boleh dielak dengan usaha yang berterusan untuk meningkatkan kualiti produk. Kecacatan biasanya berlaku kerana kaedah atau operasi yang salah tanpa standard. Juga, kecacatan mungkin disebabkan oleh operator yang berbeza melakukan operasi dengan cara yang berbeza, terutama jika mereka berada dalam shift kerja yang berlainan. Terdapat banyak kaedah untuk menghilangkan kecacatan tetapi bagi lean manufacrturing, pencegahan adalah perkara utama yang perlu diberi perhatian.

Menurut Skhmot (2017) terdapat empat langkah untuk mengurangkan kecacatan dalam poengeluaran, Pertama, cari kecacatan yang paling biasa dan fokus padanya. Kedua,

rancang proses untuk mengesan kelainan dan jangan luluskan produk yang rosak sepanjang proses pengeluaran. Ketiga, buat semula proses agar tidak mengakibatkan kecacatan. Keempat, bangunkan satu standard pengeluaran yang perlu dipatuhi bagi memastikan proses pembuatan yang konsisten serta bebas dari kecacatan.

Menurut Alhamdi (2019) kecacatan ialah kecacatan fizikal yang secara lansung akan meningkatkan kos pengeluaran, ini termasuklah kesalahan dalam dokumen, penghantaran lewat, pengeluaran mengikut spesifikasi yang salah, dan penggunaan bahan mentah yang berlebihan. Apabila kecacatan terjadi pada produk, pembaikan terhadap produk perlu dilakukan, jika tidak produk terpaksa dilupuskan. Menurut Bandi (2019) Terjadinya kecacatan bukan sahaja membazirkan sumber daya dan tenaga kerja tetapi juga menyebabkan kekurangan bahan mentah, berlakunya kelambatan dalam jadual pengeluaran, meningkatkan masa pengeluaran dan memanjangkan tempoh pengeluaran.

Dalam proses pengeluaran secara besar besaran diindustri, peralatan seperti lekapan amatlah penting dan dapat mempengaruhi kos pengeluaran sesuatu produk. Menurut Radhwan (2019) jig dan lekapan adalah peralatan pengeluaran yang dapat digunakan untuk menghasilkan produk yang sama dari segi dimensi dan bentuknya dengan kualiti yang konsisten. Menurut Radhwan (2019) prinsip asas dalam mereka bentuk jig dan lekapan adalah ianya dapat memegang bahan (produk) dengan tepat dari kedudukannya serta bahan dipegang dengan ketat dan kemas.

Madhok (2018) menyatakan Jig dan lekapan adalah alat pembuatan yang digunakan untuk menghasilkan komponen yang boleh ditukar ganti dan serupa. Jig dan lekapan adalah alat penunjuk dan pemegang bahan kerja yang unik yang direka khusus untuk proses pemesinan dan pemasangan bahagian bahagian tertentu di industri. Seterusnya penggunaan jig dan lekapan dapat mengurangkan kos pengeluaran, meningkatkan kadar pengeluaran, menghasilkan produk yang berkualiti tanpa sebarang kecacatan, mudah ditukarganti dan memudahkan pemasangan bahagian yang komplek.

3. METHODOLOGI

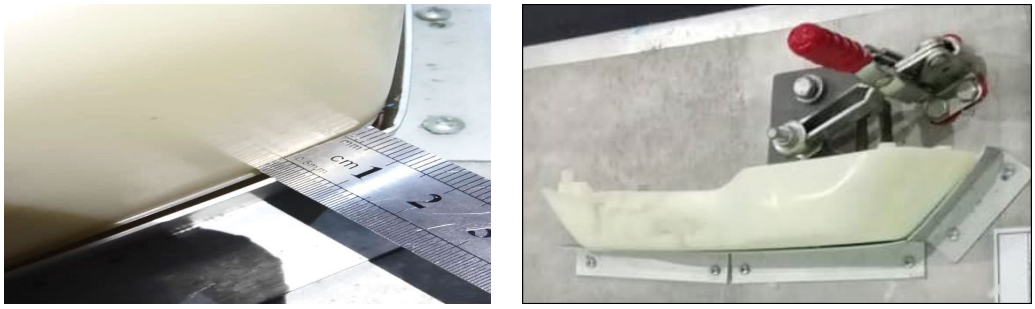
Pendekatan atau kaedah yang digunakan didalam kajian ini adalah konsep CDIO iaitu conceive, design, implement dan operate. Menurut Queen University (2018) CDIO adalah satu anjakan paradigma dalam pendidikan yang menekankan asas-asas penyelidikan, rekabentuk, perlanksanaan fungsi sistem dalam dunia sebenar. Aplikasi konsep CDIO dapat menyelesaikan sesuatu masalah kejuruteraan dengan menyelidik pucanya, merancang kaedah penyelesaian, mengaplikasi dan menggunakan aplikasi tersebut dalam keadaan sebenar.

3.1 Conceive (Memahami)
Conceive adalah kaedah untuk mengenalpasti punca kecacatan yang menyebabkan kadar penolakkan yang tinggi di dalam pengeluaran produk *armrest*. Pemerhatian pada stesen kerja yang terlibat didalam pengeluaran produk *armrest*, masalah utama yang ditemui adalah berpunca daripada lekapan yang digunakan semasa proses kerja ikatan pelekat.



Rajah 4: Lokasi melekatkan *PU Foam bun* pada *Substrate*

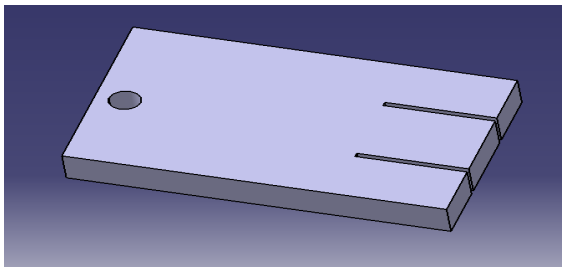
Rajah 4 menunjukkan lokasi kedudukan *PU foam bun* yang perlu dilekatkan pada substract. Penggunaan lekapan pada proses ikatan pelekat sepatutnya menghasilkan ikatan yang kemas dan tidak berlaku sebarang kecacatan. Namun begitu pada stesen kerja ini menyumbangkan kadar kecacatan yang tinggi bagi pengeluaran *armrest*.



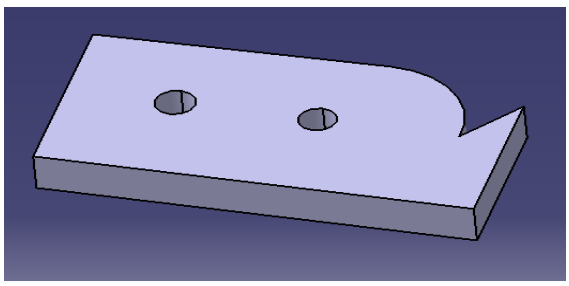
Rajah 5: Ruang antara lekapan dan *substrate*

Rajah 5 menunjukkan bahawa terdapat sedikit ruang (*gap*) apabila substract dipasang pada lekapan . Ukuran gap antara substract dan lekapan adalah 3 mm, gap ini merupakan salah satu punca yang menyebabkan kecacatan yang dipanggil sebagai *Foam Bump*. Gap ini akan menyebabkan PU foam bum tidak berada pada kedudukan yang tepat pada *substrate* semasa proses ikatan pelekat. Fungsi lekapan pada proses ikatan pelekat adalah untuk menekan atau memapatkan *PU foam bun* pada substract pada kedudukan yang tepat. Oleh itu dengan penggunaan lekapan ini, kemungkinan kecacatan untuk berlaku adalah besar dan seterusnya menyebabkan produk akan ditolak.

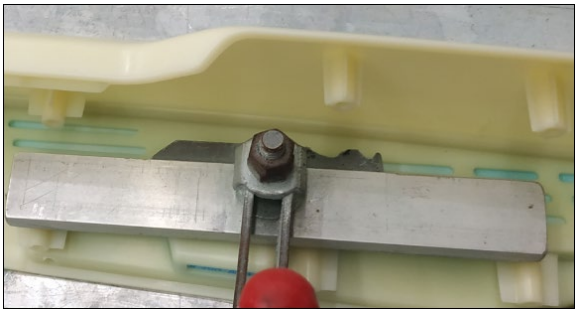
3.2 *Design* (Rekabentuk)
Bagi kajian ini, lakaran awal rekabentuk lekapan dibuat berdasarkan lekapan yang sedia ada. Pengubahsuaian dilakukan pada *Clamp support locator* dan *locator* untuk *substrate*. Rekabentuk yang telah ditambahbaik ini kemudian dipindahkan kepada renkabentuk menggunakan perisian CATIA.



Rajah 6: *Clamp support locator* untuk *substrate*

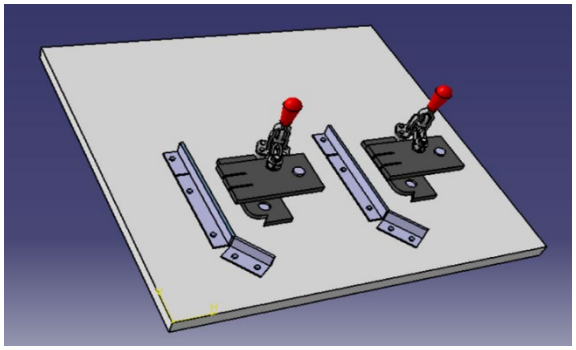


Rajah 7: *Locator* untuk *substrate*



Rajah 8: *Clamp support locator* untuk *substrate* yang sedia ada

Rajah 6 dan rajah 7 menunjukkan rekabentuk *clamp support locator* dan *locator* untuk *substrate* yang telah ditambahbaik bagi menggangtikan clam *locator* yang sedia ada. Rajah 8 pula menunjukkan clamp *locator* yang sedia ada. Kedua-dua *clamp locator* dan *locator* untuk *substrate* dapat menyokong *substrate* supaya berada pada kedudukan yang betul dan tepat semasa proses ikatan pelekat bagi melekatkan *PU foam bun* pada *substrate*.

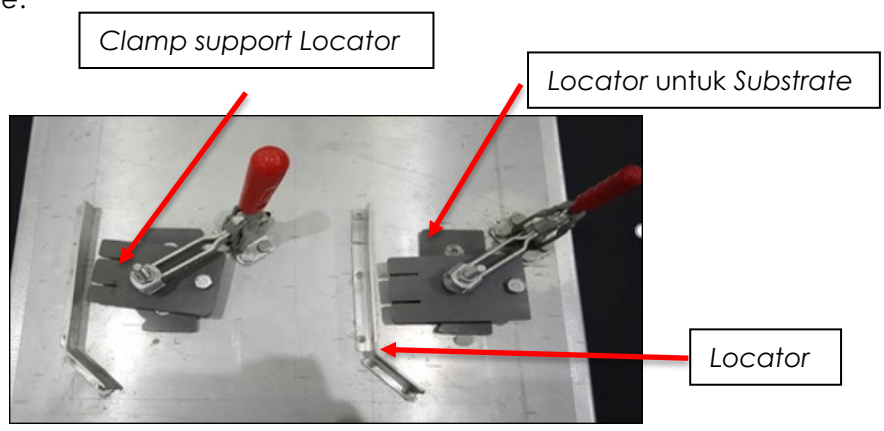


Rajah 9: Lukisan pemasangan lekapan bagi proses ikatan pelekat

Rajah 9 menunjukkan lukisan pemasangan lekapan yang telah ditambah baik. Rekabentuk ini sedia untuk dihasilkan lekapan yang sebenar utuk digunakan pada stesen kerja ikatan pelekat bagi pengeluaran produk *armrest*.

3.3 Implement (Melaksana)

Implement bermaksud mentranformasi rekabentuk yang telah dilaksanakan dalam perisian CATIA menjadi lekapan sebenar. Rekabentuk Lekapan yang telah ditambahbaik dibina menggunakan bahan aluminium bagi *locator* manakala *mild steel* bagi *clamp support* dan *locator* untuk *substrate*.



Rajah 10: Lekapan yang telah ditambah baik

Rajah 10, menunjukkan lekapan yang telah siap dibina dengan penambahbaikan pada *clamp support locator, locator* untuk *substrate* dan *locator.*

3.4 Operate (Menggunakan)
Operate bermaksud menggunakan produk yang telah dilaksanakan untuk memberi keputusan seperti yang diharapkan di dalam objektif kajaian. Maka lekapan yang telah dibina diguna pakai pada stesen kerja ikatan pelekat. Kadar kecacatan direkodkan untuk membuat analisis perbanding sebelum dan selepas penambahbaikan pada lekapan dilakukan.

4. DAPATAN KAJIAN

Data kadar kecacatan yang menyebabkan produk *armrest* sebelum dan selepas penambahbaikan lekapan untuk proses ikatan pelekat direkodkan untuk melihat trend yang berlaku terhadap pengeluaran *armrest*.

Jadual 1: Kadar penolakkan sebelum penambaikan Lekapan

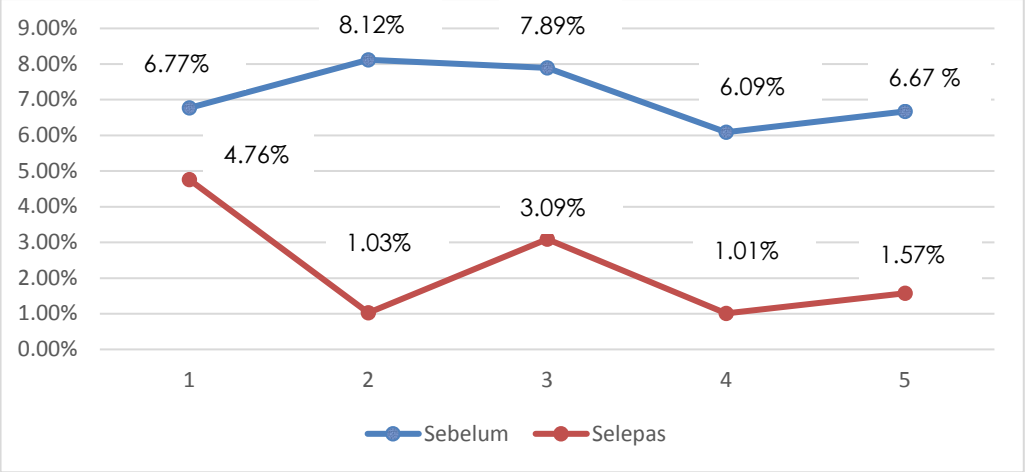
Pengeluaran *Armrest*	Hari				
	4 Feb 2019	5 Feb 2019	6 Feb 2019	7 Feb 2019	8 Feb 2019
Jumlah Pengeluaran	192	197	190	197	195
Jumlah Penolakkan	13	16	15	12	13
Peratus Penolakkan	6.77 %	8.12 %	7.89 %	6.09 %	6.67 %

Jadual 1, menunukkan jumlah pengeluaran produk *armrest* dan kadar penolakkan yang diambil sebelum penambahbaikkan lekapan dilakukan, data ditunjukkan dalam jumlah bilangan dan peratus. Data ini diambil selama lima hari pada bulan Februari 2019 dari jam 8.00 pagi sehingga 5.00 petang.

Jadual 2: Kadar penolakkan selepas penambaikan Lekapan

Pengeluaran *Armrest*	Hari				
	15 April 2019	16 April 2019	17 April 2019	18 April 2019	19 April 2019
Jumlah Pengeluaran	189	194	194	199	190
Jumlah Penolakkan	9	2	6	2	3
Peratus Penolakkan	4.76 %	1.03 %	3.09 %	1.01 %	1.57 %

Jadual 2, menunukkan jumlah pengeluaran produk *armrest* dan kadar penolakkan yang diambil selepas penambaikkan lekapan dilakukan, data ditunjukkan dalam jumlah bilangan dan peratus. Data ini diambil selama lima hari pada bulan April 2019 dari jam 8.00 pagi sehingga 5.00 petang.



Rajah 11: Perbandingan Peratus Kadar Penolakkan

Rajah 11, menunjukkan perbandingan kadar penolakkan sebelum dan selepas penambaikkan lekapan dilakukan. Graf menunjunkkan perbezaan yang ketara bagi peratus kadar penolakkan selepas penambahbaikkan dilakukan.

Jadual 3: Peratus perbezaan kadar Penolakan Sebelum dan Selepas

Pengeluaran *Armrest*					
Peratus kadar penolakkan sebelum penambaikkan lekapan	6.77 %	8.12 %	7.89 %	6.09 %	6.67 %
Peratus kadar penolakkan selepas penambaikkan lekapan	4.76 %	1.03 %	3.09 %	1.01 %	1.57 %
Peratus Perbezaan	10.38%	87.31%	60.83%	83.42%	76.46%

Jadual 3, menunjukkan peratus perbezaan kadar penolakkan sebelum dan selepas penambahbaikkan lekapan dilakukan. Peratus perbezaan terendah adalah 10.38 % manakala peratus perbezaan tertinggi adalah 87.31 %. Daripada perbandingan data sebelum dan selepas penambahbaikkan lekapan adalah jelas menunjukkan kadar penolakkan dapat dikurangkan dan seterusnya meningkatkan kadar pengeluaran produk *armrest*.

Permerhatian secara analitik yang dilakukan terhadap lekapan yang telah ditambahbaik menunjukkan lekapan ini dapat memegang atau mengepit *substract* dan *PU foam* dengan sempurna, dimana lekatan diantara kedua-dua substract dan PU foam adalah kemas dan sambunganya rata serta licin. Lekapan ini juga telah dapat mengatasi atau menghilangkan masalah ruang (*gap*) yang wujud pada lekapan yang lama. Ruang (*gap*) ini menyebabkan kedudukan *PU foam* pada *substract* tidak berada pada kedudukan yang betul. Oleh sebab itu, lekapan yang telah ditambahbaik ini memberikan bacaan data yang menunjukkan pengurangan kadar penolakan didalam pengeluaran produk *Armrest*.

5. KESIMPULAN

Berdasarkan dapatan kajian, seperti yang dinyatakan dalam objektif pertama iaitu menganalisis kadar penolakkan bagi produk *armrest* pada stesen kerja ikatan pelekat. Kadar kecacatan yang menyumbang kepada kadar penolakkan bagi pengeluaran produk *armrest* menunjukkan penurunan yang ketara. Maka penambahbaikkan lekapan telah memberi nilai tambah dan menyumbang kepada peningkatan produktivi dalam pengeluaran *armrest*. Masalah yang dihadapi pada stesen kerja ikatan pelekat telah dikenalpasti dan telah dapat

diatasi. Oleh itu masalah berlakunya kecacatan yang kenali sebagai *Foam bun* telah dapat diatasi dengan menggunakan lekapan yang telah ditambah baik.

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SISTEM PEMANTAUAN KADAR DENYUTAN JANTUNG KENDERAAN (SiPeka iZen)

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Abstrak. Sistem kawalan keselamatan aktif dan pasif kenderaan direka bagi mengelakkan berlakunya kemalangan, mengurangkan kemungkinan terjadinya sesuatu kemalangan dan melindungi pemandu dan penumpang dari kecederaan sewaktu kemalangan. Serangan sakit jantung semasa memandu merupakan salah satu punca yang boleh menyebabkan berlakunya kemalangan di jalan raya. Tujuan sistem pemantauan kadar denyutan jantung kenderaan ini dibangunkan adalah untuk memberi amaran awal kepada pemandu dan seterusnya meningkatkan tahap keselamatan pemandu dan kenderaan tersebut. Sistem ini dilengkapi dengan sensor nadi yang mengesan dan menunjukkan kadar denyutan jantung seseorang, dalam bacaan unit BPM. Bacaan denyutan nadi ini dipaparkan kepada pemandu melalui sistem paparan digital LCD yang diletakkan di dalam kenderaan. Disamping itu, Diod LED yang di kawal oleh papan litar Arduino UNO telah digunakan untuk memberikan amaran kepada pemandu apabila bacaan BPM melebihi daripada tahap biasa. Sistem ini juga mampu memberikan notifikasi dalam bentuk e-mel kepada keluarga pemandu sekiranya bacaan semasa denyutan nadi pemandu melebihi atau kurang daripada nilai yang telah ditetapkan.

Kata Kunci: Denyutan nadi, arduino UNO, amaran awal

1. PENGENALAN

Pereka kenderaan hari ini memberi lebih penekanan mengenai aspek keselamatan sesebuah kenderaan (Haq et al., 2013). Pereka kenderaan sentiasa berusaha untuk mengurangkan kematian dan kecederaan dengan memasukkan reka bentuk serta teknologi baru yang dikembangkan untuk sistem keselamatan aktif dan pasif. Sistem keselamatan pasif terdiri daripada komponen kenderaan yang bertindak balas terhadap kemalangan untuk melindungi penumpang dari kecederaan, sementara ciri sistem keselamatan aktif sentiasa bertindak untuk mengurangkan kemungkinan kejadian yang tidak diingini itu berlaku (Wenzel & Ross, 2005). Ciri keselamatan aktif berfungsi secara senyap untuk memeriksa kelajuan putaran tayar, lokasi kenderaan di lorongnya, atau posisi pedal pecutan dan brek. Kini, banyak sistem keselamatan dihasilkan oleh peraka bentuk kenderaan demi memastikan kenderaan dapat dipandu dalam keadaan yang selamat untuk keselamatan penumpang (Sieveka et al., 2001).

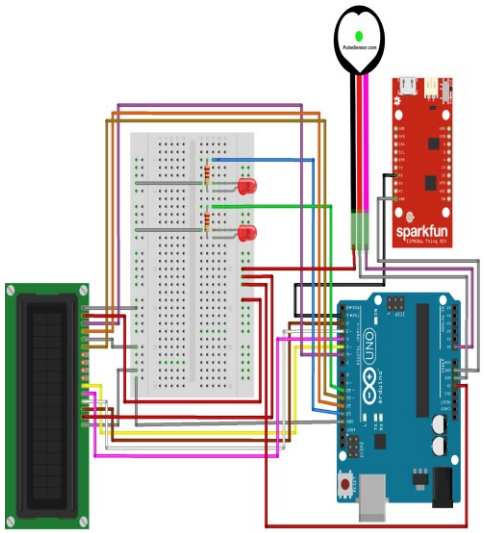
Ciri keselamatan pasif yang berfungsi seperti zon hancur membantu untuk menyerap dan mengedarkan tenaga hentakan kemalangan sebelum sampai ke tempat duduk penumpang dan pemandu. Tambahan lagi, beg udara, tali pinggang keledar, dan sandaran kepala membantu memastikan pemandu dan penumpang tidak bergerak dalam ruangan kenderaan (Moon et al., 2012). Akhir-akhir ini, pereka kenderaan juga telah memfokuskan diri untuk membangunkan sistem pencegahan kemalangan yang canggih dan sistem keselamatan yang aktif seperti sistem kawalan kestabilan elektronik (ESC), sistem amaran perlanggaran hadapan, sistem peringatan penukaran lorong, sistem brek anti-kunci (ABS), monitor bantuan brek dan lain-lain. Sub-sistem ini telah dikembangkan secara optimum dan dilaksanakan untuk mencegah atau mengurangkan keparahan kemalangan (Vashist &

Kumar, 2017). Dengan pengenalan Program Penilaian Kereta Baru (NCAP) yang menetapkan keselarasan dalam ujian sesebuah kemalangan, pembangunan sub-sistem kenderaan menjadi lebih tertumpu pada bidang keselamatan.

Serangan sakit jantung adalah salah satu penyakit yang disebabkan oleh tersumbatnya aliran darah pada arteri koroner yang menyebabkan otot jantung kekurangan oksigen (Kurniawan et al., 2015). Menurut Kementerian Kesihatan Malaysia (KKM), serangan penyakit jantung adalah salah punca utama kematian yang berlaku di Malaysia. Oleh itu, serangan penyakit jantung bukan sesuatu yang boleh dianggap ringan, malah lebih bahaya lagi sekiranya pemandu kenderaan yang di serang penyakit jantung semasa memandu. Hal yang demikian boleh menyebabkan lebih banyak nyawa menjadi pertaruhan semasa di jalan raya. (HASSAN, 2019) melaporkan beberapa keratan akhbar yang menunjukkan kemalangan jalan raya yang disebabkan oleh serangan penyakit jantung. Oleh itu, untuk mengelakkan daripada berlakunya kemalangan jalan raya yang disebabkan serangan penyakit jantung. Sistem pemantauan kadar denyutan jantung telah direkabentuk untuk memberi amaran awal kepada pemandu sebelum berlakunya serangan penyakit jantung, seterusnya dapat mengurangkan kadar kemalangan jalan raya.

2. METODOLOGI KAJIAN

Sistem SiPeKa iZen adalah satu sistem yang digunakan untuk membaca kadar denyutan jantung bagi seorang pemandu kenderaan. Sistem ini dilengkapi oleh pengesan nadi, diod pemancar cahaya (LED) dan di kawal oleh papan litar mikropemproses Arduino UNO seperti yang ditunjukkan pada Rajah 2.1 dan Jadual 2.1 yang berfungsi untuk memberi amaran kepada pemandu apabila bacaan BPM adalah rendah atau tinggi daripada biasa melalui paparan hablur cecair (LCD). Bacaan kadar denyutan jantung akan mula dipaparkan apabila sensor sistem ini diletakkan di salah satu jari pemandu. Antara langkah penting dalam menggunakan sistem ini ialah semasa meletakkan sensor di salah satu jari pemandu bagi memastikan bacaan adalah tepat. Selain itu, sistem ini juga mempunyai paparan LED di mana bacaan kadar jantung seseorang pemandu itu dapat dipaparkan di skrin paparan LED. SiPeKa iZen juga dilengkapi oleh sistem notifikasi (ESP8266) kepada emel keluarga pengguna yang telah didaftarkan ke dalam program SiPeKa iZen melalui applikasi Blynk sekiranya bacaan BPM melebihi 120 BPM atau kurang daripada 60 BPM.



Rajah 2.1 Litar Skematik Produk (Fritzing)

Jadual 2.1 Fungsi Alat Arduino

Pin No	Fungsi	Name
1	Bumi	Ground
2	Voltan bekalan; 5V	Vcc
3	Pelaras kontra	V_{EE}
4	Memilih daftar arahan apabila rendah; dan data mendaftar apabila tinggi	Mendaftar
5	Rendah untuk menulis ke daftar; Tinggi untuk dibaca dari daftar	Tulis
6	Menghantar data ke pin data apabila denyutan tinggi hingga rendah diberikan	Aktifkan
7-14	8-bit data pins	DB0- DB7
15	Lampu latar V_{CC} (5V)	Led+
16	Backlight Ground	Led-

Setelah mengaktifkan sistem, masukkan id Wi-Fi dan kata laluan pada pengekodan. Setelah memasukkan id dan kata laluan Wi-Fi, masukkan perkhidmatan aplikasi e-mel dan notifikasi melalui aplikasi Blynk. Pengekodan melalui aplikasi Blynk untuk degupan jantung (BPM) merbahaya, tinggi dan rendah ada ditunjukkan pada Rajah 2.2, 2.3 dan 2.4. Sekiranya degupan jantung dalam bacaan rendah, tinggi atau merbahaya, pemandu atau keluarga pemandu akan mendapat notifikasi berbentuk e-mel.

```
if (data == 'C')
{
  delay(5);
  if (Serial.read() == '#')
  {
    Blynk.email("mohd.syafiq.amzar@gmail.com","BPM Dangerous", "Kadar degup
    Blynk.notify("BPM DANGEROUS");
    Blynk.tweet("Kadar degupan jantung pengguna Twitter ini melebihi kadar
    // code kena tinggal
    //led1.off();
    //status_bahaya = 0;
```

Rajah 2.2: 'BPM DANGEROUS BPM > 220' akan di hantar ke emel

```
char data = Serial.read();
if (data == 'A')
{
  delay(5);
  if (Serial.read() == '#')
  {
    // code kena tinggal
    //led1.on();
    Blynk.email("mohd.syafiq.amzar@gmail.com","BPM HIGH", "BPM Lebih dari 110"
    Blynk.notify("BPM HIGH");
    //status_bahaya = 1;
```

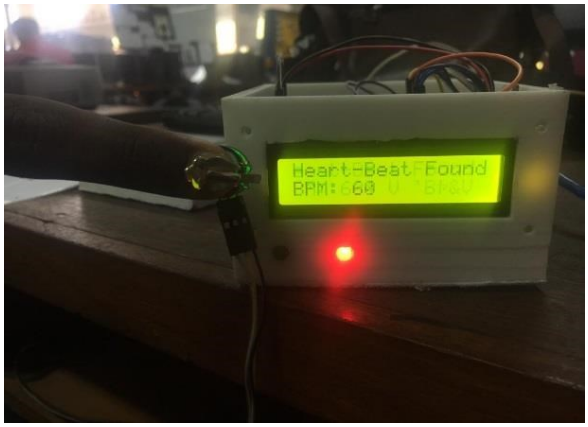
Rajah 2.3: 'BPM HIGH' BPM>110 akan di hantar ke emel

```
if (data == 'B')
{
  delay(5);
  if (Serial.read() == '#')
  {
    Blynk.email("mohd.syafiq.amzar@gmail.com","BPM LOW", "BPM kurang dari
    Blynk.notify("BPM LOW");
    // code kena tinggal
    //led1.off();
    //status_bahaya = 0;
```

Rajah 2.4: 'BPM LOW' BPM<60 akan di hantar ke emel

3. ANALISIS DAN KEPUTUSAN

Hasil dapatan daripada sistem ini telah menunjukkan bacaan kadar denyutan jantung dimana bacaan BPM akan dipancarkan pada paparan LCD apabila pengesan nadi diletakkan di salah satu jari pemandu. Apabila bacaan degupan jantung melebihi dari bacaan 110, bacaan BPM akan dipaparkan pada paparan LCD serta pancaran cahaya LED berwarna hijau akan dinyalakan untuk membuat tanda amaran kepada pengguna di dalam kenderaan seperti yang ditunjukkan pada Rajah 3.1. Apabila bacaan degupan jantung kurang dari bacaan 60, bacaan BPM akan dipaparkan pada paparan LCD serta pancaran cahaya LED berwarna merah akan dinyalakan untuk membuat tanda amaran kepada pengguna di dalam kenderaan seperti yang dintunjukkan pada Rajah 3.2. Manakala jika bacaan degupan jantung dikesan berada di antara 60 hingga 110, bacaan tersebut akan ditunjukkan pada paparan skrin LCD dan pancaran LED berwarna merah hanya akan berkelip mengikut nilai ulangan bacaan.

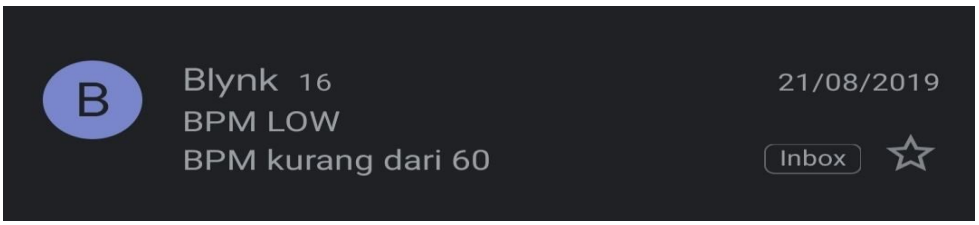


Rajah 3.1 Sistem Pemantauan Kadar Denyutan Jantung (BPM < 60)

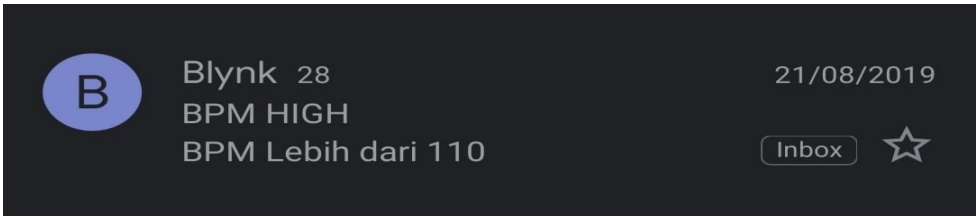


Rajah 3.2: Sistem Pemantauan Kadar Denyutan Jantung (BPM > 110)

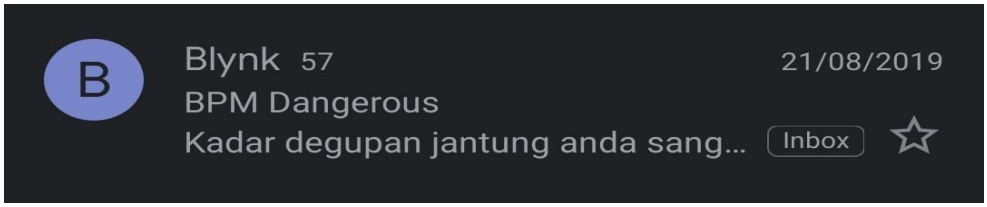
Hasil dapatan daripada sistem pemantauan kadar degupan jantung ini juga adalah untuk memberi notifikasi khas berbentuk e-mel kepada pemandu atau keluarga pemandu mengenai bacaan kadar degupan jantung sewaktu pemanduan. Apabila bacaan degupan jantung kurang dari bacaan 60, satu emel khas telah dihantar kepada pihak yang terlibat yang menyatakan mesej 'BPM LOW - kurang dari 60' seperti yang ditunjukkan pada Rajah 3.3. Apabila bacaan degupan jantung melebihi dari bacaan 110, satu emel khas telah dihantar kepada pemandu dan keluarga pemandu yang menyatakan mesej 'BPM HIGH - lebih dari 110' seperti yang ditunjukkan pada Rajah 3.4. Manakala jika bacaan kadar degupan jantung dikesan melebihi dari bacaan 220, satu emel khas juga telah dihantar kepada pemandu dan keluarga pemandu yang menyatakan mesej 'BPM Dangerous - Kadar degupan jantung sangat tinggi' semasa pemanduan seperti yang ditunjukkan pada Rajah 3.4.



Rajah 3.3: Notifikasi E-mel kadar bacaan BPM rendah (BPM < 60)



Rajah 3.4: Notifikasi E-mel kadar bacaan BPM tinggi (BPM > 110)



Rajah 3.5: Notifikasi E-mel kadar bacaan BPM rendah (BPM > 220)

4. KESIMPULAN

Kertas kajian ini membincangkan sistem keselamatan aktif kenderaan yang memantau kadar degupan jantung pemandu untuk memberikan amaran awal kepada pihak terlibat apabila bacaan degupan jantung tidak berada tahap yang normal semasa pemanduan. Penggunaan pengesan nadi dan diod pemancar cahaya (LED), paparan skrin LCD yang di kawal oleh papan litar mikropemproses Arduino UNO telah digunakan untuk mengesan kadar denyutan jantung pemandu. Aplikasi Blynk telah diguna pakai untuk mengekodkan program notifikasi berbentul e-mel di dalam sistem pemantauan degupan jantung kenderaan ini. Hasil bacaan kadar degupan jantung pada tahap rendah, tinggi dan merbahaya dapat dipaparkan pada paparan LCD. Pancaran cahaya LED berwarna merah atau hijau yang mengikut kadar bacaan semasa dapat dipancarkan. Manakala, notifikasi khas berbentuk e-mel kepada pengguna atau keluarga pengguna dapat dihasilkan untuk memberikan peringatan awal dan seterusnya meningkatkan tahap keselamatan pemandu dan sesebuah kenderaan.

Cadangan penambahbaikkan khususnya untuk memperbaiki sistem pemantauan kadar degupan jantung ini adalah melalui pengekodan program yang lebih spesifik yang dimana dapat digunakan untuk mengesan jantina pemandu, seterusnya boleh membezakan tahap degupan jantung yang normal dalam memberikan peringatan yang tepat antara dua jantina yang berbeza. Disamping itu, penggunaan pengesan nadi tanpa wayar atau pengesan nadi yang diletakkan pada bahagian roda stereng kenderaan juga boleh digunakan untuk meningkatkan keselesaan pemandu ketika menggunakan sistem ini semasa pemanduan.

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DEVELOPMENT OF N3 PLC TRAINER-SENSOR SERIES AS TEACHING AIDS IN AUTOMATION COURSE

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Abstract. N3 PLC Trainer-Sensor Series is a teaching aid that combines various types of hardware such as discrete sensors as input devices, Programmable Logic Controllers (PLC) as microcontroller and pilot lamps as output devices. It is design as an alternative teaching aids specifically for the teaching and learning process in Programmable Logic Control & Automation course, which is the basic competency that must be mastered by electrical engineering polytechnic students. The existing technique use during practical session, specifically for the sensor's topic is, students need to construct circuit using loose parts components, consisting different type of sensors and pilot lamp as the output. The tear and wear for the loose components is high because multiple usage by the students throughout the year. The TRIZ (Theory and Innovative Problem Solving) methodology is used to design the solution during the development of this innovation product. N3 PLC TRAINER-SENSOR SERIES has two main kits namely Sensor Kit and Programmable Logic Controller Kit. The Sensor Kit consists of one main section and one supply area. The main parts consist of six types of digital sensors: Inductive Sensor (NPN & PNP type), Capacitive Sensor (NPN & PNP type), Through Beam Sensor, Diffused Sensor, Retro Reflective Sensor and Limit Switch. The Programmable Logic Controller Kit has three main parts and one supply source. The use of loose components that are assembled on a metal box, is sturdy and user friendly compared to the existing methodology used during the practical work session. Furthermore, this trainer also suitable to be used by other educational institutions specializing in electrical engineering in Malaysia.

Keywords: PLC, discrete sensors, teaching aids

1. INTRODUCTION

Learning outcome achievement is an important aspect for Outcome Based Education implementation. Based on the syllabus provided, lecturer needs to plan and conduct teaching and learning session that will ensure that the students achieve the targeted course learning outcome. The Programmable Logic Control (PLC) & Automation course syllabus for Polytechnic Malaysia, includes the study of various types of discrete sensors, actuators, and their applications in automation system; either using the conventional hardwired relay connection or to a PLC system.

A Programmable Logic Controller or PLC is a special form of microprocessor-based controller that uses programmable memory to store instructions and to implement functions such a s logic, sequencing, timing, counting and arithmetic in order to control machines and processes (Bolton, 2009). Sensor is a type of instrument tools that transforms a physical variable of interest into a measurable form. It can convert the physical variable input into a signal variable output, that can be transmitted to an electrical or mechanical circuit. The signal output from the sensor can be displayed, recorded, or used as an input signal to a secondary device or system. (Webster,1999). Discrete or digital sensor is a type of sensors send signal that is either on/off or

1/0. The on status indicates an object is detected or the level has been reached while the off status indicates there is no object detected.

There are many types of discrete sensors used in an automation system such as limit switch, reed switch, proximity sensors and photo electric sensors. The functions and application of each type of sensors are varied. So as a future technician and engineer, the students must have knowledge and skills on the usage and connection of each device. This topic is specifically thought in the Programmable Logic Controller (PLC) & Automation course. This course is a compulsory subject for Diploma of Electrical Engineering in Polytechnic Malaysia (Idris. & Patakor, 2017). The current syllabus has stated that 25% of the total course assessment is contributed from practical work. The current teaching aids available in the laboratory only consists of contact switches, which are push button, toggle switch and limit switch. Furthermore, the proximity sensors used in the laboratory are loose part, where repeated usage by the students will likely damage the sensors.

This paper presents the development of N3 PLC Trainer-Sensor Series as a teaching aids in automation course, specifically the Programmable Logic Controller (PLC) & Automation course. The objective is to provide alternative teaching aids that can be use during teaching and learning session. It will facilitate the student's achievement of their learning outcome for various types of sensors, sensors output wiring connections and, the input output devices connection to PLC. At the same time, the learning process duration can be saved when using plug and play methods.

The trainer consists of 2 different model of limit switches, inductive proximity sensors (both NPN and PNP type), capacitive proximity sensors (both NPN and PNP type), 3 types of NPN photo electric sensors; through beam, diffused and retro-reflective type. All the input devices are assembled on a metal box and the wirings are connected to female connectors. Students will learn on the operation and wiring connection for all the sensors. There are two types of output sensor wiring, which is the sinking (NPN) and sourcing (PNP). For the first stage, students will do the wiring for basic sensor connection which only involve the connection between the sensor as the input device, pilot lamp as the output device and direct current (DC) voltage supply. Students will construct both type of wiring connections and observe the sensor operation. For the second stage, students will use OMRON Programmable Logic Controller (PLC) as the microcontroller and construct the wiring between sensor, output, and PLC. This trainer is an ideal teaching aid that can demonstrate and teach more realistic industrial application of the sensors in both the knowledge and practical skills, that will better improve student's learning outcome for this course.

1.1 Overview of Programmable Logic Control (PLC) & Automation course

Programmable Logic Control (PLC) & Automation course is a compulsory subject that is teach during the fourth semester for Diploma of Electrical Engineering in Polytechnic Malaysia. It is conducted for 14 weeks per semester which consists of 2 hours of theory and practical work for each week. The theory cover s six chapters namely Introduction to Automation System, Logical Sensors and Actuators, Introduction to PLC System, PLC Programming, PLC Applications and Installing, Maintenance and Troubleshooting of PLC System. The theoretical part is assessed using two quizzes, theory, one end of chapter and final examination. The practical work consists of six practical works. The first two practical works cover the conventional hardwired connection for automation system, using relay, electromechanical timer, input devices such as switches and sensors as well as output devices and actuators. The remaining four practical works involve PLC, which covers the PLC programming and designing PLC application in the industry.

2. LITERATURE REVIEW

The design of N3 PLC Trainer-Sensor Series was based on Course Learning Outcomes (CLO) for Programmable Logic Control (PLC) & Automation course, the Programmed Educational Objectives (PEO) and Program Learning Outcomes (PLO) for Diploma in Electrical Engineering

(DET) And Diploma In Electronic Engineering (Control) (DJK) in Polytechnic Malaysia. The learning activities were conducted using two approaches; Teacher Centered Learning (TCL) approach and Student-Centered Learning (SCL) approach.

Programmable Logic Controllers (PLC) is a specialized type of systems used to control machines and processes. They have been introduced in the early 1970s to replace the existing relay control logic that became obsolete and expensive for implementing systems at that time. On the other hand, PLCs have offered flexibility, higher reliability, better communication possibilities, faster response time, and easier troubleshooting. So far, PLCs have been mainly of interest for industrial control engineers that introduced, developed, and standardized their own design methods and programming languages (Blakley, 2000 & Gawali, 2009).

A discrete input, is an input that is either ON or OFF condition, In the ON condition, a discrete input is declared as logic 1 or high while in the OFF condition a discrete input is declared as logic 0 or OFF (Patel, 2017). Discrete sensors can accurately measure many different things, are easy to instrument, provide built-in communication capabilities, and still are very cheap (Koutsoukos, 2003). Discrete sensors are widely used in the automation industry.

Learning outcomes achievement is crucial issue in a teaching process. However, there are several classical problems in study activities such as less attractive and entertaining for the students. Teacher as facilitator should have the ability to encourage the students on developing and improving knowledge, hands-on skill, attitude, and creative idea to get the qualified graduates (Slameto, 2010). Therefore, to realize the learning condition, using teaching aids is a must. Teaching aids are defined as all physically tools or equipment's that can be used to deliver the lesson materials including textbooks, miniature, prototype, dummy object and all multimedia devices (Mulyasa, 2009).

Separating individual component during practical implementation especially involving PLC module, I/O devices, and power supply, makes the laboratory workbench full of apparatus, which tends to be messy and full of wires. When all the components are embedded in one module, the laboratory workbench only need to accommodate one single module without unnecessary apparatus. It also improves the working environment during the practical session and enhancing the students' understanding and hands-on skill which is good for preparing them to enter the job industries once they are graduated from this institution. (Burhan, Azman, & Talib, 2015).

The current teaching aids available in the laboratory only consists of contact switches, which are push button, toggle switch and limit switch. Furthermore, the proximity sensors used in the laboratory are loose part, where repeated usage by the students will likely damage the sensors due to tear and wear. The new teaching aids was developed by assembling various types of digital sensors, PLC, and pilot lamp in a metal box. Students will use the plug and play method to construct the circuit. Besides improving the working environment, this teaching aids also fulfill the curriculum of the Department of Polytechnic Studies, Ministry of Education Malaysia by emphasizing the effectiveness level on student learning achievement as a whole by taking into consideration the needs to master the skills of designing, installing and maintaining PLC Automation Systems, especially under Sensor & Actuator, Introduction to PLC and PLC Applications topics.

3. RESEARCH METHODOLOGY

The development N3 PLC Trainer Sensor Series was referring to TRIZ, acronym for the "Theory of Inventive Problem Solving", which was developed by G.S. Altshuller. TRIZ can be refer as a useful method in new product development process to produce solution (Ekmekci & Koksal, 2015). By referring to TRIZ, the ideal solution for development of N3 PLC Trainer Sensor Series as in Table 1.

Table 1: TRIZ Principles to Find the Solution for N3 PLC Trainer Sensor Series

Principle Number	Description	Solution
10	Preliminary action	Pre-arrange objects such that they can come into action from the most convenient place and without losing time for their delivery
13	The other way round	Make movable part fixed

Figure 1 shows the flow chart of the overall proses to develop N3 PLC Trainer Sensor Series, during the preliminary stage.

3.1. Design System

Figure 2 shows the block diagram of N3 PLC Trainer Sensor Series, consisting of four main components which are input devices, controller, output devices and power supply. All devices mounted in two separate kit which is Sensor Kit and Programmable Logic Controller Kit. The programming device is used to program the PLC CPU, to control the state of output devices.

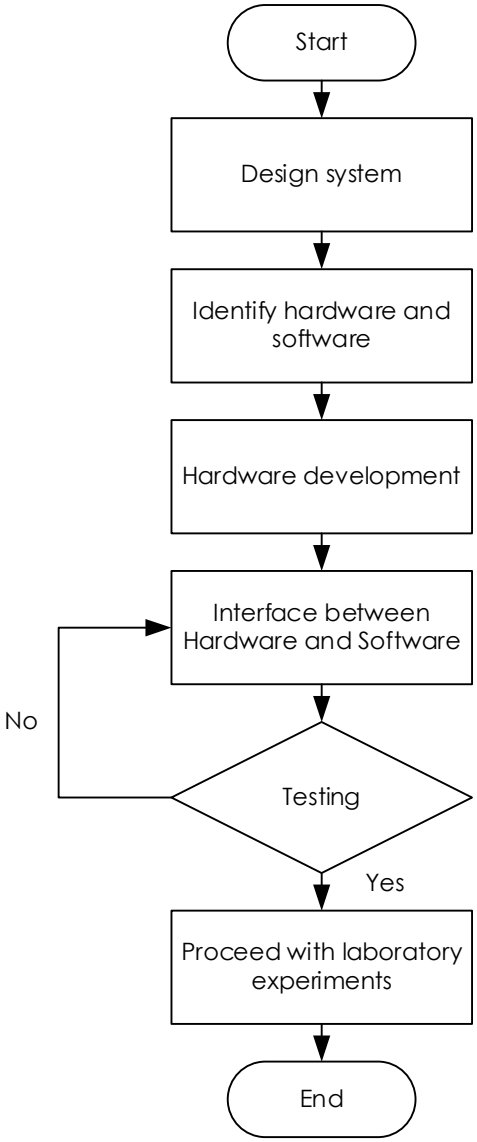


Figure 1: Flow Chart for Overall Process to Develop N3 PLC Trainer Sensor Series

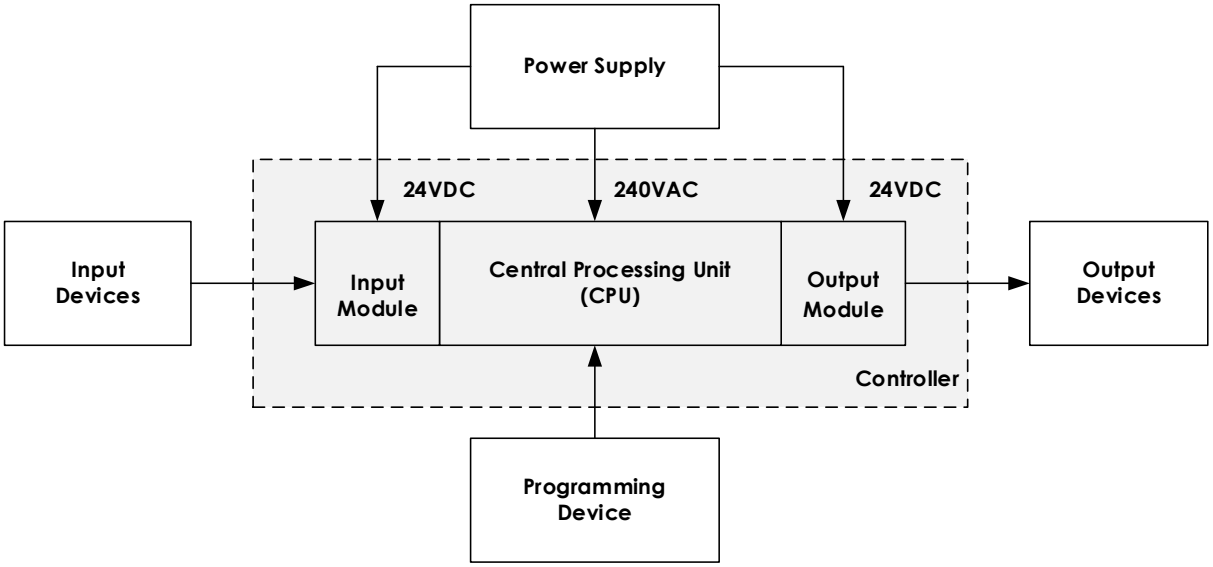


Figure 2: Block Diagram of N3 PLC Trainer Sensor Series

3.2. Hardware and Software

The sensor kit comprises of six types of discrete sensors which are:

- Inductive Sensor: Model PRWL18-5DN-V and PRWL18-5DP-V.
- Capacitive Sensor: Model CR30-15DN and CR30-15DP.
- Through Beam Sensor: Model EE-SPW411.
- Reflective Sensor: Model EX-40.
- Retro Reflective Sensor: Model E3Z-B.
- Limit Switch: Model CM-1703 and CM-1704.

There are two types of output sensor wiring which are Negative-Positive-Negative (NPN) transistor and Positive-Negative-Positive (PNP) transistor. Each of them has a different output wiring connection as shown in Figure 3-1 and Figure 3-2.

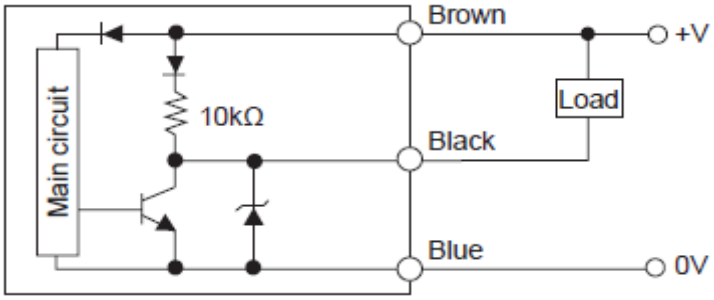


Figure 3-1: Output Wiring of NPN Sensor

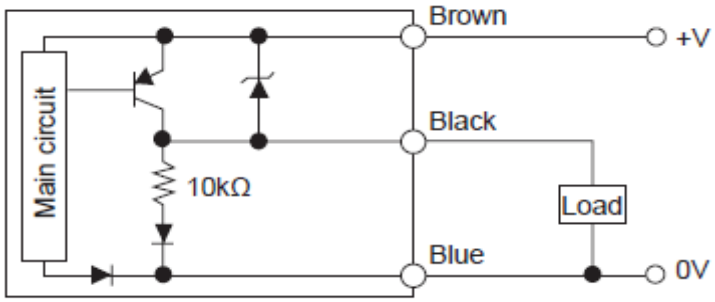


Figure 3-2: Output Wiring of PNP Sensor

The Programmable Logic Controller (PLC) Kit consists of:

- Power Supply: Switch Mode power supply with input voltage range: 110~240VAC and output voltage range: 24VDC.
- PLC Controller: CP1E-E20SDR-A PLC manufacture by OMRON. This PLC has 12 inputs(I) and 8 outputs(O) build-in I/O module.
- Two types of DPDT push buttons (Start/Stop) and selector switch. This will allow the PLC kits to operate as a standalone, without the sensor kit.
- Output devices: 24VDC pilot lamps as indicator for the output modules.

CX-Programmer is programming software for all Omron's PLC series. It is a programming tool for creating the ladder programs that are to be executed by PLC CPU. Any personal computer that has installed CX-Programmer software can be a programming device for downloading the ladder diagram program to PLC CPU via USB (Universal Serial Bus) cable. The USB port is used as an interface because it is the most common type of computer port used in today's computer.

3.3. Hardware Development

The development stage began with the design of N3 PLC Trainer Sensor Series front panel layout using Microsoft Visio 2016. The front panel layout was designed based on the sizing of metal casing which is 40cmX27.5cmX7cm. Then, by referring to the design layout, holes were drilled to place the hardware at the exact position, before the wiring and soldering process.

All component was installed to female connectors and banana plug male connector was used for joining the I/O. This plug and play method make easier during practical work session (Burhan, Azman, & Talib, 2015). Then power supply wiring connection start from 240VAC to power the PLC CPU and switch mode power supply as shown in Figure 4, then the power supply is converted to 24VDC, to be used for the power supply section at PLC Kit.

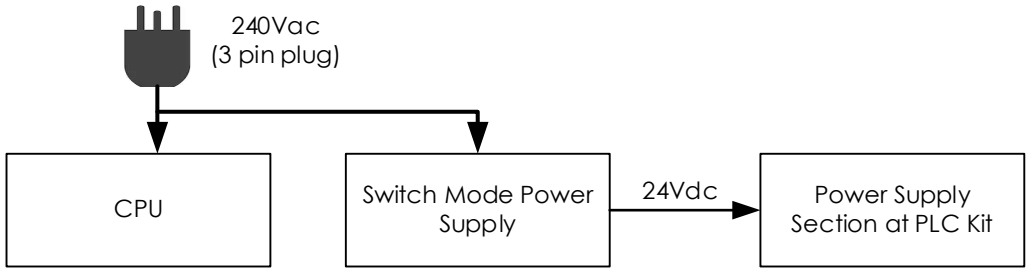


Figure 4: Connection of 240Vac Power Supply

The PLC Kit is divided into four sections, namely power supply section, input devices section, PLC section and output devices section as shown in Figure 5. Power supply section consist of eight female connectors. The female connectors are used to represent positive and negative terminal of 24VDC power supply, to power up Common (COM) at the PLC I/O module. The input devices section consists of DPDT start and stop push button and selector switch with female connectors. The PLC section comprises of PLC module, 12 input, 8 outputs and I/O COM with female connectors. The wiring from PLC Module is transferred to the front panel via the female connector. Lastly the output devices section consists of 24VDC red, yellow, green, and blue pilot lamp with female connector.

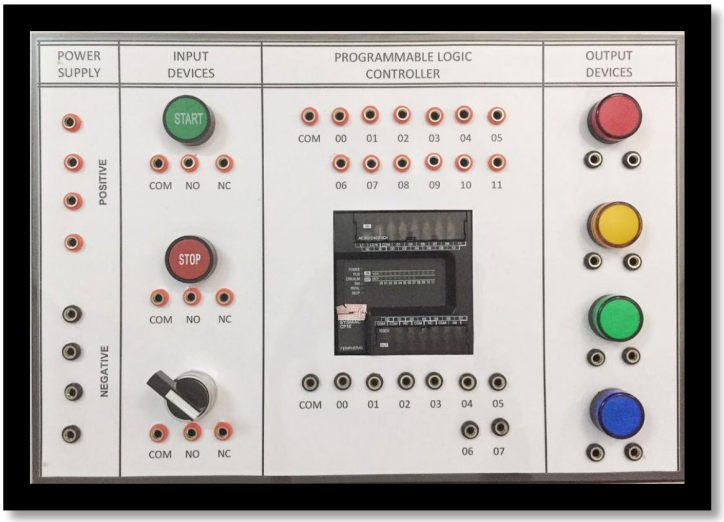


Figure 5: Programmable Logic Controller Kit

The Sensor Kit as shown in Figure 6 is divided into two sections: power supply section and sensors section. The power supply section consists of eight female connectors to represent positive and negative power supply terminal. While sensor section consists of six types of discrete sensors with female connector.

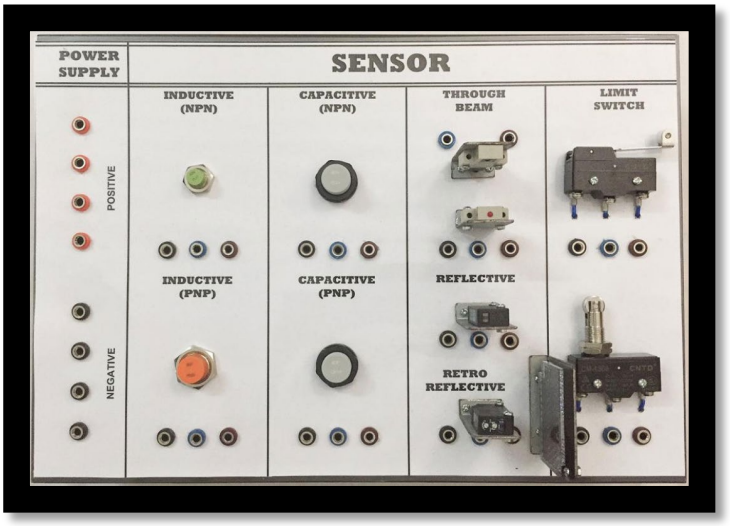


Figure 6: Sensor Kit

3.4. Hardware and Software Interface

Both PLC Kit and sensor kit can operate in standalone mode or combine. All input devices form the Sensor Kit can be connected to the PLC Kit, at the input module as shown in Figure 7-1 by using address 000 - 011. The output devices which is pilot lamp can be connected to the PLC output module as in Figure 7-2 by using address 10000 – 10007.

L1	L2/N	COM	01	03	05	07	09	11
NC	⏚	00	02	04	06	08	10	

Figure 7-1: PLC Input Module Port

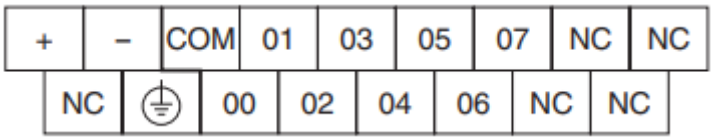


Figure 7-2: PLC Output Module Port

The interface process between hardware and software can done by using programming device. Any personal computer that was installed with CX-Programmer software can be used for downloading the ladder diagram program to CPU PLC via USB (Universal Serial Bus) cable as shown in Figure 8. The USB port is used as an interface because it is the most common type of computer port used in today's computer.

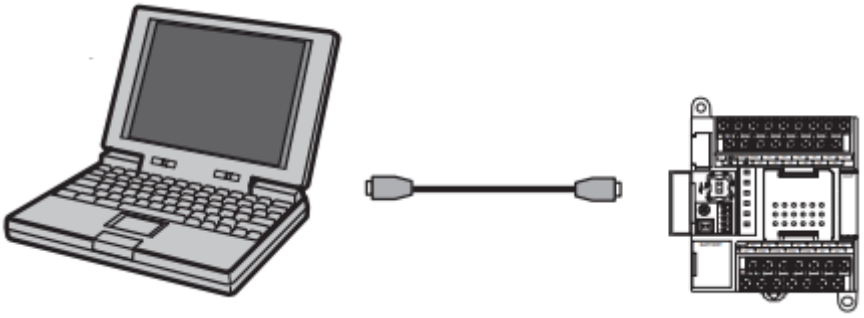


Figure 8: Programming Device and PLC Control Unit

The programming language use is the ladder diagram. It is called ladder diagram because it is shaped as a ladder and each line is called rung. By using the Personal Computer for the programming task, user is able to design the programming, simulate the programming and monitor the real time input output status during hardware operation. Figure 9-1 shows a sample of ladder diagram with both the input and output status in off state while Figure 9-2 shows both the input and output status in on state. The green color indicates electrical current flow.

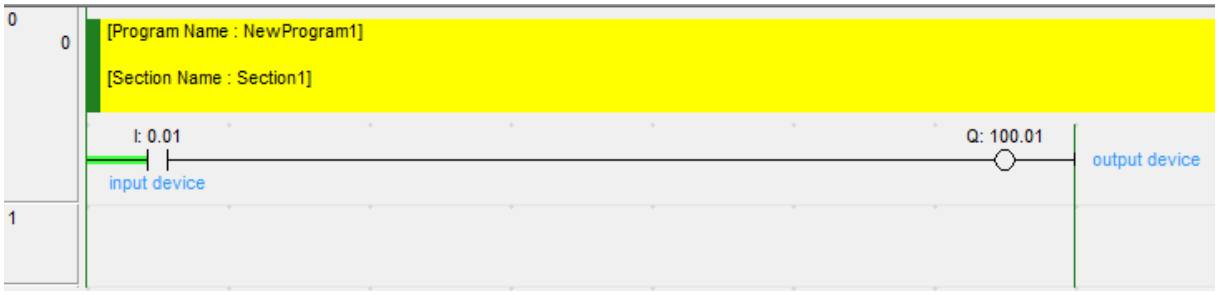


Figure 9-1: Real Time I/O Status Monitoring (Off State)

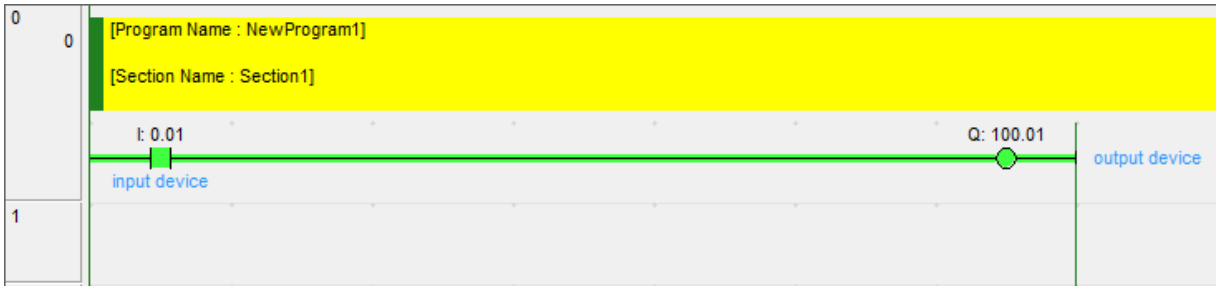


Figure 9-2: Real Time I/O Status Monitoring (On State)

4. RESULTS AND ANALYSIS

Table 2 shows list of input devices in sensor kit when tested with PLC Kit based on scenario and the result obtained. The aim of this testing is to ensure that all the input device function as expected, thus conclude N3 PLC Trainer Sensor Series is fit for use. The scenario listed in the table are based on sensor type either NPN or PNP and the detection criteria of the sensor. Result obtained for all input device are as expected.

Table 2: List of Input Device Tested Based on Scenarios the Result Obtained

No	Input Device	Scenario	Result
1	Inductive Sensor PRWL18-5DN-V (NPN)	1. User connect COM input module of PLC with POSITIVE power supply. 2. Metal object placed near the sensor	Pilot lamp turn ON when metal object placed near the sensor as expected
2	Capacitive Sensor CR30-15DN (NPN)	1. User connect COM input module of PLC with POSITIVE power supply. 2. Metal and non-metal object placed near the sensor	Pilot lamp turn ON when metal and non-metal object placed near the sensor as expected
3	Inductive Sensor PRWL18-5DP-V (PNP)	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Metal object placed near the sensor	Pilot lamp turn ON when metal object placed near the sensor as expected
4	Capacitive Sensor CR30-15DP (PNP)	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Metal and non-metal object placed near the sensor	Pilot lamp turn ON when metal and non-metal object placed near the sensor as expected
5	Through Beam EE-SPW411 (NPN)	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Object placed between emitter and receiver	Pilot lamp turn ON when object placed between emitter and receiver sensor as expected
6	Reflective EX-40 (NPN)	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Object placed in front of sensor	Pilot lamp turn ON when object placed in front of sensor as expected
7	Retro Reflective E3Z-B (NPN)	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Object placed between sensor and reflector	Pilot lamp turn ON when object placed between sensor and reflector as expected
8	Limit Switch CM-1703	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Sensor connected in Normally Open (NO) condition. 3. Object touched the sensor	Pilot lamp turn ON when object touched limit switch as expected

No	Input Device	Scenario	Result
		1. User connect COM input module of PLC with NEGATIVE power supply. 2. Sensor connected in Normally Close (NC) condition. 3. Object touched the sensor	Pilot lamp turn OFF when object touched limit switch as expected
	Limit Switch CM-1704	1. User connect COM input module of PLC with NEGATIVE power supply. 2. Sensor connected in Normally Open (NO) condition. 3. Object touched the sensor	Pilot lamp turn ON when object touch limit switch as expected
9		1. User connect COM input module of PLC with NEGATIVE power supply. 2. Sensor connected in Normally Close (NC) condition. 3. Object touched the sensor	Pilot lamp turn OFF when object touch limit switch as expected

A total of 36 students of Diploma in Electrical Engineering were asked to complete a feedback form after using the N3 PLC Trainer-Sensor Series. The aim was to study the user satisfaction on N3 PLC Trainer-Sensor Series as teaching aid in automation course. As shown in Table 3, the Cronbach's Alpha for usability and user satisfaction was 0.915, which reflects the high value of the reliability coefficient.

Table 3: Reliability Statistics

Cronbach's Alpha	No of item
0.915	20

Table 4: Mean Score Interpretation Scale

Mean Value	**Mean Score Interpretation**
0.00 – 1.66	Low level
1.67 – 3.33	Middle level
3.34 – 5.00	High level

Table 5: Analysis of user satisfaction on N3 PLC Trainer-Sensor Series

No	Item	Mean	Standard Deviation
1. Design/Layout			
1	I like the design of N3 PLC Trainer – Sensor Series which is compact and portable	4.94	0.232
2	I like the interface of N3 PLC Trainer – Sensor Series.	4.94	0.232
3	N3 PLC Trainer – Sensor Series has good label description.	4.50	0.507
4	The characteristics of N3 PLC Trainer – Sensor Series is simple and concise.	4.56	0.504
2. Functionality			
5	N3 PLC Trainer – Sensor Series has all functions and capabilities that I expect it to have.	4.42	0.500

6	The labsheet used for N3 PLC Trainer – Sensor Series was clear.	4.69	0.467
7	All the components in N3 PLC Trainer – Sensor Series function well.	4.69	0.467
3. Ease of use			
8	N3 PLC Trainer – Sensor Series can describe the actual connection of the logical sensor.	4.67	0.478
9	It is easier to construct the logical sensor sourcing and sinking wiring connection by using the N3 PLC Trainer – Sensor Series	4.94	0.232
10	The information provided in the N3 PLC Trainer – Sensor Series was clear.	4.92	0.280
11	Overall, the N3 PLC Trainer – Sensor Series was easy to use.	4.81	0.401
4. Learnability			
12	I understand the function of logical sensor on N3 PLC Trainer – Sensor Series correctly.	4.89	0.319
13	I was able to apply the connection on N3 PLC Trainer – Sensor Series correctly.	4.86	0.351
14	I was able to construct the logical sensor sourcing and sinking wiring connection correctly based on the theory.	4.94	0.232
5.Satisfaction			
15	I am interested to use the N3 PLC Trainer – Sensor Series.	4.89	0.319
16	I am confident to use the N3 PLC Trainer – Sensor Series.	4.89	0.319
17	Overall, I am satisfied with the N3 PLC Trainer – Sensor Series.	4.89	0.319
6.Outcomes/Future Use			
18	I believe I could be more productive by using the N3 PLC Trainer – Sensor Series.	5.00	0.00
19	N3 PLC Trainer – Sensor Series was able to convince me in improving my skills.	4.97	0.167
20	N3 PLC Trainer – Sensor Series comply with the DEJ5153 – Programmable Logic Controller & Automation syllabus.	5.00	0.00

Table 5 shows the analysis result conducted using IBM Statistics SPSS software. By referring to the mean score interpretation as stated in Table 4 (Hadiyanto, et al., 2013), the overall level of user acceptance for N3 PLC Trainer-Sensor Series is high. There are total of 20 items asked, which are group into six main items. The min score for Design/Layout is 4.735, Functionality is 4.60, Ease of use is 4.835, Learnability is 4.897, Satisfaction is 4.89 and Outcomes/Future Use is 4.99. The results prove that the N3 PLC Trainer-Sensor Series was suitable to be used as a teaching aids for automation subject.

5. CONCLUSION

The development of N3 PLC Trainer-Sensor Series as a teaching aids for automation course satisfied the objective identified. Based on the survey conducted, it is proven the new teaching aids was suitable to be used during teaching and learning session, The two kits can be used according to the assigned topic based on the syllabus to facilitate teaching and learning session. The use of loose components that are assembled on a metal box and plug and play method, is sturdy and user friendly especially during the practical work session. Thus, the students can understand the topic better and improve their learning outcome for the automation course. This teaching aids can also be used in any institution that offers electrical engineering and automation program specifically the Programmable Logic Controller course.

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GREEN PEG

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Abstrak. Di dalam kerja amali ukur, piket yang digunakan di dalam kerja lapangan terutama di kawasan Politeknik Port Dickson sebagai penanda stesen sementara biasanya akan ditinggalkan sehingga kerja pengukuran selesai. Hasil soal selidik awal yang dilakukan mendapati penggunaan kayu sebagai stesen kadangkala boleh mengundang masalah seperti sukar untuk mengesan kedudukan piket, piket mudah reput dan piket kayu boleh mencederakan mereka yang lalu lalang di kawasan pengukuran sekiranya kayu tidak ditanam dengan sempurna. Oleh itu, satu kajian telah dilakukan untuk menghasilkan *Green Peg* untuk menggantikan piket kayu di mana *Green Peg* ini dihasilkan daripada bahan terbuang dengan membuat kajian penelitian bahan ke atas material bagi memilih material terbaik untuk menghasilkan piket bagi menggantikan piket kayu. Selepas itu, satu kajian keberkesanan telah dilakukan ke atas *Green Peg* bagi melihat sejauh mana piket yang dihasilkan dapat mengatasi masalah piket kayu yang sukar untuk dikesan, mudah reput dan boleh mencederakan kerana sifatnya yang sukar untuk ditanam pada paras tanah. Hasil kajian mendapati material plastik lebih sesuai digunakan sebagai piket menggantikan piket kayu kerana material plastik itu sendiri lebih tahan lasak jika dibantingkan dengan kayu dari sudut perubahan bentuk. Green Peg yang telah dihasilkan telah diberi kepada beberapa kumpulan pelajar untuk digunakan bagi melihat sejauh mana ia berfungsi dan didapati ia lebih fleksibel berbanding piket kayu sediada. Namun begitu, penambahbaikan untuk menghasilkan stesen piket yang lebih baik perlu terus dilakukan di mana ia boleh ditambah baik dari sudut material bahan itu sendiri dan reka bentuk piket serta fungsinya.

Kata Kunci: *Green Peg sebagai stesen ukur*

1. PENGENALAN

Ukur Terabas merupakan proses untuk menyedikan jaringan titik kawalan mengufuk di mana kedudukannya dapat ditentukan dengan mendapatkan nilai bearing dan jarak daripada garisan stesen-stesen yang bersambung.

Menurut *Abdul Hamid Mohamed (2000), t*erabas bermaksud *kedudukan sesuatu titik di atas permukaan bumi dapat ditentukan dengan merujuk kepada kedudukan suatu titik lain. Terabas ukur mengandungi suatu siri garisan yang berkesinambungan. Arah dan jarak garisan tersebut diperolehi menerusi proses pengukuran dari satu titik kepada satu titik yang lain* (Tuan Stia, 2007).

Di Politeknik Port Dickson, jaringan titik kawalan atau pun dikenali sebagai stesen ukur adalah menggunakan piket kayu. Proses penyediaan jaringan kawalan mengufuk di dalam amali ukur biasanya mengambil masa hampir seminggu dan kerja biasanya melibatkan pengumpulan data yang bersambung dari satu stesen ke stesen yang lain. Ini menyebabkan stesen ukur yang terdiri daripada piket kayu perlu ditinggalkan sepanjang tempoh amali. Oleh itu stesen piket perlu dipasang dengan betul agar tiada perubahan stesen yang boleh mengakibatkan selisih pada data.

Di Politeknik Port Dickson, stesen ukur yang digunakan untuk amali terabas teodolit biasanya akan ditinggalkan sehingga kerja pengukuran selesai. *Stesen ukur perlu ditanda untuk tempoh selama kerja ukur atau lebih lama lagi.*

Hasil kajian awal mendapati kayu sebagai stesen ukur kadangkala boleh mengundang masalah seperti sukar untuk mengesan kedudukan piket, piket mudah reput dan piket kayu boleh mencederakan mereka yang lalu lalang di kawasan pengukuran sekiranya kayu tidak ditanam dengan sempurna.

Green Peg dihasilkan bertujuan untuk menggantikan penggunaan piket kayu sediada. Dihasilkan dengan material plastik dengan menggunakan bahan terbuang. Ia adalah bertujuan untuk memudahkan pelajar mengesan kembali stesen ukur yang telah ditinggalkan dengan mudah. Selain itu *Green Peg* dengan material plastik ini lebih tahan lama dan tidak mudah reput disamping tidak akan mencederaakan kerana permukaan pada *Green Peg* lebih rata jika dibandingkan dengan piket kayu sediada.

2. SOROTAN KAJIAN

Merujuk kepada "Peraturan Ukur Kadaster, 2009" tanda ukur iaitu stesen ukur hendaklah ditanam dengan kemas di dalam tanah dan bahagian atasnya berada pada ketinggian yang sesuai di permukaan tanah.

Di Politeknik Port Dickson, penggunakan piket kayu sebagai stesen ukur kadangkala menimbulkan masalah dalam proses menanam dan ini menyebabkan bagaian atas piket tidak berada pada ketinggian yang sesuai. Iaitu piket mudah terjojol yang boleh menimbulkan masalah.

Ia disokong oleh kenyataan pada topik ukur terabas teodolit iaitu ia menyatakan, bagi terabas tujuan umum, piket kayu digunakan di mana iainya ditanam sehingga bahagian atas piket sama paras dengan tanah (Nik M. Farid.2010). Jika piket terjojol keluar dari paras tanah, besar kemungkinan akan terlanggar dan mencederakan. Proses kerja ukur memerlukan stesen ukur bersifat kukuh dan tahan lama. Ini penting bagi memastikan data yang berkualiti sahaja dihasilkan.

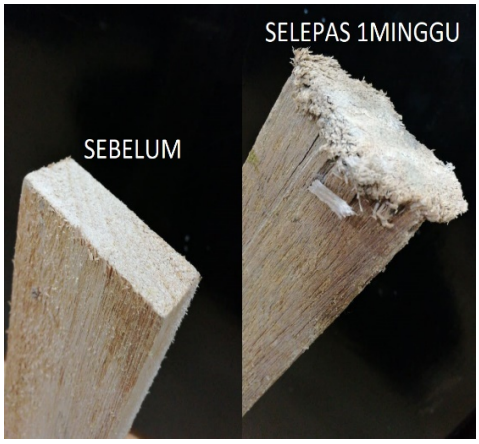
Ciri stesen ukur ini ada dinyatakan pada "Garis Panduan Amalan Kerja Ukur Kadaster dalam Persekitaran eKadaster, 2009" Di mana ia menyatakan, Penandaan stesen ukur mestilah kukuh, tidak mudah terganggu dan mestilah jelas kelihatan. Namun, ciri yang dinyatakan tidak sepenuhnya dimiliki oleh piket kayu dan kesukaran piket kayu ditanam pada paras tanah ini mungkin disebabkan oleh faktor pemukaan tanah yang keras dan bentuk piket kayu itu sendiri.

Pada Rajah 1 menunjukan piket kayu yang ditanam tidak berada pada paras tanah yang mana ia boleh menyebabkan kecederaan sekiranya ada yang terlanggar atau tersepak.

Selain daripada kesukaran untuk menanam piket kayu pada paras tanah, piket kayu juga mudah untuk berubah bentuk dan reput. Seperti yang ditunjukkan pada Rajah 2.



Rajah 1 : Piket sukar ditanam pada paras tanah



Rajah 2 : Perubahan Piket Kayu

Kayu adalah bahan yang berubah maka kekuatannya bergantung kepada banyak faktor yang akan mempengaruhi secara bersendirian atau secara Bersama dan akan memberi kesan kekuatan dan keboleh kerjaan kayu (Zakaria Hussain, 2012).

Kandungan kelembapan pada kayu boleh berubah-ubahmengikut keadaan persekitaran, sekiranya kandungan berlebihan, kayu akan mengembang dan permukaan kayu mula ditumbuhi kelapuk atau cendawan dan mengakibatkan struktur kayu akan rosak. Kapasiti Beban Kayu dalam Merekabentuk Tiang Kayu Berdasarkan MS 544:2001 dan 5268:1996. Perubahan bentuk kayu ini boleh menyumbang kepada kesukaran untuk mengesan kembali piket kayu yang ditanam dan ditinggalkan sepanjang kerja pengukran dijalankan (Nur Hamizah Rahmat, 2010).

Atas kesemua faktor ini lah, *Green Peg* dihasilkan dan cadangan menghasilkan *Green Peg* ini adalah dengan mengambil kira material untuk menghasilkan *Green Peg* dan kajian ke atas *Green Peg* bagi memastikan *Green Peg* yang dihasilkan dapat mengatasi masalah piket kayu yang sukar untuk dikesan, mudah reput dan boleh mencederakan kerana sifatnya yang sukar untuk ditanam pada paras tanah.

2. METODOLOGI KAJIAN

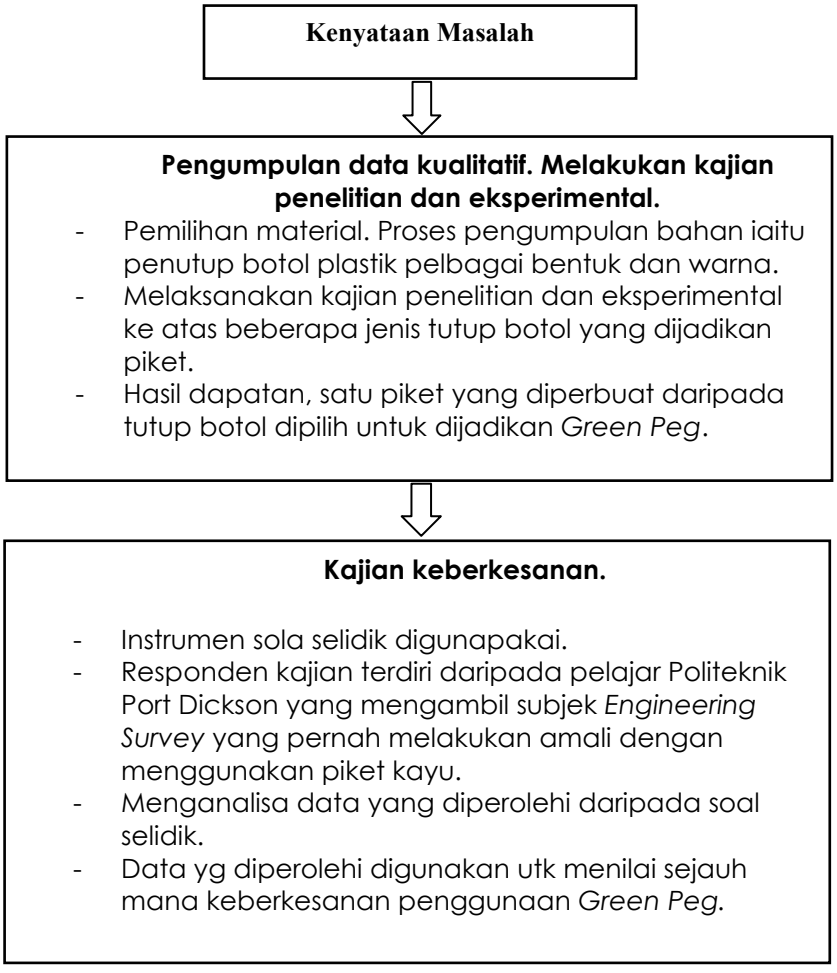
Penyelidikan atau kajian adalah satu kegiatan pengumpulan, pengolahan dan analisis data yang dilakukan secara sistematik dan cekap untuk memecahkan sesuatu persoalan. Dengan itu, tujuan menjalankan kajian ialah untuk memperoleh jawapan melalui penggunaan suatu langkah ilmiah yang sistematik dan saintifik.

Di dalam pembangunan Green Peg, data kualitatif digunakan iaitu dengan menggunakan kaedah penyelidikan eksperimetal bagi membuat perbandingkan bahan iaitu bahan yang digunakan dalam kajian ini ialah tutup botol daripada pelbagai bentuk. Hasil perbandingan akan menentukan bahan yang paling sesuai untuk digunakan dalam penghasilakn Green Peg.

Pemilihan kaedah kajian secara soal selidik adalah yang paling sesuai untuk mengutip data kuantitatif untuk mengukur *attitudes, perceptions* dan *opinion* (Wagner, 1984) and (Groves, 1993).

Oleh yang demikian, instrument soal selidik diguna pakai dalam kajian ini di mana responden kajian terdiri daripada pelajar Politeknik Port Dickson yang mengambil subjek *Engineering Survey* yang pernah melakukan amali dengan menggunakan piket kayu. Menganalisa data yang diperolehi daripada soal selidik, ini akan membantu bagi menilai sejauh mana keberkesanan penggunaan *Green Peg*.

Berikut adalah carta alir proses kajian;



Di dalam pembangunan *Green Peg*, pemilihan bahan merupakan element penting untuk memastikan Green Peg yang dihasilkan memenuhi ciri-ciri stesen ukur yang kukuh, tahan lama dan mudah dikesan. Pemilihan bahan pakai buang yang sesuai juga dititik beratkan agar objektif menyokong amalan kitar semula tercapai.

Bagi menjamin jangka hayat stesen, material plastik dipilih bagi menggantikan penggunaan piket kayu sediada. Penggunaan piket kayu sebagai stesen terabas sebelum ini banyak menimbulkan masalah dari sudut ketahanan dan ketepatan ukuran.

Dalam kajian ini, pemilihan tutup botol terpakai seperti di Rajah 3 dari material plastik dipilih untuk dijadikan piket. Beberapa jenis penutup botol dikumpulkan, dibersihkan dan diteliti dari sudut bentuk dan struktur.



Rajah 3 : Pemilihan tutup botol terpakai daripada material plastik

Bagi penandaan titik tengah pada piket, skru berukuran 6.3mm seperti di Rajah 4 digunakan. Skru dipasang di tengah-tengah penutup botol sebagai tanda titik stesen untuk proses pemusatan alat.



Rajah 4 : Penggunaan skru 6.3mm sebagai tanda stesen.

Hasil daripada pengumpulan bahan terpakai iaitu tutup botol, enam jenis penutup botol telah dipilih seperti pada Rajah 5.



Rajah 5 : Penutup botol dipilih untuk penghasilan *Green Peg*.

Untuk menghasilkan piket untuk kerja pengukuran, setiap penutup botol dipasang skru sebagai tanda stesen seperti pada Rajah 6.



Rajah 6 : Pemasangan skru sebagai tanda stesen

Bagi memilih penutup botol yang mana paling sesuai untuk dijadikan piket. Ujikaji ketahanan dilakukan dengan melihat bentuk perubahan pada permukaan botol selepas proses penanaman piket dilakukan.

Ujikaji ketahanan dilakukan dengan melihat kepada perubahan bentuk piket sepanjang ia digunakan pada Praktikal *Traverse Survey* and Total Station DCC20063 *Engineering Survey* DKA2B Sesi Dis 2019. Tujuh kumpulan pelajar menggunakan tujuh jenis piket yang berbeza bagi menilai ketahanan piket sepanjang tempoh praktikal iaitu lima minggu.

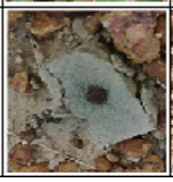
Sepanjang lima minggu ini, *Green Peg* yang memenuhi ciri-ciri stesen ukur yang kukuh, tahan lama dan mudah dikesan akan dipilih. Kekukuhan dan ketahan piket diukur dengan melihat perubahan pada bentuk piket sepanjang lima minggu praktikal berlangsung. Manakala piket mudah dikesan untuk proses menyambung pengukuran diukur berdasarkan soal selidik penggunaan oleh pelajar.

3. ANALISIS DAN KEPUTUSAN PENGHASILAN *GREEN PEG*

Penganalisaan kekukuhan dan ketahanan diukur berdasarkan perubahan bentuk piket yang berlaku pada Praktikal *Traverse Survey* dan *Total Station* DCC20063 *Engineering*

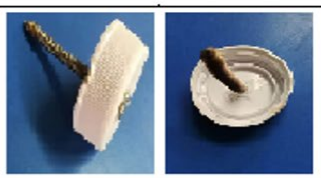
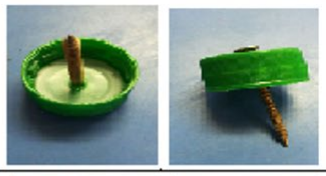
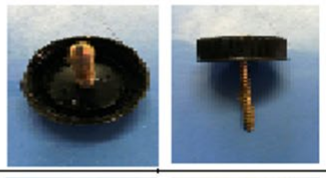
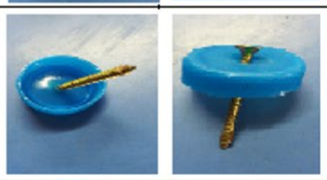
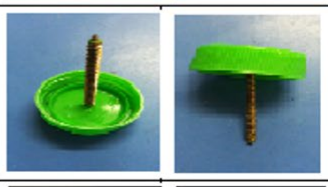
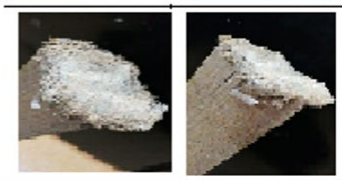
Survey DKA2B Sesi Dis 2019. Tujuh kumpulan pelajar menggunakan tujuh jenis piket yang berbeza bagi menilai ketahanan piket sepanjang praktikal lima minggu.

Jadual 1: Kadar Perubahan Bentuk Piket Sepanjang Lima Minggu

	Jenis piket	Ming 1	Ming 2	Ming 3	Ming 4	Ming 5
Kumpulan 1	piket 1					
Kumpulan 2	piket 2					
Kumpulan 3	piket 3					
Kumpulan 4	piket 4					
Kumpulan 5	piket 5					
Kumpulan 6	piket 6					
Kumpulan 7	piket kayu					

Jadual 1 menunjukan perubahan bentuk piket selama lima minggu yang digunakan pada Practikal *Traverse Survey* dan *Total Station* DCC20063 *Engineering Survey* DKA2B Sesi Dis 2019. Berdasarkan daripada Jadual 1 Piket 3 menunjukan perubahan paling sedikit jika dibandingkan dengan kesemua piket yang lain termasuk piket kayu.

Jadual 2: Kadar Perubahan Bentuk Piket Sebelum dan Selepas

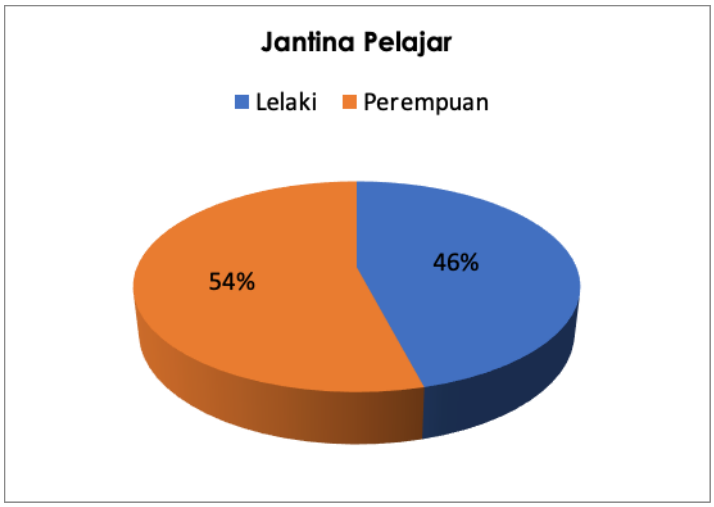
	Jenis Piket	Sebelum Praktikal	Selepas Praktikal
Kumpulan 1	piket 1		
Kumpulan 2	piket 2		
Kumpulan 3	piket 3		
Kumpulan 4	piket 4		
Kumpulan 5	piket 5		
Kumpulan 6	piket 6		
Kumpulan 7	Piket kayu		

Jadual 2 menunjukan perubahan bentuk piket sebelum dan selepas amali. Piket digunakan pada Practikal *Traverse Survey* dan *Total Station* DCC20063 *Engineering Survey* DKA2B Sesi Dis 2019. Pada Jadual 2, Piket 3 tidak menunjukkan perubahan ketara selepas amali dilakukan jika dibandingkan dengan kesemua piket yang lain termasuk piket kayu.

Borang soal selidik telah diedarkan kepada pada pelajar bagi mendapatkan maklum balas berkaitan dengan penggunaan *Green Peg*. Objektif soal silidik ini ada lah untuk mengetahui sejauh mana keberkesanan *Green Peg* dalam pengukuran.

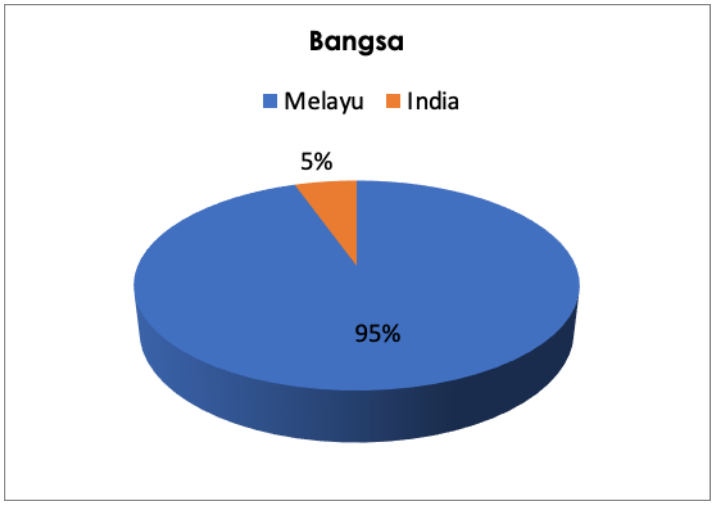
Borang soal silidik ini mengandungi tiga bahagian iaitu Bahagian A mengenai latar belakang pelajar. Bahagian B mengenai perbandingan penggunaan Piket kayu dan *Green Peg*. Analisa kajian adalah mengikut bahagian seperti yang terdapat pada borang soal selidik.

Hasil analisa Bahagian A adalah berkaitan dengan jantina, bangsa, serta status pelajar di dalam Kursus DCC20063 *Engineering Survey*.



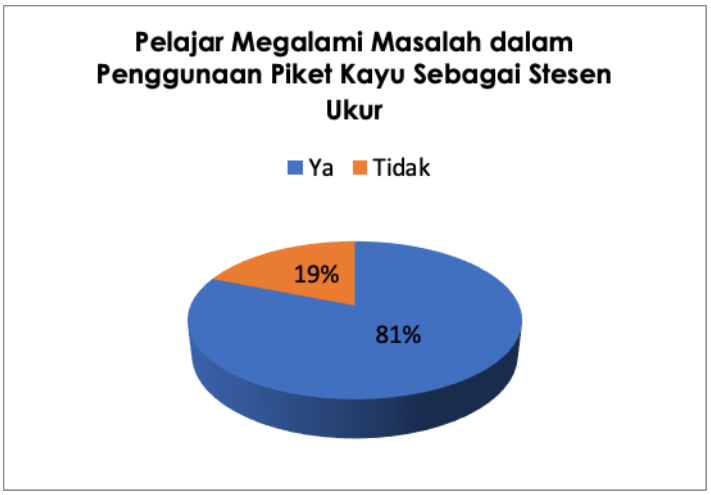
Rajah 7: Kumpulan Pelajar

Merujuk kepada Rajah 7, Pelajar DCC20063 *Engineering Survey* bagi sesi Dis 2019 terdiri daripada 54% pelajar perempuan dan 46% adalah pelajar lelaki. Peratusan ini diambil daripada jumlah keseluruhan pelajar seramai 37 orang.



Rajah 8 : Bangsa Pelajar

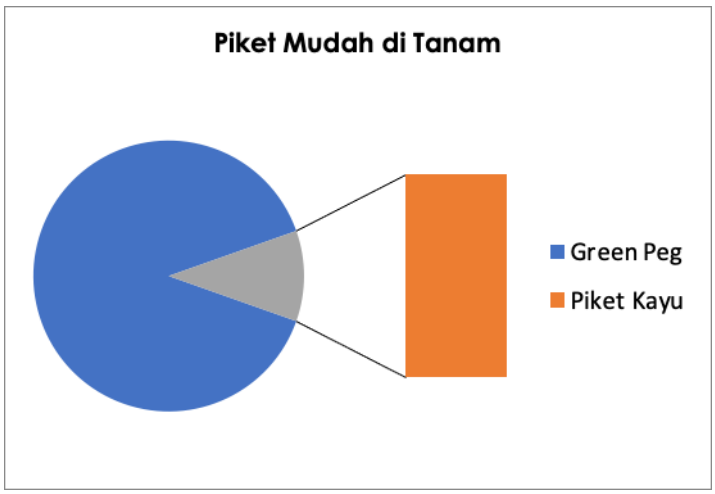
Merujuk kepada Rajah 8, Pelajar DCC20063 *Engineering Survey* bagi sesi Dis 2019 terdiri daripada 95% Bangsa Melayu dan 5% adalah Bangsa India.



Rajah 9 : Pelajar Pelajar Megalami Masalah dalam Penggunaan Piket Kayu Sebagai Stesen Ukur

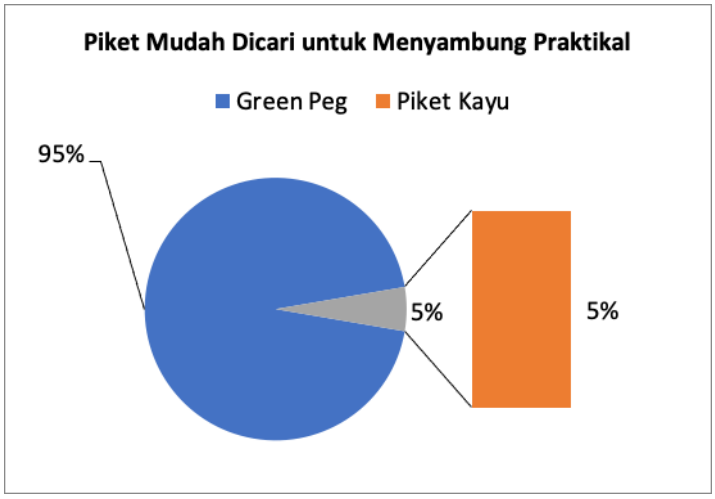
Merujuk kepada Rajah 9, sebanyak 81% pelajar mengalami masalah dalam penggunaan piket kayu sebagai stesen ukur. Manakala 19% lagi tidak mengalami masalah.

Hasil analisa Bahagian B adalah mengenai perbandingan penggunaan piket kayu dan Green Peg.



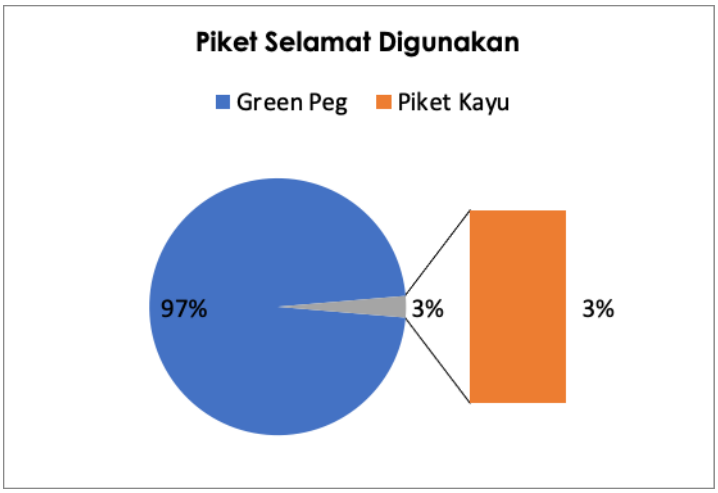
Rajah 10 : Piket Mudah Ditanam

Merujuk kepada Rajah 10, sebanyak 89% pelajar bersetuju Green Peg mudah ditanam. Manakala 11% pula menyatakan piket kayu mudah ditanam.



Rajah 11 : Piket Mudah Dicari Untuk Menyambung Praktikal

Merujuk kepada Rajah 11, sebanyak 95% pelajar berpendapat *Green Peg* mudah dicari untuk menyambung praktikal manakala 5% pula berpendapat piket kayu mudah dicari untuk menyambung praktikal.



Rajah 12 : Piket Tahan Lama dan Tidak Mudah Reput

Merujuk kepada Rajah 12, sebanyak 97% pelajar menyatakan *Green Peg* selamat digunakan berbanding 3 % yang memilih Piket kayu.

4. KESIMPULAN

Berdasarkan daripada hasil kajian yang telah dijalankan, Piket 3 merupakan piket yang paling sesuai dijadikan *Green Peg* untuk menggantikan penggunaan piket kayu. Ini kerana struktur Piket 3 ini tahan lama dan tidak mudah reput disamping tidak mudah berubah bentuk pada permukaan piket.

Manakala hasil daripada instrument soal selidik ia mendapati penghasilan *Green Peg* telah mencapai objektifnya. Ini disokong dengan melihat keputusan analisa soal selidik pada bahagian B yang menunjukkan perbandingan di antara piket kayu dan *Green Peg*. Di mana *Green Peg* lebih mudah ditanam pada paras tanah dan ia tidak mudah terjojol jika dibandingkan dengan piket kayu. *Green Peg* juga mudah dikesan semula untuk menyambung kerja pengukuran selepas ditinggalkan.

Selain itu struktur *Green Peg* juga lebih tahan lama dan tidak reput walaupun selepas 5 minggu digunakan dan ditinggalkan di padang.

Walaupun kajian telah mencapai objektif, namun kajian masih boleh diteruskan dengan membuat penambahbaikan dari sudut material. Di mana kajian lanjut boleh diteruskan untuk melihat sejauh mana ketahanan *Green Peg* jika ia digunakan lebih dari tempoh 5 minggu. Kajian juga boleh diteruskan dengan mencari bahan lain yang mungkin lebih baik dari bahan yang digunakan di dalam kajian ini iaitu selain daripada penutup botol.

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DEVELOPMENT OF INTERACTIVE 360-DEGREE VIRTUAL TOUR APPLICATION: INSPECTION & MAINTENANCE OF DISTRIBUTION SUBSTATION 11/0.4kV

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Abstrak. Interactive 360° Virtual Tour Application: Inspection & Maintenance of Distribution Substation 11/0.4kV is a virtual guided tour that provides real experience for educators and students on how to conduct inspection and maintenance procedures in 11/0.4kV distribution substation. All these procedures are hazardous and can only be done by competent personnel certified by the Energy Commission. This is a hindrance for the educators and students to implement teaching and learning sessions. The purpose of development is to expose them to real situations in a location that is impossible to access and cause harm especially involving high voltage equipment. Usability & user satisfaction study was conducted among the electrical engineering students who used this application. It is developed using Wonda VR software and the method used to develop this application refers to the m-ADDIE model consist of Analysis Phase, Design Phase, Development Phase, Implementation Phase, and Evaluation Phase. As a result of Descriptive Statistical Analysis using IBM Statistics SPSS software (version 19), the level of user acceptance of this application is high, and this proves that this application is suitable for use in learning sessions and meets the needs of users.

Keywords: Virtual tour; distribution substation; competent personnel; m-ADDIE

1.INTRODUCTION

Politeknik Sultan Azlan Shah (PSAS) as a provider of Technical & Vocational Education & Training (TVET) needs to produce skilled students with an experience of handling high voltage equipment in electrical substations before they go through a real work environment after graduation. Knowledge of the equipment and its operation is the foundation required by professional users in this field (G. R. Lima, 2018). Unfortunately, due to safety factors, this could not be realized due to safety issues as well as a competent person needed for handling high voltage equipment, according to Energy Commission. In PSAS, it is almost impossible to bring the students into the electrical substation, except by taking them using a virtual tour.

In this paper, 'Inspection & Maintenance of Distribution Substation 11/0.4kV' topic has been selected and coincides with the content of the Malaysian Polytechnic curriculum. The virtual tour application has been developed to help students explore virtual situations or scenes that are impossible to access and involve high voltage equipment in the real world. Next, a study on usability and user satisfaction was conducted among the students who use this application.

2. LITERATURE REVIEW

In this study, students will experience the 360-degree virtual tour which consists of 360-degree images and videos. Learning through 360-degree video experience has been widely used in various fields such as cultural heritage (Lemonia Argyriou, 2017), safety training (Hai Chien

Pham, 2018; Eiris, Jain, Gheisari, & Wehle, 2020), nursing education (Romain Christian Herault, 2018) and many more. 360-degree video is a special case of virtual reality (VR) in which viewers view a sphere (or close-up) of video centered at a single position. Uncontrolled by defined views, viewers experience the video environment in a way that is closer to real life. 360-degree video, when used with projection tools such as Head-Mounted Display (HMD), adds to the extent of the metaphorical dimensions of presence and can be classified as VR applications according to Paul Milgram (1994).

It is difficult for a student and an engineer to practice at a real substation due to safety factors (G. R. Lima, 2018). Therefore, to provide this experience, a 360-degree virtual tour application was developed to provide a learning experience to the user. By watching the 360-degree video, students will be exposed to the real experience (Adnan, Ahmad, Yusof, Kamal, & Kamal, 2019), and feeling of 'presence' (Hyttinen & Hatakka, 2020) as well as not exposed to high voltage hazards.

3. RESEARCH METHODOLOGY

This application was developed using the m-ADDIE Model. The m-ADDIE model was chosen because each phase is clear and guides the development process of a new multimedia-based educational software (Ahmad Zamzuri, 2018). There are 5 phases in this model, which are Analyze Phase, Design Phase, Development Phase, Implementation Phase, and Evaluation Phase. m-ADDIE is designed and modified from the existing ADDIE model, specifically for the development of multimedia educational software.

3.1 Analysis Phase

The analysis phase is the earliest in the development of this application. It provides an overview of the applications developed. Based on the preliminary study, the title *Inspection & Maintenance Of Distribution Substation 11 / 0.4kv* has been selected and consists of the main sub-content: *Preparation (PPE and Tools), Inspection Procedures, Single Line Diagram and Maintenance*. A competent person from Syarikat Elektrik Jamaluddin Sdn. Bhd. has been appointed along with lecturers in the Electrical Engineering Department to develop materials and applications. The target user is among the electrical engineering students.

Simulation is a learning environment that describes the actual method with the help of computer software while drill exercise is an information repetition approach to familiarize students with a topic (Ahmad Zamzuri, 2018). In this case, simulation and drill exercises are used as an operating method while the learning methods involved are self-learning and collaboration. Students need to use the HMD and access the application individually but can collaborate with their peers to complete the tasks assigned while using the application.

Substation 5 in PSAS has been selected as the location for 360-degree video filming for this study. The hardware used to record video is a 360-degree camera with tripod. While the software used to develop this application is Wonda VR. Users only need a smartphone, HMD, and internet line to access the learning content in this application. HMD will provide users the feel of 'present' in a sub-station environment while using the application and they are cheaper and more sophisticated than they were years ago (Kuntz & Cíger, 2012).

3.2 Design Phase

The design phase is the phase that should visualize, navigate, and shape the interface or display of the application developed (Ahmad Zamzuri, 2018). In other words, during this phase, there is a process of transferring the information that has been collected and translated into storyline form.

3.3 Development Phase

In this phase, the development of the applications is based on the stipulations in the design phase. All sketches of storylines need to be followed so that in line with the content to be

presented. This application has been set to be online to make it easier for students to access the content without having to download the application into their phones.

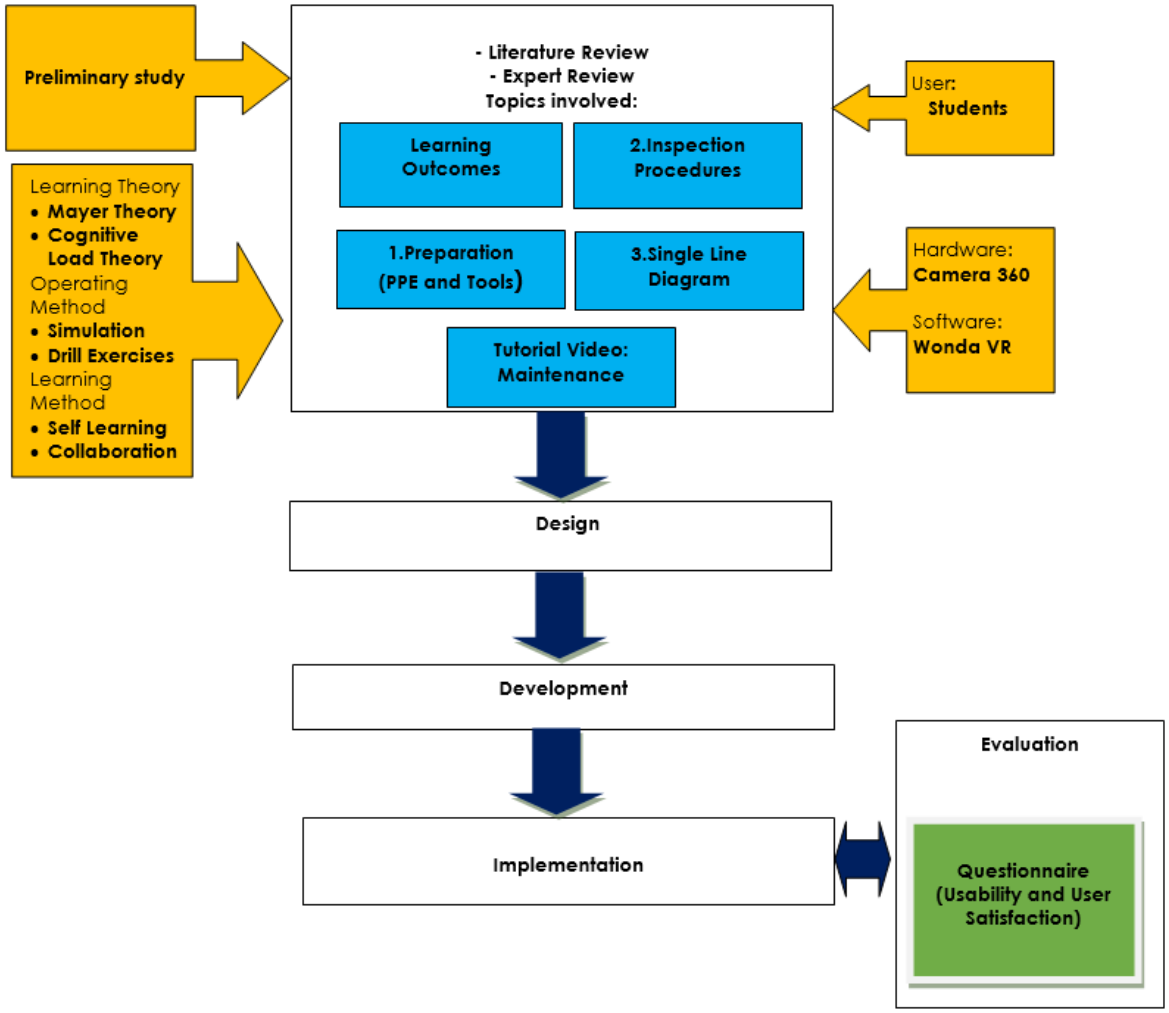


Figure 1: Development Process Based on m-ADDIE Model

The verbal and visual elements in this multimedia presentation refer to Mayer's Theory which involves the use of sensory memory, working memory, and long-term memory of students (Mayer, 2009). To ensure the learning content remains in the students' long-term memory, these three things from Cognitive Load Theory needs to be considered: the difficulty of the content presented, the way the content is presented, and the process or effort that takes place to register the information obtained in the long-term memory.

3.4 Implementation and Evaluation Phase

In this phase, the completed application will be run and tested against the target user. The students will be given a link to the application and browse the entire contents based on the sequence of content. Then, students will answer the questionnaire provided. Students also need to complete the assignments given.

Figure 2 shows the main menu for this application. It contains the Learning Outcomes, topics involved as well as a 360-degree video tutorial. Users can access these topics or sections by place the small 'white dot' in the center of the hotspot in the application. They need to move their heads up and down and turn their body around 360 degrees to move the 'white dot'. Before that, the user needs to set their smartphone to VR mode (split-screen) and placed it into the HMD. The use of HMD is necessary to give the effect as 'present' in the virtual electrical sub-substation.



Figure 2: Main Menu

Figure 3 shows the first interface in Chapter 1: Preparation - PPE Tools. The user needs to place the 'white dot' on the Start button to explore the content in Chapter 1.

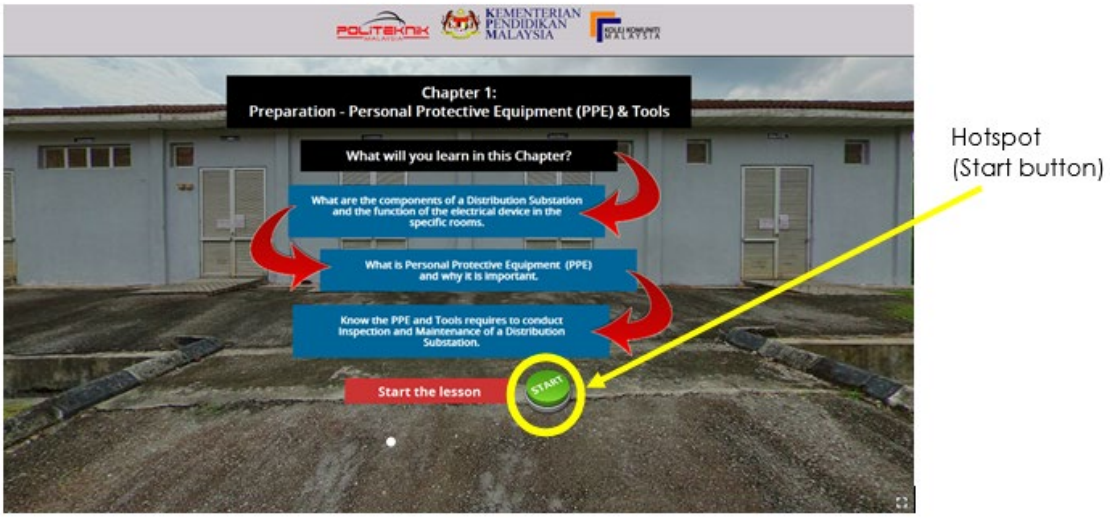


Figure 3: Learning Outcome of Chapter 1

Figure 4 shows the interface of The Components of Distribution Substation. The user needs to place the 'white dot' in the center of the hotspot (bulb symbol) to identify the functions for each room in the substation. They also can move to the previous or next page by placing the 'white dot' on the Previous or Next button or to the main menu by placing the 'white dot' on the Home button.



Figure 4: Interactive Explanation of Distribution Substation Components

Figure 5 shows the activity in this virtual tour application. They need to move their heads up and down and turn their body around 360 degrees to search all PPEs and tools used in the inspection and maintenance procedure.

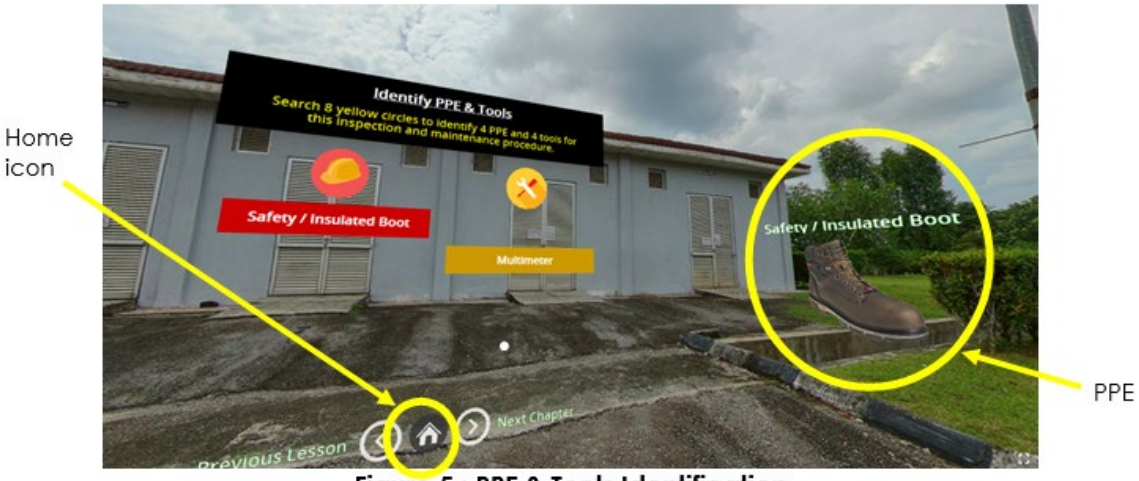


Figure 5 : PPE & Tools Identification

Figure 6 shows the components of the front panel of the vacuum circuit breaker. Users will experience the 360-degree surrounding in the substation.

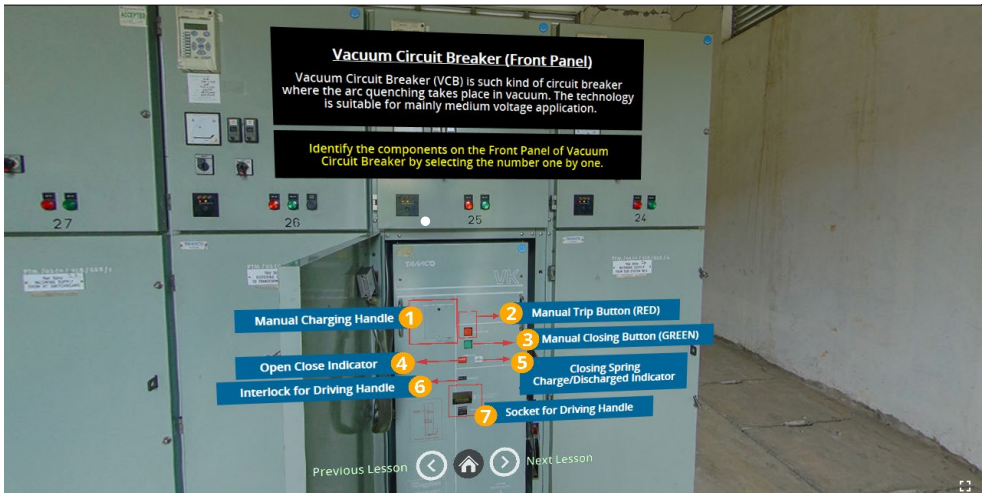


Figure 6: Interactive Explanation of Vacuum Circuit Breaker (Front Panel)

Figure 7 shows the components of the back panel of the main switchboard (MSB). The user needs to identify the components one by one interactively.



Figure 7: Interactive Explanation of Back Panel of Main Switch Board (MSB)

Figure 8 shows the 360-degree video tutorial explained by the competent person from Syarikat Elektrik Jamaluddin Sdn. Bhd. Users can experience the real maintenance procedure in a 360-degree environment in this virtual tour application.



Figure 8: 360-degree Video Tutorial

Figure 9 shows how the application being used and demonstrated by the students in front of the former Minister of Higher Education in the opening ceremony of Techology-enabled Collaborative Classroom, PSAS.



Figure 9: Implementation in The Classroom

4.0 ANALYSIS AND RESULTS

Cronbach's Alpha for usability and user satisfaction was .976, which reflects the high value of the reliability coefficient (referring to Pallant (2001).

Table 1: Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
.976	19

Table 2: Mean Score Interpretation Scale (Mohd Najib, 2003)

Mean Value	Mean Score Interpretation
1.00 – 2.33	Low level
2.34 – 3.67	Middle level
3.68 – 5.00	High level

Table 3: Usability and User Satisfaction Mean Score

No. Item	Item	Mean	Standard Deviation
Design/Layout			
1	I like using the interface of the application	3.9032	1.10619
2	The organization of information on the application was clear	4.0645	.89202
3	The interface of this application was pleasant	3.9032	.94357
Functionality			

4	This application has all functions and capabilities that I expect to have	3.9677	1.13970
5	The information provided in the application was clear	4.0645	.92864
6	All the features in the application functions well	3.9677	.94812
Ease of use			
7	It was easy to use this application	4.0323	.98265
8	It was easy to find the information I need	3.9355	.72735
9	The information provided in the application was clear	4.0968	.90755
10	Overall, this application was easy to use	4.0323	.98265
Learnability			
11	It was easy to learn using this application	4.0323	.98265
12	Not too much information to read before I use the application	3.9355	.72735
13	The information provided by the application was easy to understand	4.0968	.90755
Satisfaction			
14	I felt comfortable using this application	4.0645	.96386
15	I enjoyed exploring the application	4.0968	1.04419
16	Overall, I am satisfied with this application	4.0323	.98265
Outcomes/Future Use			
17	I believed I could become productive quickly using this application	4.0000	1.03280
18	This application was able to convince me on improving my skills	3.9032	.97826
19	From my experience using this application, I think I would use it regularly	3.9677	1.0160

Usability and user satisfaction study was conducted to the 31 electrical engineering students in PSAS. The questionnaire was adapted from the Post-Study System Usability Questionnaire (PSSUQ) and was used to obtain feedback from the students. As a result of Descriptive Statistical Analysis using IBM Statistics SPSS software (version 19) and referring to the mean score interpretation scale (Mohd Najib, 2003), the level of user acceptance of this application is high through the mean score value of six items: Design/Layout is 3.9570, Functionality is 4.0000, Ease of Use is 4.0242, Learnability is 4.0215, Satisfaction is 4.0645 and Outcomes/ Future Use is 3.9570. This proves that this application is suitable for use in learning sessions and meets the needs of users. Formative assessment is given to students through an assignment that has been verified by the Head of Program, but the findings are not discussed in this paper.

5. CONCLUSION

360-degree Virtual Tour Application: Inspection & Maintenance of Distribution Substation 11/0.4kV has successfully developed and the usability and user satisfaction study has been conducted to the students. The student's acceptance is high for this finding, which is above the mean score value of 3.68. Therefore, the researchers plan to continue the research especially on the effectiveness of this application in the future. Hopefully, this will strengthen the achievement of learning outcomes through experience-based learning and simulation of real situations.

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PARAMETER FIZIKAL DAN KIMIA AIR SISA INDUSTRI PEMBUATAN TEMPE DI PORT DICKSON

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Abstrak. Kajian ini dijalankan untuk mengukur sifat fizikal dan kimia air sisa industri kecil pembuatan tempe di Kg Baru Port Dickson. Kualiti Air sisa yang dilepaskan ke sungai perlu diuji bagi memastikan pencemaran sungai tidak berlaku. Kualiti air sisa juga penting dan perlu dipastikan agar efluen yang dialirkan ke saliran tidak memberi kesan buruk atau perubahan kekal kepada alam sekitar yang bakal menjejaskan ekosistem lain. Kajian ini telah dijalankan untuk menentukan parameter fizikal dan kimia air sisa iaitu jumlah pepejal terampai, kekeruhan, bacaan suhu, nilai PH, ammonia nitrogen dan oksigen terlarut. Pengukuran secara in-situ seperti oksigen terlarut, pH dan suhu telah dilakukan dengan menggunakan multiparameter YSI 556, manakala kaedah HACH dan APHA digunakan untuk menganalisis di makmal. Kemudian nilai bacaan akan dibandingkan dengan dengan nilai piawaian yang dibenarkan. Berdasarkan keputusan yang diperolehi daripada analisis yang dibuat, didapati bacaan pepejal terampai adalah (26 - 69 mg/l), kekeruhan (6.26 – 49.2 NTU), nilai suhu ialah (27.9 – 29.2°C), pH (6.27 – 6.71), kandungan ammonia nitrogen adalah (0.34 – 1.6 mg/l) dan oksigen terlarut (6.51 – 6.56 mg/l). Hasil kajian menunjukkan parameter Pepejal Terampai tidak menepati piawaian yang ditetapkan oleh Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979 Parameter Had Maksima bagi Standard A dan B pindaan 2000. Justeru itu tindakan penilaian dan pemantauan terhadap pelepasan air sisa ini perlu diberi perhatian dari semasa ke semasa bagi memastikan efluen yang dilepaskan ke saliran adalah menepati piawaian Jabatan Alam Sekitar. Keputusan keseluruhan menunjukkan sungai di lokasi kajian telah diklasifikasikan sebagai sedikit tercemar. Rawatan air sisa perlu dilakukan sebelum efluen dilepaskan ke saliran bagi memastikan efluen dirawat terlebih dahulu.

Kata Kunci: air sisa, pencemaran sungai

1. PENGENALAN

Pengurusan air sisa merupakan elemen yang penting yang perlu dilaksanakan dalam memastikan air sisa kumbahan dapat dirawat dengan sistematik, berkesan dan efluen yang dilepaskan ke saliran menepati piawaian yang dibenarkan. Air sisa industri merupakan salah satu punca berlakunya pencemaran air sungai. Oleh itu pihak yang berkaitan perlu menitikberatkan langkah pencegahan agar masalah–masalah yang berkaitan pencemaran dapat dielakkan seperti mendatangkan pencemaran bau, punca jangkitan penyakit, pemandangan atau nilai estetika lain yang boleh memberi tanggapan negatif kepada orang ramai.

Aktiviti pembuangan sisa domestik yang tidak terkawal seperti sisa plastik, kertas dan sisa makanan akan menyebabkan peningkatan pencemaran sungai. (Mustakim, N. S., Ramli, M. W., & Ngai Weng, C., 2019). (Jabatan Alam Sekitar, 2013) menyatakan sungai tercemar disebabkan oleh rawatan kumbahan tidak efektif dan sisa daipada industri yang tidak

dirawat. Selain itu ia juga disebabkan oleh aktiviti pertanian, domestik, perniagaan komersial dan lain-lain lagi.

Pada dasarnya tahap kebersihan dan kualiti air sisa adalah merujuk kepada piawaian berdasarkan Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979 Parameter Had Maksima bagi B pindaan 2000. Kajian ini sangat penting bagi memastikan pemantauan dan pengawalan dapat dilaksanakan dengan lebih efektif. Jesteru itu, kajian ini dilaksanakan untuk menentukan status kualiti air sisa hasil daripada kilang perusahaan tempe di Port Dickson.

Keberkesanan efluen yang dilepaskan ke saliran perlu dipastikan agar tidak mendatangkan pencemaran dan menganggu keseimbangan ekosistem. Sekiranya efluen yang dilepaskan tidak dirawat dengan efektif, ia akan menyebabkan kesan buruk kepada semua termasuklah manusia, haiwan akuatik dan nilai estetik bagi keseluruhan kawasan berdekatan.

1.1 Penyataan masalah

Industri kecil di Port Dickson semakin bertambah dan didapati premis-premis ini kebanyakkannya menyalurkan air sisa secara terus ke saliran permukaan tanpa rawatan. Adalah penting untuk memastikan efluen yang disalirkan ke saliran mengikut piawaian yang ditetapkan agar tidak menyebabkan kemudaratan kepada kesihatan penduduk, hidupan air dan nilai estetik bagi keseluruhan kawasan berdekatan.

Pembuangan air sisa kilang penghasilan tempe di Kampung Baru Si Rusa Port Dickson telah menyebabkan pencemaran bau dan juga pencemaran air sungai berhampiran. Bau yang busuk adalah berpunca daripada air rendaman kacang soya untuk menghasilkan tempe. Kajian berkenaan sifat fizikal dan kimia air sisa amat penting dilaksanakan bagi memastikan kandungan air sisa tidak mencemarkan alam dan menyebabkan kesan buruk terhadap ekosistem.



Rajah 1.0: Air sisa industri disalurkan secara terus ke sungai

1.2 Objektif Kajian

Tujuan utama kajian adalah untuk mengkaji kualiti efluen yang disalirkan oleh kilang perusahaan tempe di Port Dickson. Matlamat kajian ini dapat dicapai melalui objektif seperti di bawah:

i. Menentukan status kualiti air sisa di antara parameter kualiti air yang dikaji adalah iaitu jumlah pepejal terampai, kekeruhan, bacaan suhu, nilai pH, ammonia nitrogen dan oksigen terlarut.

ii. Membandingkan nilai efluen dengan nilai piawaian berdasarkan Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979 Parameter Had Maksima bagi B

pindaan 2000 dan juga merujuk Piawaian Interim Kualiti Air Kebangsaan Jabatan Alam Sekitar 2003.
iii. Mencadangkan strategi atau kaedah yang efektif bagi memastikan efluen daripada industri dirawat sebelum disalirkan ke sungai di Port Dickson.

1.3 Skop Kajian
Kajian ini dilakukan pada anak sungai di Kampung Baru Si Rusa, Port Dickson. Skop kajian ini adalah untuk mendapatkan status kualiti efluen yang dikeluarkan oleh kilang penghasilan tempe. Parameter yang diukur untuk mengukur kualiti air sisa adalah terbahagi kepada sifat fizikal dan kimia. Sifat fizikal yang diukur adalah kekeruhan, pepejal terampai dan suhu manakala sifat kimia yang diukur adalah ammonia nitrogen, oksigen terlarut dan nilai pH. Hasil kajian adalah untuk menentukan kandungan air sisa mengikut piawai kualiti air standard B bagi kilang atau industri yang mempunyai effluent poin dibawah (hilir) sungai. Data diperolehi akan dibandingkan dengan Akta Kualiti Alam Sekeliling 1974 dan Indeks Kualiti Air oleh Jabatan Alam Sekitar 2003. Akhir sekali pengkaji mencadangkan strategi atau kaedah yang efektif bagi memastikan air sisa atau efluen yang dilepaskan memenuhi piawaian yang ditentukan oleh pihak Jabatan Alam Sekitar.

2. KAJIAN LITERATUR

Air sisa industri bermaksud air sisa yang dibuang dari kawasan industri seperti kilang pemprosesan makanan dan minuman, kilang pembuatan alat elektronik dan lain-lain lagi. Pepejal terampai wujud dalam air sisa industri dalam keadaan pepejal pelbagai saiz, terlarut dan koloid.

Air sisa industri perlu menjalani proses rawatan bagi mengurangkan tahap bahaya sebelum disalirkan ke dalam saliran air utama. Rawatan air sisa adalah penting untuk mengurangkan penyebaran penyakit berjangkit melalui patogen dalam kumbahan. Selain itu pencemaran air permukaan dan air bumi juga dapat dielakkan dengan adanya rawatan air sisa ini. Rawatan air sisa ini boleh boleh dilakukan secara fizikal, kimia dan biologi.

2.1 Parameter Fizikal Air Sisa
Pencemaran bermaksud sebarang perubahan secara lansung kepada sifat fizikal, kimia dan biologi atau radioaktif bahagian alam sekeliling dengan melepaskan atau mengeluarkan hingga menjejaskan kegunaan yang bersifat berfaedah dan menyebabkan suatu keadaan yang merbahaya kepada kesihatan, keselamatan atau kebajikan awam atau hidupan liar sama ada di darat atau di air, tumbuh-tumbuhan atau menyebabkan suatu perlanggaran terhadap sebarang syarat had atau sekatan yang dikenakan di bawah akta ini. (Malaysia, 2001).

Sifat fizikal air boleh dikenalpasti dengan cara melihat, merasa dan menghidu iaitu sifat yang berkaitan dengan gerak balas penglihatan, sentuhan, rasa dan bau. Contoh sifat fizikal adalah rasa, suhu, bau, warna, pepejal terampai dan kekeruhan.

2.1.1 Suhu
Suhu yang tinggi akan menyebabkan mikroorganisma membiak bertindak dengan lebih aktif di dalam air sisa. Aktiviti yang menyebabkan kenaikan suhu adalah seperti pemanasan air untuk kegunaan mandian dan sebagainya. Suhu sesuai bagi pertumbuhan dan tumbesaran bakteria ialah antara 23°C hingga 35°C.

2.1.2 Pepejal Terampai
Jumlah pepejal terampai bermaksud bahan yang tertapis sebagai baki pada suhu pemanasan antara 103°C ke 105°C (Azmi Idris, 1998). Nilai pepejal terampai yang dibenarkan merujuk Standard B adalah mestilah kurang daripda 100 mg/l.

2.1.3 Ujian Kekeruhan

Kekeruhan adalah parameter penting dan berlaku disebabkan oleh bahan-bahan terampai di dalam air. Bahan-bahan tersebut dioksidakan dan menjadikan air tersebut kelihatan keruh atau tidak jernih. Bacaan air akan tinggi jika sedikit cahaya diuraikan manakala bacaan akan rendah jika cahaya banyak diuraikan. Hidupan yang terampai di dalam air (plankton) serta bahan organik di dalam air akan menyebabkan kekeruhan air. Kekeruhan air yang melebihi 5 NTU boleh dikesan dan dilihat secara visual. Jika kadar kekeruhan sangat tinggi ia akan menyebabkan permintaan air akan berkurang.

2.2 Parameter Kimia Air Sisa

Parameter kimia memainkan peranan paling penting untuk menentukan kualiti sumber air. Parameter kimia penting seperti oksigen terlarut, permintaan oksigen kimia, permintaan oksigen biokimia, (COD), nilai pH dan nitrogen-ammonia (NH3-N) perlu menepati piawaian yang ditetapkan oleh Jabatan Alam Sekitar.

2.2.1 Nilai pH

PH atau darjah keasidan digunakan untuk menyatakan tahap keasidan yang dimiliki oleh larutan. Keasidan bermaksud kepekatan ion hidrogen ($H^{+)}$ dalam pelarut air. Nilai pH bersamaan 7 adalah bersifat nuetral. Nilai pH melebihi 7 menunjukkan penyelesaian mempunyai sifat alkali, manakala nilai pH kurang daripada 7 menunjukkan keasidan.

2.2.2 Ammonia Nitrogen

Kehadiran ammonia nitrogen yang tinggi dalam air sisa akan menyebabkan kehadiran bau busuk. Nilai ammonia nitrogen yang dibenarkan merujuk Standard B adalah tidak melebihi 25 mg/l. Bahan ini selalu ditemui di tapak pelupusan sampah dan bersifat toksik. Ia selalunya di tapak pelupusan sampah dan bahan buangan. (Jabatan Pengairan Dan Saliran Malaysia, 1995). Parameter ini diukur dalam milligram per liter. Ia digunakan secara meluas untuk menentukan kadar pencemaran air dan air sisa.

2.2.3 Oksigen Terlarut

Kandungan oksigen terlarut di dalam air menunjukkan tahap kesuburan ekosistem dalam air. Menurut (Gandaseca et al., 2011) kepekatan oksigen terlarut juga bergantung kepada kadar kelajuan aliran air serta suhu yang rendah. Kandungan oksigen adalah lebih banyak apabila suhu rendah.

2.3 Rawatan Kumbahan

Pertambahan industri menyebabkan kesan negatif terhadap alam sekitar. Pengurusan air sisa secra teratur sangat penting bagi memastikan masalah ini tidak mengancam sumber air. Rawatan kumbahan di loji rawatan moden menghasilkan efluen yang berkualiti tinggi dan selamat dilepaskan ke laut. Rawatan kumbahan adalah berfokus kepada pembuangan organisma patogenik, penyingkiran bahan-bahan terampai dan rawatan organik terbiodegradasikan (Adawiyah, 2015)

2.4 Piawaian Efluen

Efluen yang dilepaskan daripada loji rawatan perlu menepati piawaian yang telah ditetapkan. Sampel efluen perlu diambil dan diuji di makmal untuk memastikan piawaian ini ditpenuhi sebelum efluen disalirkan ke sungai. Ini juga penting bagi memastikan loji rawatan beroperasi dengan betul. Efluen yang dilepaskan ke hulu sungai perlu menepati Piawaian A, manakala efluen yang dilepaskan ke hilir sungai perlu menepati Piawaian B. Piawaian-piawaian ini ditetapkan oleh Akta Kualiti Alam Sekeliling 1974. Efluen untuk Kawasan kajian ini haruslah mematuhi Piawai B kerana efluen dilepaskan ke hilir sungai. Had Piawai A dan Piawai B dipaparkan dalam Jadual 2.0.

Nilai yang diperoleh dirujuk kepada Piawai Interim Kualiti Air Kebangsaan (INWQS) (INWQS, 2014) seperti yang ditunjukkan dalam Jadual 2.1. INWQS terdiri daripada enam kelas iaitu Kelas I, IIA, IIB, III, IV dan V yang merujuk kepada pengelasan sungai-sungai di Malaysia. Kualiti air sungai perlu dipelihara dan dipastikan berada dalam julat yang ditetapkan.

Jadual 2.0. Piawaian A dan B Akta Kualiti Alam Sekeliling 1979

APPENDIX K2

Extracted from Environmental Quality (Industrial Effluents) Regulations 2009 (PU (A) 434)

FIFTH SCHEDULE
[Paragraph 11(1) (a)]

ACCEPTABLE CONDITIONS FOR DISCHARGE OF INDUSTRIAL EFFLUENT FOR MIXED EFFLUENT OF STANDARDS A AND B

	Parameter	Unit	Standard A	Standard B
	(1)	(2)	(3)	(4)
(i)	Temperature	°C	40	40
(ii)	pH Value	-	6.0-9.0	5.5-9.0
(iii)	BOD_5 at 20°C	mg/L	20	40
(iv)	Suspended Solids	mg/L	50	100
(v)	Mercury	mg/L	0.005	0.05
(vi)	Cadmium	mg/L	0.01	0.02
(vii)	Chromium, Hexavalent	mg/L	0.05	0.05
(viii)	Chromium, Trivalent	mg/L	0.20	1.0
(ix)	Arsenic	mg/L	0.05	0.10
(x)	Cyanide	mg/L	0.05	0.10
(xi)	Lead	mg/L	0.10	0.5
(xii)	Copper	mg/L	0.20	1.0
(xiii)	Manganese	mg/L	0.20	1.0
(xiv)	Nickel	mg/L	0.20	1.0
(xv)	Tin	mg/L	0.20	1.0
(xvi)	Zinc	mg/L	2.0	2.0
(xvii)	Boron	mg/L	1.0	4.0
(xviii)	Iron (Fe)	mg/L	1.0	5.0
(xix)	Silver	mg/L	0.1	1.0
(xx)	Aluminium	mg/L	10	15
(xxi)	Selenium	mg/L	0.02	0.5
(xxii)	Barium	mg/L	1.0	2.0
(xxiii)	Fluoride	mg/L	2.0	5.0
(xxiv)	Formaldehyde	mg/L	1.0	2.0
(xxv)	Phenol	mg/L	0.001	1.0
(xxvi)	Free Chlorine	mg/L	1.0	2.0
(xxvii)	Sulphide	mg/L	0.50	0.50
(xxviii)	Oil and Grease	mg/L	1.0	10
(xxix)	Ammoniacal Nitrogen	mg/L	10	20
(xxx)	Colour	ADMI*	100	200

Sumber: Peraturan-Peraturan Kualiti Alam Sekeliling (Kumbahan & Efulen Industri) 1979

Jadual 2.1. Piawaian Interim Kualiti Air Kebangsaan

Parameter	Unit	Kelas I	IIA	IIB	III	IV	V
pH	-	6.5-8.5	6-9	6-9	5-9	5-9	-
DO	mg/L	7	5-7	5-7	3-5	<3	<1
BOD	mg/L	1	3	3	6	12	>12
COD	mg/L	10	25	25	50	100	>100
SS	mg/L	25	50	50	150	300	300
AN	mg/L N	0.1	0.3	0.3	0.9	2.7	>2.7

Nota:

Kelas **Penggunaan**

- Kelas I - Pemeliharaan untuk persekitaran semula jadi. Bekalan air I – secara praktiknya tidak memerlukan rawatan. Perikanan I – untuk spesies akuatik yang sangat sensitif.
- Kelas IIA
  Bekalan air II – memerlukan rawatan konvensional. Perikanan II – untuk spesies yang sensitif.
- Kelas IIB Sesuai untuk aktiviti rekreasi yang melibatkan sentuhan badan.
- Kelas III
  Bekalan air III – untuk kegunaan bekalan air, memerlukan rawatan yang insentif minuman binatang ternakan.
- Kelas IV Pengairan tanaman.
- Kelas V Selain daripada yang dinyatakan di atas dan tidak sesuai digunakan.

Sumber: Jabatan Alam Sekitar Malaysia 2003

Sistem Indek IKA digunakan untuk memudahkan pengumpulan data kepada parameter yang disenaraikan dalam INWQS. Keenam-enam parameter tersebut telah diberikan pemberat atau nilai yang tertentu. Nilai-nilai tersebut akan dikumpulkan dan diwakili oleh hanya satu nombor sahaja iaitu nilai Indeks Kualiti Air (IKA) (Sánchez, E., Colmenarejo, M.F., Vicente, J., Rubio, A., García, M. G., Travieso, L., Borja, 2006). Tujuan IKA adalah mentafsirkan status kualiti air supaya lebih mudah difahami oleh umum. (Fulazzaky, M.A., Teng, W.S. & Mohd Masirin, 2010). Pengiraan untuk mendapatkan nilai IKA diperoleh daripada beberapa sub-indeks yang telah ditetapkan.

2.7 Kajian berkaitan

Menurut (Shafii et al., 2018) Pencemaran sungai berlaku kerana aktiviti manusia seperti pertanian, pembinaan, pembuangan sampah, perikanan dan perindustrian. Perancangan dan juga pembangunan perlu dibuat dengan lebih baik dan teliti bagi menjamin kesejahteraan rakyat dan juga keseimbangan ekosistem.

Kebiasaannya bagi sesebuah sungai yang bersifat konkrit atau 'sungai bandar', di kawasan hulu saliran airnya masih belum dipengaruhi oleh unsur-unsur pencemaran, akan tetapi di bahagian tengah dan hilirnya biasanya telah tercemar dengan agak teruk disebabkan saliran telah melalui kawasan-kawasan yang terdapat pelbagai aktiviti manusia yang telah menyumbang ke arah pencemaran. (Iman Syaiffudin & Toriman, 2020)

Akta kualiti Alam Sekeliling yang diluluskan pada tahun 1974 merupakan peraturan, perintah dan piawaian berkaitan dengan pencemaran air daratan. Akta ini diwujudkan untuk mengatasi masalah berkaitan alam sekitar. Akta ini agak menyeluruh dan perlu dipatuhi oleh semua. Pencemaran merangkumi "apa-apa perubahan sama ada secara langsung atau tidak kepada sifat-sifat fizikal, bahan, kimia, atau biologi pada mana-mana bahagian alam sekeliling. (Shuhaiza., 2012).

Hasil kajian mendapati kebanyakan industri masih tidak mencapai status pematuhan yang memuaskan untuk sesetengah parameter kajian. Program pemantauan kualiti air perlu dijalankan secara berterusan dalam jangka masa yang lebih panjang untuk menilai status kualiti air dan tahap pencemaran sistem saliran air di kawasan-kawasan tersebut. (Mazlin Bin Mokhtar et al., 2001)

3. METODOLOGI

3.1 Kaedah

Kajian ini dilaksanakan di kilang perusahaan tempe yang terletak di Kampung Baru Si Rusa Port Dickson. Lokasi ini dipilih kerana ia merupakan salah satu industri kecil yang terdapat di Port Dickson dan menghasilkan efluen yang disalurkan ke dalam sungai berdekatan. Perkara ini boleh menyebabkan berlakunya pencemaran sungai jika langkah pencegahan tidak dilakukan di peringkat awal. Kajian sifat fizikal dan kimia air sisa industri kecil ini dilaksanakan secara in situ dan menggunakan alat-alat analisis di makmal yang merangkumi spektrofotometer HACH DR2000, alat kaca, kukus air, neraca elektronik, set refluks dan ketuhar. Ujikaji makmal dibuat di makmal kualiti air Syarikat Air Negeri Sembilan (SAINS). Sampel air diambil dengan menggunakan tangan atau dipanggil *grab sampling*. Pengambilan sampel air di lokasi kajian dilakukan antara jam 11.00 hingga jam 11.45 pada 22 Januari 2020 dan 19 Februari 2020. Pengambilan sampel air dibantu oleh 3 pegawai SAINS. Jumlah sampel diambil adalah 32 sampel dan jumlah titik sampel adalah 4 titik. Setiap titik persampelan diuji sebanyak 3 kali bagi setiap parameter yang sama untuk mendapatkan bacaan yang tepat.

Botol sampel perlu dibilas dengan air sungai dahulu bagi mewujudkan kehomogenan dalam botol tersebut. Seterusnya sampel air dimasukkan ke dalam botol kaca bagi mengelakkan penerimaan cahaya. Botol polietilena perlu direndam terlebih dahulu dalam 10% larutan asid nitrik (HNO3) untuk membuang semua bendasing dalam botol. Kemudian botol sampel dimasukkan ke dalam kotak berisi ais. Suhu ditetapkan adalah kurang daripada 4°C bagi

tujuan pengawetan. Semua botol sampel dilabelkan dengan maklumat tarikh, masa dan nombor stesen. Catatan berkenaan keadaan cuaca dan maklumat lain dibuat dalam buku log harian di lapangan. Seterusnya sampel dianalisis di makmal pada hari yang sama. Analisis dilakukan berdasarkan kaedah APHA (1998) dan HACH (2000).

3.2 Lokasi Persampelan
Dalam kajian ini, sebanyak 4 lokasi titik telah ditentukan untuk pengambilan air sampel. Kedudukan titik pensampelan ditunjukkan seperti dalam Jadual 3.0.

Jadual 3.0: No Pendaftaran Sampel, Lokasi Persampelan, Masa Dan Jarak Antara Setiap Lokasi Persampelan Air pada 22 Januari 2020

Bil	No Pendaftaran Sampel	Lokasi Persampelan	Masa	Jarak dari Titik sampel 1 (m)
1	LL/0001	Air Tapisan (Dalam Tong Hitam Rendaman Air)	11.00 pg	0 m
2.	LL/0002	Air Selepas Ditapis	11.20 pg	3.5 m
3.	LL/0003	Air Sebelum Buang ke Sungai	11.30 pg	8.0 m
4.	LL/0004	Air Sisa (Dalam Sungai)	11.45pg	9.5 m

Jadual 3.1: No Pendaftaran Sampel, Lokasi Persampelan, Masa Dan Jarak Antara Setiap Lokasi Persampelan Air pada 19 Februari 2020

Bil	No Pendaftaran Sampel	Lokasi Persampelan	Masa	Jarak dari Titik sampel 1 (m)
1	LL/0005	Air Tapisan (Dalam Tong Hitam Rendaman Air)	11.00 pg	0 m
2.	LL/0006	Air Selepas Ditapis	11.20 pg	3.5 m
3.	LL/0007	Air Sebelum Buang ke Sungai	11.30 pg	8.0 m
4.	LL/0008	Air Sisa (Dalam Sungai)	11.45pg	9.5 m

Parameter fizikal atau kimia ditentukan mengikut prosedur yang ditetapkan oleh pihak berkenaan seperti Jabatan Alam Sekitar. Setiap parameter dianalisis sebanyak tiga kali untuk mendapatkan ketepatan nilai bacaan bagi setiap parameter yang diuji.

4. HASIL KAJIAN DAN PERBINCANGAN

Keputusan yang diperolehi dipaparkan dalam Jadual 4.0 dan Jadual 4.1 iaitu bacaan purata parameter jumlah pepejal terampai, kekeruhan, bacaan suhu, nilai PH, nitrogen ammonia dan oksigen terlarut bagi tarikh 22 Januari 2020 dan 19 Februari 2020.

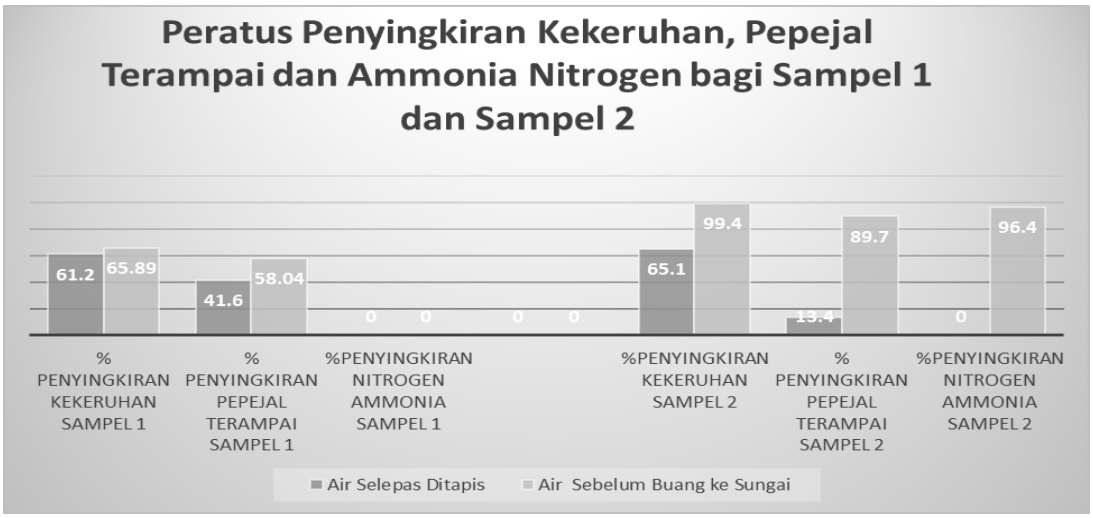
Peratus penyingkiran Pepejal Terampai, Kekeruhan dan Nitrogen Ammonia ditunjukkan dalam Rajah 4.1. Nilai parameter efluen yang dikeluarkan pada titik tiga hendaklah mematuhi Piawai B dalam Peraturan Alam Sekeliling (Kumbahan dan Efluen Perindustrian)1979.

Jadual 4.0: Jumlah pepejal terampai, kekeruhan, bacaan suhu, nilai PH, nitrogen ammonia dan oksigen terlarut pada 22 Januari 2020

Bil	No Pendaftaran Sampel	Lokasi Persampelan	Parameter					
			pH	Suhu	Kekeruhan	Oksigen Terlarut	Pepejal Terampai	Nitrogen Ammonia
			-	^{0}C	NTU	mg/l	mg/l	mg/l
1	LL/0001	Air Tapisan (Dalam Tong Hitam Rendaman Air)	4.08	30.2	2140	0.11	1113	4.8
2.	LL/0002	Air Selepas Ditapis	4.18	28.9	850	0.18	650	28.5
3.	LL/0003	Air Sebelum Buang ke Sungai	4.13	29.8	730	0.13	467	24.0
4.	LL/0004	Air Sisa (Dalam Sungai)	6.71	29.2	6.26	6.56	26	0.34

Jadual 4.1: Jumlah pepejal terampai, kekeruhan, bacaan suhu, nilai PH, nitrogen ammonia dan oksigen terlarut pada 19 Februari 2020

Bil	No Pendaftaran Sampel	Lokasi Persampelan	Parameter					
			pH	Suhu	Kekeruhan	Oksigen Terlarut	Pepejal Terampai	Nitrogen Ammonia
			-	^{0}C	NTU	mg/l	mg/l	mg/l
1	LL/0005	Air Tapisan (Dalam Tong Hitam Rendaman Air)	4.33	28.7	3395	0.73	673	42
2.	LL/0006	Air Selepas Ditapis	4.43	26.6	1140	0.26	438	32
3.	LL/0007	Air Sebelum Buang ke Sungai	4.51	26	1185	0.64	583	52
4.	LL/0008	Air Sisa (Dalam Sungai)	6.27	27.9	49.2	6.39	69	1.5



Rajah 4.1: Peratus Penyingkiran bagi Parameter Kekeruhan, Pepejal Terampai dan Ammonia Nitrogen

Kekeruhan adalah ukuran ketelusan cahaya sebagai dasar untuk mengukur keadaan air dengan skala NTU. Kekeruhan berlaku disebabkan oleh pepejal terampai yang biasanya tidak boleh dilihat dengan mata kasar. Pengukuran kekeruhan adalah ujian penting untuk menentukan kualiti air. Radas yang digunakan adalah mesin kacau *(stirring machine)* untuk ujian polimer larut air yang digunakan dengan proses rawatan air sisa konvensional seperti pembekuan, pemberbukuan, dan pemendapan dalam air, rawatan air sisa dan aplikasi industri lain. Berdasarkan data diperolehi nilai kekeruhan adalah antara 6.26 hingga 49.2 NTU. Nilai ini agak tinggi dan hampir tidak memenuhi Piawaian B Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979. Ini menunjukkan sungai berpotensi untuk tercemar di masa akan datang jika tiada kawalan dibuat.

Oksigen Terlarut merupakan salah satu parameter kualiti air yang penting dan perlu dititikberatkan. Jadual 4.0 menunjukkan keputusan analisis kepekatan oksigen terlarut dengan nilai paling tinggi ialah 6.56 mg/L iaitu Sampel LL/0004 dan nilai oksigen terlarut yang paling rendah adalah 0.11 mg/L bagi sampel LL/0001. Nilai oksigen terlarut yang normal perlu berada pada tahap 7mg/L dan ke atas (INWQS, 2014), namun keputusan analisis tersebut menunjukkan kebanyakan nilai oksigen terlarut bagi lokasi di sungai adalah berada pada kedudukan 6.39 mg/L hingga 6.56 mg/L dan keadaan ini membuktikan berlakunya kemorosotan kualiti air atau dikategorikan dalam Kelas II merujuk Piawaian Interim Kualiti Air Kebangsaan oleh Jabatan Alam Sekitar. Keadaan ini berlaku disebabkan oleh pelepasan air sisa industri tempe ke dalam longkang dan membiarkan ianya mengalir ke dalam sungai tanpa dirawat terlebih dahulu. Jika aktiviti ini dibiarkan berterusan tanpa kawalan, ini akan menjejaskan kualiti hidupan akuatik. Nilai oksigen terlarut yang tinggi menunjukkan kurangnya pencemaran dan jika bacaan oksigen terlarut rendah ia menunjukkan pencemaran yang tinggi (Shafii, 2008). Kadar oksigen terlarut yang yang rendah boleh membawa kepada kematian hidupan akuatik dan menjejaskan ekosistem.

Analisis Nitrogen Ammonia digunakan untuk mengesan pencemaran aktiviti pertanian, perindustrian dan juga domestik. Ammonia adalah sebatian yang terdiri daripada proses penguraian bahan organik bernitrogen. Ammonia yang tidak terion adalah sangat berbahaya kepada hidupan air. Kriteria air untuk hidupan akuatik bagi kandungan NH3N adalah 0.02 mg/L (MacKenzie L. Davis and David A. Cornwell, 2012). Merujuk kepada analisis kajian ini, nilai Nitrogen Ammonia adalah agak tinggi iaitu antara 0.34 – 1.5 mg/L. Merujuk Piawaian Interim Kualiti Air Kebangsaan, ia dikategorikan dalam Kelas IV. Peratus penyingkiran Ammonia Nitrogen adalah antara 92.9 – 96.4 peratus. Peratus penyingkiran adalah berkesan kerana lebih daripada 50 peratus. Air sisa rendaman kacang soya dari kilang tempe tersebut menjadi penyumbang utama pencemaran air sungai. Ini juga dibuktikan oleh Mazlin (2001) yang menyatakan Ammonia Nitrogen berpunca daripada air sisa industri. Pencemaran ini boleh menganggu kesihatan manusia. Penyakit yang terlibat adalah seperti sesak nafas, batuk dan boleh juga menyebabkan kematian.

Nilai pH merupakan indeks kealkalian atau keasidan sesuatu bahan. Parameter ini dapat mengesan kandungan asid atau alkali bahan galian dan bahan organik di dalam air sungai. Nilai pH diukur adalah di antara 0 hingga 14. Nilai pH 7 menunjukkan sifat yang neutral manakala nilai pH kurang daripada 7 menunjukkan air sungai itu bersifat asid. Seterusnya nilai pH melebihi 7 adalah bersifat alkali. Nilai pH penting bagi kitar hidup organisma dan bakteria di dalam sungai. Nilai pH yang terlalu tinggi atau terlalu rendah boleh menjejaskan kehidupan bakteria dan organisma. Hasil analisis mendapati bahawa nilai pH bagi sampel adalah berbeza di setiap lokasi. Bacaan terendah direkodkan bagi sampel LL/0001 (4.08) manakala bacaan tertinggi direkodkan pada sampel LL/0007 (6.27). Ini menunjukkan secara keseluruhan purata Indeks Kealkalian (pH) air sampel adalah agak berasid dan berada dalam Kelas III iaitu sederhana tercemar. Oleh itu dapat dikatakan bahawa air sampel tersebut agak berbahaya kepada hidupan. Kualiti air sungai berasid sangat berbahaya kepada manusia. Keadaan berasid yang tinggi dalam badan manusia boleh menyebabkan penyakit seperti kencing manis, gaut, penyakit jantung dan darah tinggi. Namun kealkalian

yang tinggi pula boleh menyebabkan penyakit seperti penyakit buah pinggang dan batu hempedu.

Pepejal terampai mempunyai saiz zarah yang lebih besar daripada 0.001 mm. Bahan organik hadir di dalam sisa domestik merupakan komponen utama bagi pepejal terampai. Sampel akan dipanaskan di dalam oven pada suhu 103 °C. Unit bagi pepejal terampai adalah dalam unit mg/L. Hasil ujikaji menunjukkan nilai paling tinggi ialah 1113 mg/L di sampel LL/0001 dan nilai semakin rendah ialah 26 mg/L bagi sampel LL/0004. Peratus penyingkiran jumlah pepejal terampai adalah antara 89.7 – 97.7 peratus. Peratus penyingkiran adalah berkesan kerana lebih daripada 50 peratus. Nilai pepejal terampai air sungai pula antara 26 – 69 mg/l. Nilai ini menunjukkan air sungai berada dalam Kelas III iaitu sederhana tercemar. Merujuk Piawaian Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979 Parameter Had Maksima bagi Standard A dan B pindaan 2000, nilai pepejal terampai yang diperolehi bagi sampel air sungai (69 mg/l) adalah tidak mematuhi piawaian.

Dapatan kajian membuktikan berlakunya pencemaran di sungai berhampiran akibat aktiviti industri. Pihak berwajib perlu mengambil langkah-langkah yang holistik demi melestarikan alam sekitar terutamanya sungai dengan baik, bersih, dan selamat. (Mustakim, Ramli, & Ngai, 2019).

5. CADANGAN DAN KESIMPULAN

Beberapa cadangan dibuat bagi memastikan pencemaran sungai tidak berlaku akibat air sisa industri di masa depan iaitu:
i. Menggalakkan penggunaan penapis air sisa daripada serat semulajadi untuk merawat air sisa supaya mematuhi piawaian Jabatan Alam Sekitar.
ii. Membuat Pemantauan Secara Berjadual terhadap kualiti air sisa dengan melaksanakan ujian kualiti influen dan efluen secara berkala dan kerap. Ujian kualiti dapat mengukur keberkesanan olahan air sisa sebelum dilepaskan ke sungai.
iii. Penggunaan Teknologi *phytoremediation* yang dibangunkan penyelidik Universiti Malaysia Pahang (UMP) yang bukan saja berkesan merawat air sisa tetapi menjimatkan kos hampir 50 peratus. Menurut penyelidik menerusi kaedah ini, akar menyerap air dan zat dari tanah, aliran air dan air bawah tanah seterusnya membersihkan bahan kimia yang dilakukan sejauh akar itu sampai seterusnya membersihkan bahan kimia yang dapat dilakukan sejauh akar itu boleh sampai. Tumbuhan phytogreen adalah seperti teratai, keladi bunting, kiambang, purun, selimpat dan ekor kucing.

Dapat disimpulkan bahawa kualiti efluen kilang tempe di Port Dickson berada dalam keadaan sederhana tercemar mengikut klasifikasi Indeks Kualiti Air. Hasil kajian juga menunjukkan parameter Pepejal Terampai tidak menepati piawaian yang ditetapkan oleh Akta Kualiti Alam Sekeliling (Kumbahan dan Hasil Industri) Peraturan 1979 Parameter Had Maksima bagi Standard A dan B pindaan 2000. Hasil kajian yang diperoleh diharap dapat dijadikan titik permulaan dan rujukan bagi kajian kualiti air pada masa akan datang. Proses pembangunan yang tidak terancang akan menyebabkan penurunan kualiti air dan seterusnya akan merosakkan ekosistem kita. Selain itu kajian ini dilihat sebagai perintis untuk kajian seterusnya dilaksanakan dalam usaha memperbaiki tahap kualiti air sisa yang dilepaskan ke sungai. Oleh itu, semua pihak haruslah bertanggungjawab dan sama-sama memainkan peranan masing-masing dalam usaha mengekalkan alam sekitar yang tidak tercemar.

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EFFECTS OF TRAFFIC VOLUMES TOWARDS THE LEVEL OF SERVICE AND CARBON ABSORPTION ON THE SUSTAINABLE CONCRETE

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Abstract. Motor vehicle is one of the largest contributors of greenhouse gases emission (GHGs) while human transportation and industrial activities caused the major greenhouse gases emissions of carbon dioxide (CO_2) and carbon monoxide (CO). The purpose of this study is to measure the level of service (LOS) of an intersection and to explore the relationship between the carbon absorption rate in the carbonation of lightweight foamed concrete containing fly ash-cement mixture and carbon emission rate from motor vehicles that are passing through the signalized intersection at Lukut, Port Dickson. The method used in this research is the application of SIDRA 6.0 software to evaluate and improve the service level of an intersection as well as to measure the rate of carbon emission. Some laboratory tests such as concrete compression test and carbonation test are also conducted to determine to what extent the carbon absorption rate of lightweight foamed concrete specimens with the increasing amount of fly ash is directly proportional to the traffic flow. The results of this research shows that SIDRA 6.0 software is capable in helping to analyze and enhance the signalized intersection at the study area from LOS of F to C and the 55.8% reduction of CO_2 emission into the air from 1,485.7 kg/h to 656.7 kg/h. Lightweight foamed concrete with cement replacement of fly ash by 20% is the most effective in absorbing carbon compared to the ordinary concrete, with an 8.2mm depth of absorption within the 3-month period of exposure at the intersection. The production of lightweight foamed concrete with fly ash mixture that is capable of absorbing carbon dioxide is an important aspect that needs to be continuously assessed its potential in reducing carbon emission from motor vehicles and this will make way for the foamed concrete to be used for sustainable environmental benefits.

Keywords: *Carbon dioxide, traffic congestion, Carbonation, Foamed concrete,*

1. INTRODUCTION

Climate change emanating from CO_2 emissions has emerged as the most challenging environmental problem in recent decades. The increase in the composition or concentration of CO_2 in the atmosphere indicates the increasing re-absorption rate of the earth and the infrared rays emissions, thus the air temperature near the Earth's surface will rise due to the trapped heat. In Malaysia, motor vehicles are considered as one of the major air pollution contributors and the number of motor vehicles are increased by 7.4% per annum from about 5 million in 1990 to 23.7 million in 2013 (MOT 2013). Due to traffic congestion at intersections in Malaysia, delays are observed repeatedly at peak times due to poor strategy for road networks (Albrka at el. 2014). According to the Environmental Quality Report (2013), air pollution problems generated by mobile sources such as motor vehicles are a serious problem. Other contributing factors of air pollution are the increase in the number of motor vehicles, the usage of leaded petrol and the use of non-standardized and less efficient engines.

1.1 Problem statement

In the construction industry, Portland cement production that is widely used will release up 7% of carbon dioxide into the atmosphere that can affect quality of an environment. The production of one tonne of Portland cement produces about one tonne of CO_2 and other GHGs (Elchalakani et al. 2014). Therefore, the national construction industry needs to identify and recommend the appropriate materials to completely replace the Portland cement in concrete. In other way, traffic congestion is one of the major problems that challenge developed countries around the world (Albrka at el. 2014). As a result of traffic congestion at intersections in Lukut Port Dickson, delays and long queues are observed repeatedly during peak hours due to the poor strategies of road networks. In recent decades in Port Dickson, an explosive growth in the demand for transport vehicles and the total number of recorded motor vehicles has grown up and hence, increasing the number of vehicles cause traffic congestion, resulting in slower travel speed. Furthermore, one of the significant ways to improve the performance of the network is by coordinating traffic signal in intersections using applicable modern software (Alshetwi , 2018).

1.2 Objectives of the research

The objectives of this research are:

(i) To measure the level of service (LOS) of the intersection

(ii) To find the correlation between the carbon absorption and the carbon emission rate obtained from the traffic volume at the Lukut intersection, Port Dickson

(iii) To propose measures that could improve the level of junction performance and reduce carbon emissions into the atmosphere.

1.3 The scope of the study

The scope of this research are:

(i) This study is limited to foam concrete studies with a density control of 1800 kg/m3

(ii) 5%, 10%, 20% and 30% (Fly Ash) are mixed as part of the cement substitute

(iii) Carbon absorption rate or carbonation depth is using Phenolphthalein test.

(iv) SIDRA 6.0 software is used in determining the level of junction service (LOS) and determining the amount of CO^2 emissions at the intersection where the sample area of the cube is placed for carbon absorption testing.

2. LITERATURE REVIEW

Road traffic encounters several problems, such as air pollution and energy consumption, which result in a major constraint for sustainable mobility (baubaker et al. 2016). Many studies in various countries have analyzed the CO_2 emissions and implementing mitigation policies and sustainable energy planning for emissions reduction. Consequently, various related methodologies and applications related to CO_2 emissions reduction planning are reviewed. Mandavilli et al. (2008) used the unsignalized and signalized intersection design and research aid (SIDRA) software to study the environmental impacts of roundabouts. They concluded that NOx, CO, HC, and CO2 emissions can be reduced by 48%, 42%, 65%, and 59%, respectively by converting stop-controlled intersections to roundabouts.

However, computer simulation is very essential for the analysis of freeway and urban street systems. The Signalized Intersection Design and Research Aid (SIDRA) Software is an intersection-based platform as an assistance for timing, capacity and performance analysis of isolated intersections. The SIDRA intersection software is used as an aid in the evaluation and design of signalized intersections (fixed-time/pretimed and actuated), roundabouts, single point interchanges, signalized pedestrian crossings, roundabout metering, two-way stop sign control, give-way/yield sign-control and all-way stop sign control (Irtema et al. 2014). The level of service (LOS) provides a qualitative ranking of the traffic operational conditions experienced by users of facility and also Highway Capacity Manual define the LOS category for freeways and multilane highway.

In the construction industry, Portland cement production that is widely used will release up 7% of carbon dioxide into the atmosphere that can affect quality of an environment. The production of one tonne of Portland cement produces about one tonne of CO_2 and other GHGs (Elchalakani et al. 2014). Therefore, the national construction industry needs to recommend and identify the appropriate materials to completely replace the Portland cement in concrete. In this study, fly ash is used as one of the alternative substitutes for cement in the foamed concrete mix. Research by Wang at el. (2017) stated that the carbonation depth of fly ash concrete made with 30% replacement was much larger than of ordinary concrete and an increase in compressive stress, carbonation will decreased. However, Morandeau (2015) also conclude that the total porosity decrease with a rearrangement of the microstructure due to carbonation and the creation of big capillary pores for the paste with the highest contents of fly ash.

However, superplastisizer can decrease the porosity of concrete and effect the carbonation resistance of concrete via their effects on the pores structures of hydrate product (Shi at el. 2016). Research by Hussain et al. (2017) concluded that due to the lack of calcium hydroxide in the fly ash mixes it's make higher penetrability and higher rate of carbonation compare to ordinary concrete. Namsone et al. (2017) pointed out, that creating of more durable Foam concreate makes possible to increase life cycle of material and promote rational use of natural resources. Therefore the sustainable concrete need to recommend to replace the OPC and can absorb the carbonation at atmosphere.

3. MATERIALS AND METHODS

3.1 The traffic volume and the use of SIDRA 6.0 software

In order to find out whether the loading and the service at the intersection is at the substantial level, a study on the traffic volume information that presents on the road networks at the Lukut intersection, Port Dickson should be implemented. Furthermore, the observation data collection of the traffic volume and the traffic flow was analyzed using SIDRA 6.0 software. The service level of an intersection and the rate of carbon emission by the motor vehicles that are passing through the signalized intersection are then analyzed.

The method of data collection of traffic volumes can be observed in various ways according to the type of data required. In this study, this method is operated in the field by recording videos to calculate the number of vehicles passing one point of intersection every peak hour in the morning (7.00 am - 8.00 am), noon (12.00 pm -1.00 pm) and evening (5.00 pm - 6.00 pm). The data is collected for 3 days involving both weekends and weekdays base on Manual H.C.M (2000) and these data and areas were considered potential by looking at the plots of traffic capacities and being able to determine different levels of traffic volumes; high, moderate and low, in order to cover a wide range of data (Albrka at el. 2014). The highest traffic flow capacity is taken at each exit of the intersection. By using this method, the calculations can not only be made more accurately, but also the classified data can be easily determined. The data obtained is analyzed using the SIDRA 6.0 software to obtain the intersection level information and the amount of carbon emitted from the motor vehicle fumes.

3.2 Experimental methods in laboratory

The next research is on the properties of fresh lightweight foamed concrete and the addition of fly ash as cement replacement cover involve both slump test and density tests. The density control of foamed concrete with fly ash is important to ensure the uniformity of the mixture. The study is conducted on harden concrete with the aim to assess the properties of strength and durability of lightweight foamed concrete. This study also covers the carbonation test for the samples that are exposed to motor vehicles for three months at the signalized intersection. There are also samples that are placed in the Concrete Laboratory for the data comparison purposes.

3.2.1 Materials and sample preparations

The foaming agent used in the present research is a protein based foaming agent. Different foaming agents have different foam expansion and outputs. Thus, the quality of this product relies on the quality of the foam. The protein based foaming agent is from the animal rendering process as a component of an animal by-product. Protein based foaming agent is preferred due to its ability to create more stable foams. The amount of foaming agent included in the composition is adjusted to obtain a density of 1800kg/m³.

The ratio of Portland cement to fine aggregates in this composition is 1:2 (0.45). The purpose of fine aggregates (sand) used in the composition is to improve the properties of the mixture, facilitate finishing, promote uniformity and inhibit segregation. The size of the fine aggregates used is less than 5.0 mm. However, the ratio of water to Portland cement is 1 : 2.2. Water is an important ingredient during the mixing with cement in order to form a paste that binds the aggregates together. The water causes the hardening of the composition through hydration. The water to cement ratio is very critical in producing an end product that is strong and workable.

Fly Ash - Class F from the Jimah Power Plant, Port Dickson has been used for the present research. The percentages of fly ash substitution to Portland cement are 5%, 10%, 20% and 30%. However for the carbonation test, the indicator is a Phenolphthalein 1% ethanol solution with 1g Phenolphthalein and 90ml ethanol dilute with water to 100ml are used in this research. The method of producing the foamed concrete with fly ash that has the ability to absorb carbon dioxide from the surrounding environment is disclosed herein. The method comprises several steps such as the mixing step of a foaming agent with water to produce a liquid mixture which then transforms the liquid mixture into a foamed mixture by introducing the air into the liquid mixture using a foam generator, and the mixing of the foamed mixture with different percentages of fly ash, Portland cement, fine aggregates and water. A foam generator is a machine that produces stable aqueous pre-foaming solution from a mixture of foaming agent, water and air. This pre-foaming solution is then mixed with mortar slurry consisting of cement, sand, different percentages of fly ash and water with the control density of 1800 kg/m³.

After curing for 7 days and 28 days, the samples are tested using the compression strength test. However for the carbonation test, foamed concrete samples are just cured around 7 days only and then should be exposed to the moving vehicles at the intersection. The samples are placed at the Lukut intersection and at the Concrete Lab of Politeknik Port Dickson for three (3) months. This experiment is carried out every one(1) month to measure the rate of diffusion of carbon dioxide absorbed by the sustainable concrete composition.

3.2.2 Laboratory testing method

a) The Depth of Carbonation (Phenolphthalein spray test)

Phenolphthalein is a PH indicator which changes progressively from the colour of pink-fuchsia to colourless when the PH drops from 10 to 8.3. When the specimens reach the carbonated age to be tested, the specimens are taken out and split in two half prisms along the length. The freshly broken surfaces were sprayed with the standard phenolphthalein solution. Measurements of the depth of carbonation are performed at four points along the specimens. The average of these eight values is taken as the carbonation depth of the specimen at the corresponding carbonated age. The carbonated zone, where $Ca(OH)_2$ is converted to $CACO_3$, remains colourless and the zone where the value of PH is above 9.5, turns to the colour of pinkish purple.



Figure 3.1: Phenolphthalein spray test

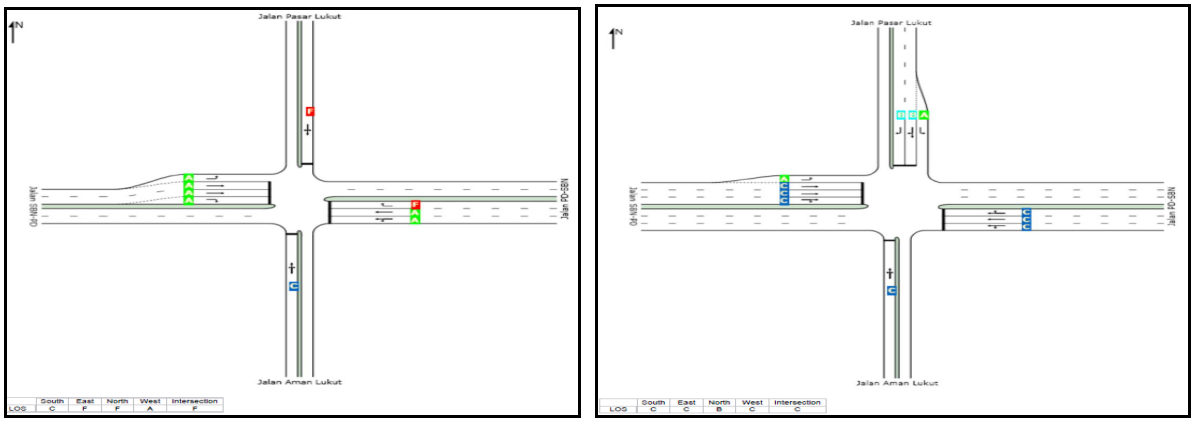
b) Compression Strength Test
Foamed concrete with fly ash cubes of 150mm x 150mm x 150mm dimension are casted for the compression strength test. The load is axially applied according to the procedure of BS EN 772-1 and AS/NZS 4456 that use the Compression Machine Test with the maximum capacity of 1500kN and continuously increase at a rate of approximately 2.5kN/s. The maximum load specimen sustained by the specimen is recorded and then divided by the cross-sectional area to obtain the compression strength.

4. RESULTS AND DISCUSSION

The collected traffic volume data was analyzed using SIDRA 6.0 software and subsequently the discussions on the results of carbonation experiment performed at the site exposed to carbon emission from motor vehicles and at the laboratory are well elaborated and analyzed. Additionally, suggestions on the improvement and some problem solving are also described.

4.1 Intersection Service Level and CO_2 Emission rate.
4.1.1. Level of service (LOS) before the improvement
Referring to the Figure 4.1a below, the total level of service of the intersection is F. Besides, the results obtained from SIDRA 6.0 software analysis shows that the carbon dioxide generated at the intersection is 1,485.7 kg/h. This indicates that the traffic flow of 5,603 vehicles per hour caused a very high of CO_2 emission. Meanwhile, the travel speed of the moving vehicles at the intersection is 4.7 km/h which means that the movement of the vehicles is very slow. Therefore, road intersection service optimization is an effective way to increase the traffic flow especially in term of cost-efficiency. In order to reduce the traffic congestion and the high carbon dioxide emission, some improvements are proposed such as adjustment of the intersection cycle time according to the amount of traffic flow, addition of slip lane and new lanes.

4.1.2 Level of service (LOS) Level after improvement
Some simulations have been implemented to improve the intersection but the first simulation finds that the proposed road design is only able to endure the traffic congestion up to 6 years with a 20% increase in traffic flow. Therefore, second simulation to improve the intersection level of service is re-implemented using the SIDRA 6.0 software and this second simulation is able to meet the road intersection design period up to 10 years ahead with a 30% increase in traffic flow. Table 4.1 show the results of intersection level of service before and after the improvement.



a) Before Improvement b) After Improvement

Figure 4.1: Level of service (LOS) before and after the improvement

Table 4.1: Variables improvement result using SIDRA 6.0 Software

Variables	Before	After	Improvement
Level Of Service	F	C	ok
CO2 Total (Kg/hr)	1,485.7	656.7	55.8 %
Travel Speed (Km/hr)	4.7	16.6	71.7 % (+)
Degree Of Saturation	6.41	0.88	86.3 %
Average Delay (s)	404.2	83.3	79.4 %
Queue Distance (m)	1,189	733	38.3 %
Fuel Consumption (l/hr)	774.7	356.4	54.0 %
Performance Index	2,285.7	1,733.6	24.2 %

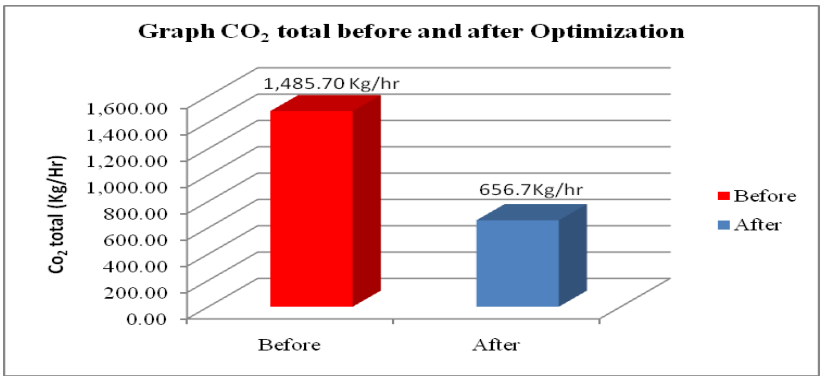


Figure 4.3 : Graph CO_2 total before and after optimization

Overall, referring to the table 4.1 and figure 4.3 above, after using the SIDRA 6.0 software, the increase in the service level of the intersection is clearly shown where the level of service (LOS) is improved from F to C, while the CO_2 emission is greatly reduced by 55.8% from 1,485.7 kg/h to 656.7 kg/h. This indicates that the intersection widening which involves the addition of lanes and the adjustment of the intersection cycle time and effective green time definitely helps in reducing the carbon dioxide emission and thereby reducing the air pollution. Meanwhile, the speed on the road is directly correlated with the traffic congestion and as displayed in the table above, the travel speed can be increased from 4.7 km/h to 16.6 km/h (71.7%). The reduction is also noticeable on the fuel consumption that is more economical by 54.0% and the performance index is also declined by 24.2%. Therefore, the intersection improvement in this study has successfully proven that in the next 10 years, the level of service of the intersection is still convenient and less traffic congestion.

4.2 The compression strength and the carbon absorption rate of sustainable concrete.

4.2.1 Sustainable concrete compression strength.

The concrete compressive strength of lightweight foamed concrete with the addition of fly ash as a cement replacement is made at the age of 7 and 28 days. The results of the concrete compressive strength is stated as in table 4.2 and figure 4.4 below.

Table 4.2 : Compression strength test result

% material replacement	Density (Kg/ m³)	weight of cube(kg) 7day	28 day	Compression strength (N/mm²) 7 day	28 day
OPC only	3210	7.07	7.30	29.33	39.36
FC only	1800	6.80	6.77	23.31	34.77
Add 5% Fly Ash	1800	6.60	6.57	25.21	35.18
Add 10% Fly Ash	1800	6.77	6.67	28.81	39.04
Add 20% Fly Ash	1800	6.36	6.47	23.59	34.70
Add 30% Fly Ash	1800	6.50	6.53	22.14	33.33

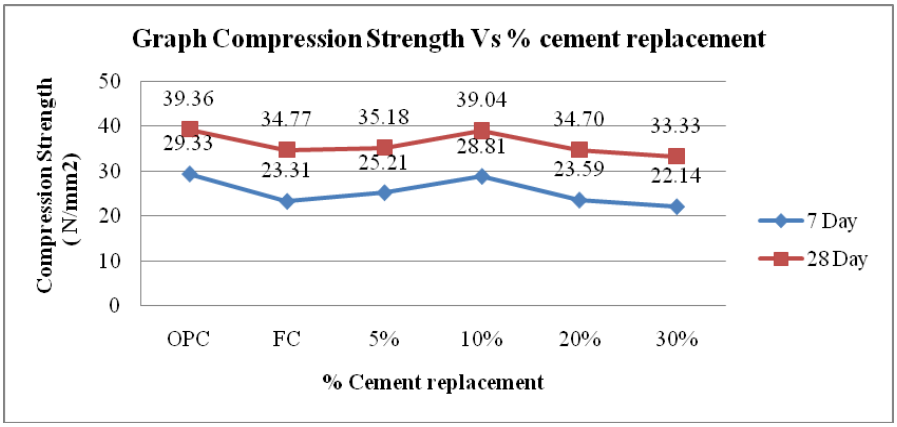


Figure 4.4 : Graph compression strength

On the 7th and the 28thday where the strength is optimum, it is observed that the concrete mix with Portland cement without any additive has the highest strength compared to the other samples which are 29.33 N/mm² and 39.36 N/mm² respectively. The concrete cube is very compact and solid. This is closely related to the weight of the cube that is observed as the heaviest when compared to the lightweight foamed concrete which is 7.30 kg. Furthermore, the concrete strength after the use of 10% fly ash additive into the foamed concrete is 30.04 N/mm² on the 28th day, where it is the highest reading compared to the other incremental percentages of fly ash. The weight of the cube is also the highest compared to the others although the density is controlled at the rate of 1800 kg/m³during the preparation of the mix. This is probably due to the material stability and the suitability of the additive found in the concrete mix that cause it to be sturdy and strong compared to the other mixtures. Overall, the obtained data can be concluded that the lightweight cube possesses low concrete density, thus leading to the decrease of compression strength

4.2.2 Depth of carbon dioxide absorption

Table 4.3 below shows the readings of the carbon absorption test on the samples placed at the signalized intersection and also at the Concrete Lab of Politeknik Port Dickson that have been carried out for 3 months.

Table 4.3 : Carbonation depth reading

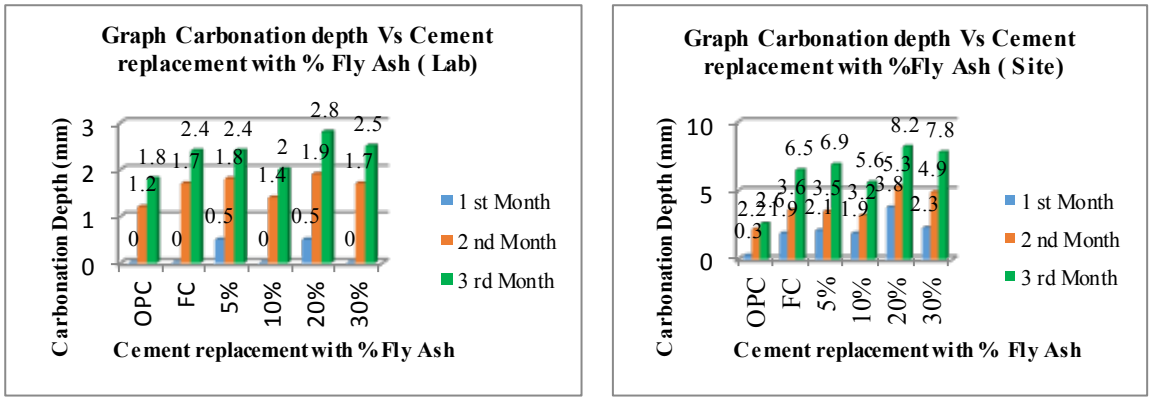
Material	Carbonation depth reading (mm)					
	1 st month		2 nd month		3 rd month	
	Site	Lab	Site	Lab	Site	Lab
OPC only	0.3	0	2.2	1.2	2.6	1.8
Foam concrete only	1.9	0	3.6	1.7	6.5	2.4
Add 5% Fly Ash	2.1	0.5	3.5	1.8	6.9	2.4
Add 10% Fly Ash	1.9	0	3.2	1.4	5.6	2.0
Add 20% Fly Ash	3.8	0.5	5.3	1.9	8.2	2.8
Add 30% Fly Ash	2.3	0	4.9	1.7	7.8	2.5

Based on figure 4.5 (a) and the research conducted at the intersection, it can be clearly seen that the readings for three months are consistent. The highest depth of carbon absorption on the sustainable concrete which is the depth of 8.2 mm is the mixture with 20% addition of fly ash as cement replacement. This condition is seen to have a relationship with the compressive strength and the weight of the tested sample whereby the 20% of fly ash addition has made the concrete to have the lightest weight compared to the others, the lowest strength and the density composition that is less compact. Thus, this condition facilitates the carbon dioxide to fill the spaces in the cubes and then in the foamed concrete by adding 20% of fly ash that is capable of absorbing carbon with the highest depth.

This carbon absorption is also closely related to the rate of vehicles using the intersection. The longer the samples being placed at the intersection, the longer the samples being exposed to the traffic flow and thus the carbon emission rate is also increased from day to day. The second highest depth of carbon absorption is the sample with the 30% increase of fly ash, at a depth of 7.8 mm for 3 months. Moreover, the lowest reading is the ordinary concrete sample without any additive.

Next, figure 4.5 (b) below shows the carbon absorption rate of the sample placed in the Concrete Laboratory of Politeknik Port Dickson that is not directly exposed to heavy and light road vehicles. This is to see how far different environmental conditions are able to affect the depth of carbon absorption rate on sustainable concrete. From the graphs and the data obtained in the first month, only the foamed concrete with the addition of 5% and 20% of fly ash have the carbon absorption readings compared to the others. However, in the last 3 rd month, the depth of carbon absorption rate is found to be the highest when the fly ash is added by 20% which is 2.8mm, followed by 2.5 mm depth of the 30% of fly ash addition, 5% of fly ash addition and the foamed concrete solely without any fly ash addition. The lowest reading of 1.8 mm is recorded on the concrete with no additional materials. This proves that heavy sample with high strength is in solid and sturdy states which will then obstruct the penetration of carbon dioxide onto the sample.

In conclusion, for sample that is exposed to traffic flow at the intersection, the depth of carbon absorption on the sustainable concrete is very high compared to the sample that is placed in the confined area in the laboratory. According to both figure 4.5, it is clearly shown that the foamed concrete with a 20% addition of fly ash is the most effective in carbon absorption while the standard concrete is only able to absorb a very low amount of carbon.



(a) Lab (b) Site

Figure 4.5 (a) Graph Carbonation Depth in lab and Site

4.0 CONCLUSION

By using the SIDRA 6.0 software, many improvements can be seen especially in terms of the level of service (LOS) and the reduction of CO_2 emission into the air. This proposed study is able to increase the service level of the intersection from F to C and also able to meet the design period of the intersection up to 10 years ahead. This study also helps to reduce the rate of carbon emission and the rate of fuel consumption which are the causes of the crucial environmental pollution problems. Moreover, the lightweight foamed concrete containing fly ash-cement mixture shows higher carbon absorption rate in natural environment compared to the standard concrete. In addition, the volume of traffic flow and carbon emission from motor vehicles at the intersection can affect the carbon absorption rate of the lightweight foamed concrete. This carbon absorption rate is also closely related to the rate of vehicles passing through the intersection. The longer the sample being placed at the intersection, the higher the exposure of the sample towards the traffic flow and large carbon emission which will then increase the depth of the carbon absorption of the sustainable concrete. Therefore, this study should be extended to strengthen the data and more systematic methods in producing more profound and technological research to produce materials that are capable of absorbing carbon from various motor vehicles and also to seek the mitigation measures to reduce the carbon emission into the air.

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PENGHAYATAN NILAI TEKUN DAN KERJASAMA PELAJAR LUAR KAMPUS PSMZA

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Abstrak. Kajian dijalankan untuk mengetahui penghayatan nilai tekun dan kerjasama di kalangan pelajar luar kampus PSMZA yang berlokasikan rumah kampung, rumah taman dan banglo. Kajian melibatkan 400 responden menjawab soal selidik bernilai Alpha 0.95 yang mempunyai empat bahagian. Analisis ujian t bebas, ANOVA dan *Post Hoc Scheffe* digunakan untuk melihat dapatan. Kajian mendapati pelajar menyewa rumah taman mempunyai penghayatan yang paling tinggi.

Kata Kunci: nilai tekun, kerjasama, penghayatan

1. PENGENALAN

Kehidupan perbandaran mempunyai kesan langsung terhadap kualiti hidup penduduknya. Menurut Nik Hassan dan Zuliskandar (2011) kemajuan sesebuah komuniti sebenarnya dipengaruhi oleh ketamadunan yang lahir dari sebuah persekitaran penempatan yang sihat.

Kekuatan serta keistimewaaan sesebuah bandar atau penempatan lebih terserlah sekiranya komuniti setempat memainkan peranan yang aktif dalam sebarang bentuk aktiviti yang menyihatkan minda dan hubungan sosial (Aiken et al., 1982). Namun begitu kajian Samsuhaizad, Jamaluddin dan Azahan (2014) membuktikan terdapat banyak gangguan yang menjejaskan prestasi bandar untuk meningkatkan kualiti penduduknya, antaranya seperti sikap tidak menghormati antara satu sama lain, ketiadaan ketekunan untuk meningkatkan hubungan sosial antara anggota serta kurangnya semangat kerjasama yang boleh meningkatkan persefahaman dan perpaduan anggota masyarakat.

1.1 Pernyataan masalah
PSMZA terletak di Bandar Dungun di bawah tanggungjawab Majlis Perbandaran Dungun (MPD). Pada 1 Januari 1981 MPD telah ditubuhkan menjadi salah satu perbandaran rasmi dalam negeri Terengganu selain dari majlis Perbandaran Kuala Terengganu dan Majlis Perbandaran Kemaman. Pada peringkat awal hanya berkeluasan 72.59 kilometer persegi namun bermula 1996 kawasan MPD meningkat kepada 2735.04 kilometer persegi (Zubir Mamat, 2015).

Sehubungan itu, pelajar PSMZA yang berada di luar kampus terdedah dengan pelbagai anasir perbandaran yang mempengaruhi nilai diri seseorang pelajar. Memandangkan hanya pelajar semester satu yang diwajibkan tinggal di kampus, menyebabkan pelajar semester tiga dan lima terpaksa menyewa rumah di kawasan sekitar PSMZA. Golongan ini lebih terdedah dengan unsur-unsur perbandaran yang mempengaruhi pemikiran serta tingkah laku sekaligus menentukan tahap interaksi mereka di dalam institusi.

1.2 Objektif kajian
Kajian ini bertujuan untuk menilai tahap penghayatan nilai-nilai Islam dalam kalangan pelajar PSMZA yang tinggal di luar kampus bagi memenuhi spesifikasi kualiti hidup mengikut kehendak Islam dan setakat mana penghayatan tersebut membawa peningkatan dalam amalan nilai-nilai Islam dalam institusi. Kajian dijalankan bagi mengkaji penghayatan pelajar pada nilai tekun, pembudayaan nilai Islam melalui nilai kerjasama dan amalan nilai-nilai Islam yang diamalkan dalam institusi.

Secara ringkasnya, objektif kajian adalah seperti berikut:
(i) Mengenal pasti tahap penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai Islam dalam kalangan pelajar luar kampus PSMZA.
(ii) Mengenal pasti perbezaan penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai Islam dalam kalangan pelajar luar kampus PSMZA berdasarkan jantina.
(iii) Mengenal pasti perbezaan penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai Islam dalam kalangan pelajar luar kampus PSMZA berdasarkan lokasi rumah sewa.

2. KAJIAN LITERATUR

2.1 Kepentingan nilai-nilai islam dalam meningkatkan kualiti hidup
Kajian (Salleh dan Zuria, 2009; Mohd Mahzan et al. 2013) menegaskan terdapatnya hubungan kolerasi yang utuh antara amalan nilai-nilai Islam dengan kemakmuran sesebuah komuniti setempat.

Islam menyokong serta menggalakkan penganutnya agar bekerja keras dalam menghasilkan sebuah komuniti yang sihat melalui sikap-sikap positif seperti kerjasama, tekun dalam memperkukuhkan perpaduan, saling menghormati dan tolong menolong dalam perkara kebaikan. (Zakaria, Noranizah dan Abdul Fatah, 2012; Mior Khairul Azrin, 2011). Selain itu aspek kejiranan juga memainkan peranan penting dalam usaha memartabatkan masyarakat secara holistik, justeru Islam amat menekankan pemeliharan struktur serta organisasi kejiranan agar sentiasa positif dalam melahirkan anggota masyarakat cemerlang (Wan Rozali, 2008; Abdul Samad, 2010). Selain faktor kejiranan, nilai-nilai Islam yang terdapat secara bersepadu dalam diri anggota masyarakat, secara hakikatnya mampu melahirkan kelompok sosial yang lebih bertamadun dan lebih berdaya saing dalam arus globalisasi. (Sabari, 2006; Khairani, 2012).

Pengkaji menumpukan terhadap dua nilai Islam iaitu nilai tekun dan kerjasama. Hal ini kerana dua nilai ini amat sesuai serta signifikan untuk dilihat serta dikaji dalam konteks kualiti hidup bermasyarakat. Nilai tekun yang dikehendaki dalam masyarakat adalah memberi tumpuan kepada sesuatu aktiviti yang dijalankan serta berusaha sehabis baik untuk membawa kecemerlangan kepada komuniti setempat. Sanggup menghadapi cabaran dan persaingan dalam perubahan semasa demi mempertingkatkan maruah agama, bangsa dan negara. Tidak mengharapkan tambahan upah, ganjaran dan sanjungan serta lebih mengutamakan kepentingan komuniti berbanding kepentingan diri. Sentiasa berusaha mengatasi sebarang masalah dengan bersungguh-sungguh sama ada secara berseorangan atau berkumpulan. Nilai kerjasama pula membawa maksud saling tolong-menolong antara sesama ahli komuniti terutama bekerjasama dalam memberi kebaikan kepada masyarakat keseluruhan. Sentiasa mengamalkan konsep kerja berpasukan, sentiasa aktif dalam mengukuh dan mempromosi perpaduan seterusnya bekerjasama dalam menangani keburukan (JPM, 2001).

2.2 Dimensi nilai kajian
Dimensi nilai tekun yang ingin diukur dalam kajian ini adalah seperti ketekunan responden dalam melibatkan diri dalam aktiviti kemasyarakatan seperti melibatkan diri dalam kempen-kempen kesedaran masyarakat anjuran pelbagai agensi kerajaan serta pelbagai badan-badan bukan kerajaan. Hal ini termasuklah segala aktiviti kemasyarakatan, program peningkatan kesedaran undang-undang serta aktiviti pemantapan institusi kekeluargaan yang dijalankan sama ada formal atau tidak formal. Formal bermaksud dijalankan oleh pelbagai agensi menggunakan premis kerajaan serta swasta sementara tidak formal apabila berlaku di surau, masjid serta dewan orang ramai (Norhaslina, 2006).

Sementara untuk nilai kerjasama pula, dimensi nilai dilihat menerusi penglibatan responden terhadap aktiviti yang secara langsung membudayakan nilai-nilai Islam seperti amalan Islam dalam kejiranan seperti kenduri tahlil arwah, kenduri cukur kepala, marhaban serta sambutan hari-hari kebesaran Islam, begitu juga dengan aktiviti yang tidak langsung seperti gotong royong, program CSR komuniti serta usaha untuk berhubungan secara baik dengan jiran sekeliling (Sabari, 2006).

3. METODOLOGI KAJIAN

3.1 Persampelan

Seramai 400 orang pelajar PSMZA yang tinggal menyewa di sekitar PSMZA telah dipilih sebagai responden kajian soal selidik. Oleh kerana jumlah pelajar yang berada di luar kampus adalah seramai 3,012 (Statistik IEO PSMZA sesi Jun, 2019) maka berdasarkan saranan Krecjie dan Morgan, 400 sampel adalah memadai untuk mewakili keseluruhan populasi. Soal selidik adalah adaptasi dari Teori Ilmu Wahyu, Tajul Ariffin (1997) yang digabung jalin dengan model penerapan nilai-nilai Islam dari Pekeliling Am Bil 2 Tahun 2001 (JPM, 2001).

Mengandungi empat bahagian utama iaitu bahagian maklumat demografi responden (10 item); bahagian penghayatan pelajar pada nilai tekun (10 item); bahagian pembudayaan pelajar pada nilai kerjasama (10 item); dan amalan nilai-nilai Islam pelajar di dalam institusi (10 item). Kajian rintis terhadap 30 responden di PSMZA menghasilkan nilai alfa Cronbach 0.95. Mohd Majid (2000) menegaskan nilai Alpha 0.70 ke atas mempunyai kebolehpercayaan yang tinggi. Pemilihan sampel pula adalah berdasarkan persampelan rawak mudah sesuai dengan saranan (Gay dan Airasian, 2000).

Jadual 1: Taburan sampel bagi setiap kampung yang terlibat dalam persampelan rawak mudah untuk mewakili populasi.

Jadual 1: Pemilihan sampel

Nama Kampung	Jumlah responden
Kg Batu Tujuh	68
Kg Batu Enam	54
Kg Balai Besar	41
Kg Pak Sabah	46
Kg Sura Hujung	47
Kg Sura Tengah	50
Kg Gong Pasir	53
Kg Alur Tempoyak	41
JUMLAH	400

3.2 Metode analisis

Objektif pertama kajian dijawab secara deskriptif mengandungi komposisi kekerapan, peratusan, nilai min serta sisihan piawai. Tafsiran skor min berdasarkan Jadual Interpretasi Skor Min seperti dalam jadual 2.

Jadual 2: Jadual Interpretasi Skor Min

SKOR	INTERPRETASI
1.00-2.33	RENDAH
2.34-3.66	SEDERHANA
3.67-5.00	TINGGI

Sumber: Jamil (2002)

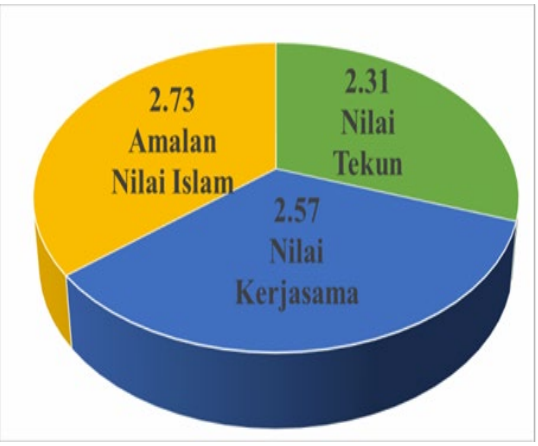
Sementara objektif kedua dan ketiga kajian dijawab dengan analisis ujian t bebas dan ANOVA satu hala. Selain itu korelasi Pearson digunakan untuk mengenal pasti hubungan antara tahap penghayatan nilai tekun dan pembudayaan nilai kerjasama dengan amalan nilai Islam. Penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai Islam adalah pemboleh ubah bebas; sementara jantina dan lokasi rumah sewa adalah pemboleh ubah bersandar.

4. KEPUTUSAN DAN PERBINCANGAN

4.1 Demografi
Mengunakan perisian SPSS 21.0, deskriptif jantina responden adalah seramai 228 (57, 25) lelaki sementara wanita adalah seramai 172(42.8%).

Sementara berdasarkan lokasi menyewa pula pecahannya adalah seramai 128(31.9%) menyewa banglo, yang menyewa rumah kampung adalah seramai 115(28.7%) sementara seramai 157(39.4%) menyewa rumah taman perumahan.

4.2 Penghayatan melalui skor min
Rajah 1 dibawah menunjukkan skor nilai min untuk tahap penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai-nilai Islam.



Rajah 1: Tahap Nilai Tekun, Nilai Kerjasama dan Amalan Nilai Islam

Rajah 1 membuktikan bahawa tahap penghayatan nilai tekun responden adalah rendah, manakala skor min sederhana untuk pembudayaan nilai kerjasama dan amalan nilai Islam.

4.3 Perbezaan skor mengikut jantina
Setelah analisis deskriptif digunakan untuk dapatan penghayatan, mengenal pasti perbezaan tahap penghayatan berdasarkan jantina dianalisis menggunakan inferensi.

Jadual 3: Perbezaan skor mengikut jantina

Aspek	Jantina	N	Min	T	df	Sig
Nilai Tekun	Lelaki	228	2.50	-4.926	412	0.000
	Wanita	172	2.17			
Nilai Kerjasama	Lelaki	228	2.64	-1.803	412	0.072
	Wanita	172	2.52			
Amalan Nilai Islam	Lelaki	228	2.38	0.532	412	0.595
	Wanita	172	2.35			

Nilai t = –4.926 menunjukkan terdapat perbezaan yang signifikan terhadap tahap penghayatan nilai tekun responden lelaki dan wanita iaitu penghayatan responden wanita(min=2.17) adalah lebih rendah jika dibandingkan dengan responden lelaki (min=2.50). Selain itu dapatan membuktikan tiada perbezaan yang signifikan terhadap pembudayaan nilai kerjasama dan amalan nilai Islam dalam kalangan responden lelaki dan wanita.

4.4 Lokasi Rumah Sewa

Ke arah mengetahui tahap perbezaan penghayatan responden berdasarkan lokasi menyewa, ujian ANOVA satu hala telah dilaksana dan dapatannya seperti dalam Jadual 4:

Jadual 4: Perbezaan tahap penghayatan berdasarkan lokasi rumah sewa.

	Rumah Sewa	N	Min	Sisihan Piawai	F	Sig.
Nilai Tekun	Banglo	128	2.10	0.581	12.001	0.000
	Kampung	115	2.31	0.674		
	Taman	157	2.49	0.735		
Nilai Kerjasama	Banglo	128	2.28	0.625	19.975	0.000
	Kampung	115	2.60	0.699		
	Taman	157	2.78	0.710		
Amalan Nilai	Banglo	128	2.17	0.534	12.951	0.000
	Kampung	115	2.36	0.657		
	Taman	157	2.54	0.658		

Nilai F = 12.001 menunjukkan terdapat perbezaan signifikan penghayatan nilai tekun, nilai kerjasama F = 19.975 dan amalan nilai Islam F = 12.951 berdasarkan lokasi rumah sewa. Di samping itu skor min yang lebih tinggi bagi responden yang menyewa rumah taman perumahan (2.49,2.78 dan 2.54) berbanding yang menyewa rumah kampung dan banglo mencadangkan responden yang menyewa di kawasan perumahan mempunyai penghayatan nilai tekun, pembudayaan nilai kerjasama dan amalan nilai Islam yang lebih baik.

Sementara untuk melihat perbezaan tersebut secara yang lebih terperinci, pengkaji melaksanakan ujian *Post Hoc Scheffe* terhadap ketiga-tiga pembolehubah bersandar secara sekaligus iaitu lokasi rumah sewa yang terdiri dari banglo, rumah kampung dan rumah taman perumahan.

Jadual 5: *Post Hoc Scheffe* perbezaan tahap penghayatan

Aspek	(L1) Lokasi Rumah Sewa	(L2) Lokasi Rumah Sewa	Perbezaan min (L1- L2)	Ralat piawai	Sig.
Nilai Tekun	Banglo	Kampung	–0.206	0.08488	0.054
		Taman	–0.385*	0.07863	0.000
	Kampung	Banglo	0.206	0.08488	0.054
		Taman	–0.179	0.08097	0.088
	Taman	Banglo	0.385*	0.07863	0.000
		Kampung	0.179	0.08097	0.088
Nilai Kerjasama	Banglo	Kampung	–0.319*	0.086	0.001
		Taman	–0.502*	0.080	0.000
	Kampung	Banglo	0.319*	0.086	0.001
		Taman	–0.183	0.082	0.084
	Taman	Banglo	0.502*	0.080	0.000
		Kampung	0.183	0.082	0.084
Amalan Nilai Islam	Banglo	Kampung	–0.192	0.078	0.051
		Taman	–0.370*	0.073	0.000
	Kampung	Banglo	0.192	0.078	0.051
		Taman	–0.177	0.075	0.061
	Taman	Banglo	0.370*	0.073	0.000
		Kampung	0.177	0.075	0.061

Perbezaan min = –0.385 menunjukkan terdapat perbezaan yang signifikan terhadap tahap penghayatan nilai tekun responden yang menyewa banglo dengan mereka yang menyewa rumah taman perumahan mencadangkan responden yang menyewa rumah taman perumahan lebih tekun mengikuti program pembelajaran keislaman dan kemasyarakatan berbanding dengan mereka yang menyewa banglo.

Sementara perbezaan min= –0.319 membuktikan terdapat perbezaan yang signifikan antara responden yang menyewa banglo dengan mereka yang menyewa rumah kampung dalam pembudayaan nilai kerjasama. Hal ini bermakna responden yang menyewa rumah kampung lebih kerap terlibat dalam aktiviti sosial berbanding dengan responden yang menyewa banglo. Selain itu responden yang menyewa rumah taman perumahan mempunyai penglibatan sosial yang lebih tinggi berbanding dengan responden yang menyewa banglo, dibuktikan dengan perbezaan min = –0.502 yang mencadangkan terdapat perbezaan yang signifikan dalam pembudayaan nilai kerjasama antara keduanya.

Perbezaan min = –0.370 pula membuktikan responden yang menyewa banglo mempunyai amalan nilai Islam yang lebih rendah berbanding mereka yang menyewa rumah taman perumahan.

5. RUMUSAN DAN KESIMPULAN

Dapatan kajian membuktikan penghayatan nilai tekun pelajar luar kampus PSMZA adalah rendah, hal ini disumbangkan oleh penglibatan pelajar yang tidak serius terhadap program serta aktiviti sosial dikawasan kejiranan mereka. Ketiadaan kesungguhan serta ketekunan dalam aktiviti sosial menyumbang kepada terhakisnya nilai-nilai Islam yang lain dalam diri pelajar. Perkara ini selari dengan kajian (Tajul Ariffin dan Nor'Aini, 2002; Abd Hadi, 2004) yang mengatakan sikap individualistik dan sibuk dengan urusan peribadi menyebabkan kerengganan sosial sekaligus merencatkan usaha penerapan nilai-nilai Islam dalam lingkungan sosial masyarakat.

Selain itu, pembudayaan nilai kerjasama hanya berada di tahap sederhana, hal ini membuktikan program serta aktiviti peningkatan kerjasama di kawasan kejiranan MPD perlu dipertingkatkan lagi serta ditambah baik. Pelajar tidak boleh disalahkan dalam soal ini sekiranya fasiliti serta premis ke arah pemupukan kerjasama tidak disediakan oleh agensi yang berwajib. Ketiadaan usaha serius oleh MPD untuk meningkatkan akses anggota komuniti dalam aktiviti pembudayaan kerjasama seperti gotong royong perdana serta program kekeluargaan seperti aktiviti sukan rakyat adalah bertentangan dengan saranan (Hoppers, 2005; Badu-Nyarko dan Zumapkeh, 2014;) yang menegaskan pembudayaan nilai kerjasama adalah perlu untuk menjamin kesejahteraan komuniti yang lebih lestari dan mapan.

Dapatan daripada analisis skor min menunjukkan bahawa skor min bagi ketiga-tiga aspek yang dikaji adalah rendah. Skor min bagi penghayatan nilai tekun adalah yang paling rendah (min = 2.31) mencadangkan pelajar luar kampus PSMZA kurang mengamalkan tolong-menolong, interaksi yang pasif serta kurang melibatkan diri dalam aktiviti kejiranan. Hal ini menyumbang kepada kurangnya interaksi sosial sekaligus menyebabkan nilai-nilai Islam terhakis dalam kawasan kejiranan sebagaimana ditegaskan oleh Aiken et al. (1982) yang mengatakan kerengganan hubungan sosial akibat kurang senyum, sikap mementingkan diri dan tidak prihatin dengan persekitaran.

Sementara pembudayaan nilai kerjasama pula hanya (min = 2.57) mencadangkan bahawa pelajar luar kampus PSMZA masih bergelut dengan masalah menyesuaikan diri dengan persekitaran. Hal ini selari dengan pandangan (Haryati, 2007; Selvi dan Katiman, 2012) yang menegaskan antara faktor-faktor yang menyebabkan kurangnya penglibatan individu dalam aktiviti sosial adalah disebabkan kesukaran dalam menyesuaikan diri dengan persekitaran bandar dan kawasan kejiranan baru.

Sekalipun amalan nilai Islam mencatat min tertinggi (min = 2.73) antara ketiga-tiga konstruk namun relatifnya masih rendah jika dilihat mengikut interpretasi skor min. Dapat dirumuskan bahawa amalan nilai-nilai Islam dalam kalangan pelajar luar kampus PSMZA adalah kurang memuaskan. Maka usaha perlu dipertingkatkan lagi terutama semasa sesi MSK (Minggu Suai Kenal) penglibatan serta tahap penglibatan sosial pelajar dengan masyarakat sekitar perlu diperkenalkan. Sehingga kajian ini ditulis, MSK masih lagi mengekalkan tradisi lama aktiviti iaitu sesi orientasi pelajar baru dengan kehidupan kampus sedangkan pelajar hanya berada di kampus semasa semester satu. Sementara untuk dua semester lagi iaitu semester tiga dan lima pelajar berada di luar kampus dan pengalaman ini tidak pula didedahkan kepada pelajar. Selain platform MSK masih banyak lagi saluran lain yang boleh meningkatkan tahap penglibatan sosial pelajar dengan komuniti luar seperti CSR, khemah ibadat dan gotong royong perdana. Hal ini perlu dipertingkatkan lagi dan perlu dilakukan secara lebih menyeluruh. Amalan terkini pemilihan pelajar untuk program tersebut kebanyakannya berdasarkan sukarela menyebabkan hanya pelajar yang sama yang terlibat dari awal semester sehingga akhir semester. Dasar mewajibkan pelajar serta pemberian markah terhadap penglibatan program pembudayaan nilai Islam serta penglibatan sosial dengan komuniti boleh diaplikasikan untuk mencapai hasil yang lebih holistik.

Kemudahan untuk bergerak menyumbang kepada penghayatan nilai tekun yang tinggi dikalangan pelajar lelaki dengan (min=2.50) berbanding dengan pelajar wanita (min=2.17), umum mengetahui kebanyakan pelajar lelaki mempunyai kenderaan sendiri seperti motorsikal sementara pelajar wanita pula majoritinya menggunakan perkhidmatan van sewa untuk bergerak. Keterbatasan ini menyebabkan ketekunan pelajar wanita melibatkan diri dalam aktiviti sosial berkurang dengan nyata. Walaubagaimana pun, pembudayaan nilai kerjasama serta amalan nilai Islam tidak pula menunjukkan perbezaan yang signifikan, hal ini berlaku lantaran kebanyakan program kerjasama adalah berdekatan dengan tempat kediaman mereka seperti aktiviti gotong royong yang lebih bersifat domestik sementara untuk amalan nilai, lebih bergantung kepada tahap kemampuan individu untuk kekal konsisten.

Dapatan kajian dalam analisis mengikut lokasi menyewa menunjukkan pelajar menyewa rumah taman perumahan mempunyai penghayatan nilai-nilai Islam yang lebih tinggi berbanding pelajar yang menyewa rumah kampung dan banglo. Selain itu pelajar yang menyewa rumah kampung mempunyai tahap pembudayaan yang lebih baik berbanding dengan yang menyewa banglo. Hal ini berlaku kerana kebanyakan rumah banglo adalah terletak di perkampungan Cina sementara semua responden pula adalah pelajar Melayu Islam yang menyebabkan aktiviti penglibatan komuniti menjadi agak terhad sehinggakan menghasilkan dapatan yang sedemikian rupa. Perkara ini juga disumbangkan oleh kebanyakan penduduk taman perumahan adalah terdiri dari komuniti Melayu Islam yang sentiasa aktif dengan aktiviti keagamaan seperti tahlil dan kenduri arwah dan golongan pelajar merupakan yang paling popular dipelawa untuk menghadirkan diri.

Pengaji merumuskan peningkatan penghayatan dan pembudayaan nilai-nilai Islam dalam kalangan pelajar luar kampus PSMZA perlu ditambah baik. Kemudahan teknologi dan program sosial sedia ada boleh dimanafaatkan untuk meningkatkan aktiviti sosial pelajar PSMZA. Pelbagai galakan serta insentif perlu ditawarkan kepada pelajar agar konsisten aktif dalam aktiviti kemasyarakatan seperti sukan rakyat, gotong royong serta sentiasa melibatkan diri dengan aktiviti keagamaan setempat seperti kenduri tahlil dan majlis sambutan hari kebesaran Islam. Hal ini kerana, penglibatan dalam aktiviti ini menyumbang secara jelas terhadap kesejahteraan hidup serta mampu melahirkan individu cemerlang.

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XLPE CABLE INSULATION RELIABILITY STUDY UNDER HIGH AND LOW TEMPERATURE USING WEIBULL ANALYSIS

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Abstract. This paper presents the consequences of a trial examination concerning the impact of low and high temperature on the unwavering quality in cross-connected polyethylene (XLPE) protected force links. The motivation behind the analysis is to decide the presentation of XLPE link protection subsequent to going through a few pressures which are electrical pressure and thermal pressure. This exploration centers around the breakdown voltage as the boundary to analyze the unwavering quality of XLPE protection between the typical conditions without maturing measure and after exposed to electric and thermal pressure. The outcomes get is being dissected by utilizing Weibull appropriation investigation.

Keywords: Weibull distribution, XLPE reliability

1. INTRODUCTION

Cross-connected polyethylene (XLPE) is made from polyethylene (PE) plastic with a three-dimensional atomic bond that is made inside a structure of a plastic. Assembling cycle of XLPE is finished by including limited quantities of synthetic added substances, (for example, cancer prevention agents) to the polymer. Added substances help improve the stream properties of a polymer that will be shaped. This cycle permits the atomic chains to shape a grid development by cross-connecting the polymer under proper treatment after expulsion (Reeves and Heathcote, 2003).

The cycle of cross-connecting changes its unique state from thermoplastic to thermoset (Tamboli et al, 2004). As a thermoset polymer, it comprises of long chain of atoms that structure connections between the chains during polymerisation. This structures a solitary organization of polymer chains that are commonly not straight, however a tangled mass.

XLPE is ordinarily utilized in electrical link development for a wide scope of voltage. An examination by Dilip K and Das Gupt (1997) had demonstrated the benefis of utilizing XLPE as protection material when all is said in done are because of their incredible physical, concoction and dielectric properties. XLPE is preferred over other protection material, for example, polyvinyl chloride (PVC), ethylene propylene elastic (EPR) and silicone elastic because of its strength against high temperature. This material additionally has high protection opposition, superb dielectric quality and a low dissemination factor at all frequencies.

2. LITERATURE REVIEW

2.1 Introduction
This section explained about breakdown voltage, aging of XLPE insulations and thermal aging and effect on cable insulations.

2.2 Voltage
2.2.1 Breakdown Voltage
The base voltage that will makes a protector become electrically conductive or in other manner give the most extreme voltage distinction to the cover that can be applied over the article before the separator leads and crumples is known as breakdown voltage.

2.3 Aging of XLPE Insulations
2.3.1 Aging
In view of its superior exhibitions, Cross-connected Polyethylene (XLPE) is generally utilized as protecting material in MV and HV transmission power links. During their working assistance, XLPE protected links are for all time exposed to warm pressure (temperature), which can cause an irreversible harm of the links protection. The warm pressure called likewise warm maturing is known as one of the critical marvel winning in protected links under assistance conditions. The ordinary working temperature of the XLPE link protection brought about by the huge ampacity in consistent state conditions is viewed as 90°C and the most extreme temperature up to 150°C is permitted in over-burden and up to 250°C in impede, regardless of whether for brief timeframes (Bernstein, B,S,1989).

A material working under focusing on conditions will last pretty much as indicated by the extent of the applied anxieties and material natural characteristics. At the point when matured in administration conditions for a while, the electrical and mechanical properties of the XLPE protection may debase, which may prompt an evident weakening in dielectric exhibitions, for example, electric conductivity, permittivity, dielectric misfortune and dielectric quality (Struik, 1978).

2.4 Thermal Aging and Effects On Cable Insulations
At the point when electrical protection, natural materials specifically, presented to 76 raised temperatures are dependent upon disintegration. Crumbling produces changes in the physical properties of materials with the goal that they become incapable to meet their capacities after a specific time, this implies disappointment. The restricting worth, PL, is the estimation of properties, which beneath the material is not, at this point ready to work acceptably. Along these lines, warm pressure can deliver disappointment without annihilating the example, and thus the restricting worth is built up as per a model, which must consider the capacity that the material is relied upon to meet in administration. Since the pace of disintegration increments quickly with rising temperature, which causes an increasing speed of the compound responses happening in materials, in this manner, it is important to restrict the temperature to guarantee long existence of electrical hardware. Since warm conduct of materials impressively changes starting with one material then onto the next, protecting materials have been arranged by the greatest temperature they can suffer for a sufficiently significant stretch of time. This characterization was made based on the concoction idea of materials. In this way, the ever-expanding number of manufactured materials and their mixes has drawn out an alternate characterization dependent on tests other than understanding.

In Japan, the warm maturing of materials was likely occupied without precedent for 1910 (Kujirai & Akagira, 1925). Warm maturing is influenced by the convergences of oxygen and 77 items in the response area. In 1925, Kujrai and Akagira revealed that in the quickened maturing test, there is a straight connection between the logarithm of the time required for the qualities to diminish to a specific level and the complementary of supreme temperature (Akahira, 1928). In the wake of giving the report, Akahira gave himself to the active

advancement of the thermo gravimetric examination, in which the mass difference in a substance with the thermo balance is estimated while expanding the temperature at a consistent speed. From 1927 to 1929, he recorded pioneer accomplishments in this field and these outcomes were received in ongoing brief timeframe warm continuance testing technique by warm investigation. The connection among temperature and weight change got conceivable to be estimated and was explored (Kujirai & Akagira, 1925).

3. METHODOLOGY

In this investigation, the cross-connected polyethylene (XLPE) will be utilized as test example. So as to set up the polyethylene examples, the crude material of cross-connected polyethylene can be gotten from polymer maker. The test examples will be set up with determined measurement which is thickness of 3.0 mm. From the examination, it is discovered that, the dissolving point for cross-connected polyethylene (XLPE) material is about 130°C.The testing measure has been directed at Polymer Laboratory of FKKSA.

So as to played out the electrical pressure try, the reasonable gear for the electrical pressure should be structure. By utilizing AutoCAD programming, the electrical pressure hardware drawing has been planned. The subsequent stage is to manufacture the electrical pressure hardware alluding to the drawing that has been made by utilizing AutoCAD.

The upper and base plane cathode of the example holder must be level so as to forestall test example from tumbling down. Moreover, the plane terminal is produced using conductor, either steel, cooper or bronze. The example holder must be customizable to make it more adaptable. The PVC around the plate is utilized to forestall or decreased the crown impact happened during the electrical pressure try. The accompanying figure shows the front and side perspective on the electrical pressure gear that has been structured.

Subsequent to finishing the electrical pressure gear establishment, the examples was tried with the maturing test technique by methods for uniform electric field worry for a time of 24 hours. The XLPE protection test was exposed to electric anxiety of 5kV, 10kV, and 15kV. There will be seven test examples for every electric feeling of anxiety. At that point, thermal pressure was directed so as to explore the impact of low temperature and high temperature on the unwavering quality of XLPE protection.

So as to lead the thermal pressure try, the appropriate chamber that can deliver the necessary temperature. For low temperature, the cooler in the Institution of High Voltage and High Current (IVAT) while broiler in Polymer Laboratory at Faculty of Science will be utilized to direct the thermal pressure explore for high temperature .The range for low temperature are -20°C,- 5°C and 10°C while the range for high temperature are 50°C ,65°C and 80°C .There will be seven test examples for every temperature and the test examples will be matured in the cooler as long as 48 hours ceaselessly.

At last, breakdown test has been led to get the estimation of breakdown voltage for each test examples after exposed to electric and thermal pressure. Most importantly, the estimation of breakdown voltage for ordinary condition test examples with no maturing cycle will be acquired. This breakdown voltage of the example will be as a source of perspective voltage to contrast and the breakdown voltage with electrical pressure and thermal pressure condition.

A progression of brief's means of expanding voltage is applied to the examples so as to give greatest worry to the example. While HVAC is infused to the example, the breakdown progress condition is screen until the example reach to breakdown condition.
The breakdown of the example can be witnessed when the flashovers for a few time between the semiconductor and the conductor. Murmuring sounds can be heard before the flashover occurred and called crown impact. There is smell after the breakdown test, this is

because of ozone was made during the investigation. As in this analysis, the breakdown example will deliver breakdown way marvel.

The estimation of breakdown voltage is recorded in the table. From that point onward, the test voltage is quickly diminished to zero and turned off and the test example will be taken out substituted for the following specimen.

4. RESULTS AND DISCUSSION

The experiment brings about this task is isolating into two sections, which is breakdown voltage for electrical pressure and thermal pressure analyze. The breakdown voltage for these two sections will be contrast and breakdown voltage in typical condition without maturing measure.

The accompanying table shows the breakdown voltage of the XLPE protection tests of around 3.0mm thick after exposed to electric feeling of anxiety of 5kVrms, 10kVrms, 15kVrms for 24 hours and different temperature at 10°C, - 5°C, - 20°C, 50°C, 65°C, 80°C for 48 hours during electrical pressure and thermal pressure explore individually. The information is gathered for each voltage that ascents from zero until the example scopes to breakdown voltage.

Table 1:Data for Electrical Stress

No of Sample	Breakdown Voltage (kVrms)			
	NORMAL CONDITION	ELECTRICAL STRESS		
		5kVrms	10kVrms	15kVrms
1	49.1	49.5	48.5	49
2	49.5	49	49.3	49.6
3	50.5	48.2	48.2	48.7
4	49.8	48.7	49.5	48.3
5	51	48.9	48	49.5
6	49.6	49.2	49	48.7
7	49.7	49.8	49.8	48.2

Table 2: Data for thermal stress

No of Sample	Breakdown Voltage (kVrms)						
	Normal Condition	High temperature			Low temperature		
		50°C	65°C	80°C	10°C	-5°C	-20°C
1	49.1	48.2	48.8	46.4	49.1	48.3	47.1
2	49.5	49.4	48.2	47.5	48.2	48.1	46.9
3	50.5	49.5	49.4	47.8	49.4	49.4	45.9
4	49.8	48.0	48.6	47.2	48.1	48.5	45.7
5	51.0	48.8	49.8	46.5	48.5	48.0	46.2
6	49.6	48.5	49.2	47.9	48.0	47.9	46.5
7	49.7	49.5	48.7	46.9	49.3	48.2	46.0

4.1 Electrical Stress Experiment

The accompanying diagram is demonstrated the likelihood of disappointment against breakdown voltage utilizing Weibull dispersion investigation. From the diagram above, it is indicated that a direct chart between the breakdown voltage and likelihood of disappointment.

From the diagram, the breakdown voltage of the XLPE protection tests exposed to electric feeling of anxiety of 5kVrms, 10kVrms, and 15kVrms is nearly equivalent to contrasted with the ordinary condition.

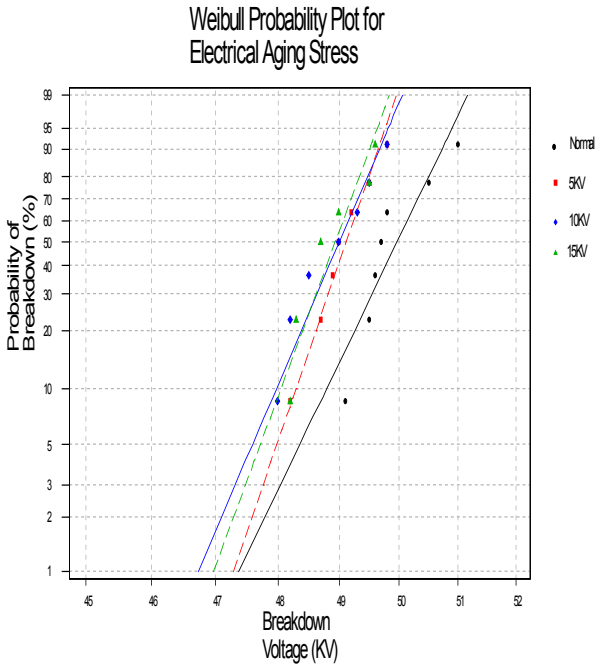


Figure 2: Result for Electrical Stress

4.2 Comparison of Thermal Stress at Low and High Temperature

The Information get from the breakdown test Is examine by utilizing Weibull conveyance investigation. By taking the likelihood of disappointment is 0.632 or 63.2% alluding to the norm of IEEE Draft Guide for the Statistical Analysis of Electrical Insulation Breakdown Data.

In this business study, the MINITAB programming is utilized to play out the Weibull circulation examination as appeared in the figure 2, figure 3 and figure 4. The estimation of breakdown voltage is appeared in the table 3:

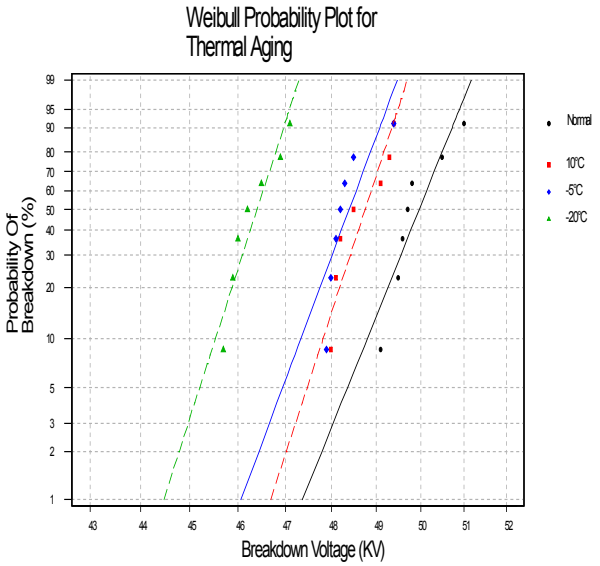


Figure 3: Result for Thermal Stress at Low Temperature

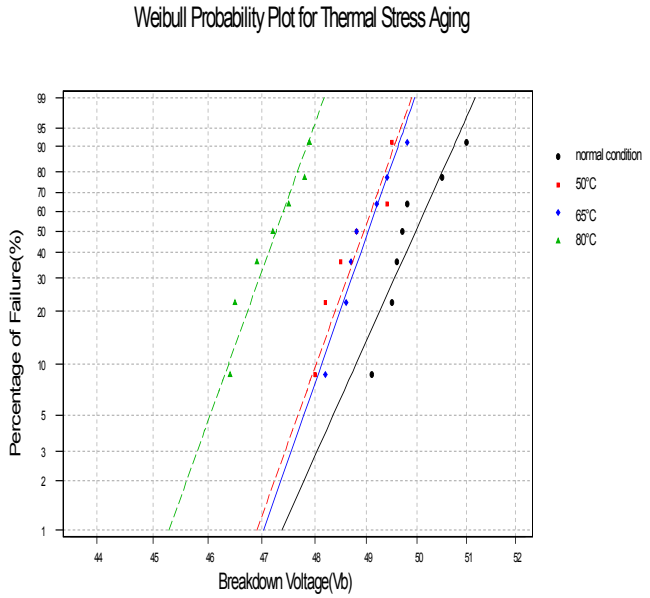


Figure 4: Result for Thermal Stress at High Temperature

Table 3: Summary of Result

BREAKDOWN VOLTAGE (kVrms)						
NORMAL	HIGH TEMPERATURE			LOW TEMPERATURE		
CONDITION	50°C	65°C	80°C	10°C	-5°C	-20°C
50.2	49.13	49.21	47.44	48.93	48.6	46.58

From the summary of result above, it is indicated that, the estimation of breakdown voltage during high and low temperature is marginally extraordinary contrasted with the ordinary state of XLPE protection example without maturing measure. As appeared in the figure 3 and figure 4, the estimation of breakdown voltage is somewhat unique after the example is exposed to the extremely low and exceptionally high temperature which is at - 20°C and 80°C individually.

As appeared in the table, the life of XLPE protections is abbreviated as the temperature diminishes and increments definitely. This is on the grounds that, in the electrical protection, natural materials specifically, presented to extremely high and low temperature are exposed to the decay cycle. The disintegration will deliver changes in the physical properties of the material with the goal that they will become powerlessness to meet their capacities after a specific time.

Subsequently, thermal pressure will create disappointment without decimating the test example of XLPE protection. Since the pace of weakening increments quickly because of the thermal pressure, it will cause an increasing speed of the synthetic responses happening in the materials. This is on the grounds that, the thermal conduct of the materials impressively changes from one material to other protecting materials and have been ordered by the most extreme temperature that they can proceed for an agreeably extensive stretch of time. Since thermal decay is because of the speeding up of compound responses created by expanding or diminishing temperature, so the maturing rate can be accepted relative to the pace of substance responses.

5. CONCLUSION

In light of the outcome acquired for the electrical pressure explore, it shows that the estimation of breakdown voltage of XLPE protection for all level electric pressure practically comparative contrasted with typical condition without maturing measure. There are no compound changes that happened on XLPE protection after exposed to different degree of electric pressure.

Nonetheless, from the outcome got for thermal pressure explore, the estimation of breakdown voltage is somewhat extraordinary contrasted with ordinary condition. From the investigation, the life of XLPE protections is abbreviated as the temperature diminishes and builds definitely to - 20°C and 80°C individually. This is on the grounds that, in the electrical protection, natural materials specifically, are exposed to the decay cycle while presented to thermal pressure.

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PEKALI PENYERAPAN BUNYI PAPAN SERPAI BERLAPIS MENGGUNAKAN GENTIAN KULIT DAN TERAS KENAF

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Abstrak. Kenaf atau Hibiscus Cannabinus L merupakan tanaman komoditi yang mempunyai nilai ekonomi yang tinggi. Namun, teras kenaf adalah merupakan produk sampingan industri kenaf yang tidak berguna dan bernilai rendah. Penggunaan teras kenaf dalam penghasilan papan serpai ini membantu meningkatkan nilainya yang sebelum ini kurang digunakan dalam industri. Dalam kajian ini, papan serpai penyerap bunyi dihasilkan mengandungi gentian kulit dan teras kenaf bagi meningkatkan penggunaan bahan yang terhasil daripada pokok kenaf dalam produk akustik. Objektif kajian ini adalah menentukan pekali penyerapan bunyi terhadap papan serpai yang mengandungi 100% teras kenaf dan papan serpai mengandungi 50% gentian kulit kenaf yang digabungkan 25% teras kenaf di bahagian atas dan bawah. Selain itu, kajian ini juga untuk mengenalpasti kesan pertambahan gentian kulit kenaf dengan ketebalan yang berbeza iaitu 20mm, 40mm dan 60mm serta ketumpatan yang malar iaitu 0.3g/cm^3 terhadap pekali penyerapan bunyi papan serpai kajian. Papan serpai dihasilkan menggunakan kaedah tekanan dan dipotong menjadi ukuran sampel berdiameter 30mm dan 100mm yang sesuai dengan pemegang specimen alat ujikaji iaitu tiub impedans bagi menentukan pekali penyerapan bunyi sampel kajian mengikut prosedur ujian standard DIN EN ISO 10534-2:2001. Hasil daripada eksperimen, pekali penyerapan bunyi papan serpai berlapis gentian kulit dan teras kenaf lebih tinggi iaitu 0.686 berbanding 0.637 pekali penyerapan bunyi papan serpai 100% teras kenaf pada ketebalan 60mm serta julat frekuensi 4000Hz hingga 5000Hz. Ini menunjukkan bahawa tambahan gentian kulit kenaf bersama teras kenaf dan peningkatan ketebalan mempengaruhi peningkatan nilai pekali penyerapan bunyi walaupun ketumpatan adalah sama. Akhir sekali, dapat disimpulkan bahawa semua sampel papan serpai berlapis dengan teras kenaf dan gentian kenaf adalah sesuai untuk tujuan bahan penyerap bunyi dan berpotensi dijadikan produk akustik.

Kata Kunci: Gentian kulit kenaf, teras kenaf, pekali penyerapan bunyi dan papan serpai

1. PENGENALAN

Kejayaan yang dicapai oleh negara maju dari segi pembangunan ekonomi, sosial dan budaya telah menimbulkan banyak masalah kebisingan kepada manusia. Pencemaran bunyi atau gangguan bunyi adalah gangguan yang mengganggu atau berlebihan yang boleh membahayakan kesihatan fizikal dan psikologi kita atau ketidakseimbangan kehidupan manusia atau alam. Dalam persekitaran dan kehidupan seharian kita menjadi sukar untuk melepaskan diri dari kebisingan. Akustik adalah sains atau kajian yang mengawal atau menghilangkan kebisingan. Terdapat empat prinsip asas yang digunakan untuk mengurangkan kebisingan iaitu penyerapan, pengasingan, pengasingan getaran, dan peredaman getaran. Sebenarnya, teknik yang paling dikenali untuk mengurangkan bunyi adalah penyerapan bunyi pada bahan itu sendiri. Mineral semula jadi kini menjadi bahan alternatif untuk rawatan penyerapan bunyi. Serat atau mineral semula jadi adalah boleh berasal dari sayur-sayuran iaitu rami kenaf, kayu, tandan buah kosong, daun nanas, rumput ular, rami, kapas, ramie, pisang dan lain-lain, bahan daripada binatang adalah bulu dan bulu terasa, atau mineral iaitu asbestos (Berardi & Iannace, 2015). Serat sintetik adalah mineral iaitu kaca gentian, bulu mineral, bulu kaca atau polimer (Berardi & Iannace, 2015).

Pendedahan manusia terhadap kebisingan berterusan 85-90 dB (A) boleh menyebabkan kehilangan pendengaran progresif, perubahan tekanan darah, hipertensi, penyakit kardiovaskular atau lain-lain. Kini di Malaysia, terdapat undang-undang yang berkaitan dengan kebisingan iaitu dikenali sebagai "Factory and Machinery Act 1967" atau Akta 139 (Malaysia, 1989). Penggunaan gentian semula jadi kenaf adalah salah satu aplikasi yang berkesan untuk mengawal kebisingan kerana kelestariannya, dapat terbiodegradasi, mesra alam, mudah dibuang dan dapat digunakan untuk banyak aplikasi (Yuhazri et al., 2011). Bahan sintetik seperti bulu batu, bulu kaca, atau polister adalah mahal dan mempunyai implikasi persekitaran berbanding menggunakan bahan gentian semulajadi yang mempunyai tahap pencemaran persekitaran yang rendah semasa penghasilannya. Tanaman kenaf mempunyai potensi besar untuk diperkasakan pada masa hadapan ekoran permintaan semakin meluas terhadap produk dihasilkan daripada tanaman itu yang disifatkan lebih mesra alam (Bernama, 2019).

Satu kajian dan pengujian telah dilakukan di China dan hasil dari pengujian tersebut menunjukkan bahawa kenaf serat dari Malaysia adalah serat berkualiti tinggi (Mohd Zulkifli Zainuddin, 2015). Namun, gentian teras kenaf yang terdiri daripada 60 peratus daripada pokok kenaf merupakan produk sampingan industri kenaf yang tidak berguna dan bernilai rendah (JurnaL.myR&D, 2020). Manakala tahap kesedaran masyarakat berhubung potensi tanaman kenaf dan pembabitan industri adalah masih rendah (Bernama, 2019). Di samping itu, usaha memperkasakan pengkormersilan produk kenaf adalah perlu dipertingkatkan (MPIC, 2011). Dalam usaha mengkomersilkan bahan kenaf, Lembaga Kenaf dan Tembakau Negara menyatakan bahan daripada batang tanaman kenaf yang dikenali teras telah dijadikan makanan haiwan dan juga terdapat pembuatan papan cip oleh Pusat Sumber Teknologi Perabot MARA (Mohd Zulkifli Zainuddin, 2015). Selain itu, sekumpulan penyelidik daripada Universiti Putra Malaysia (UPM) daripada pelbagai kepakaran menjalan penyelidikan daripada teras kenaf dan berjaya menghasilkan inovasi bingkai dinamakan 'PUTRA®Frame' (JurnaL.myR&D, 2020).

Dalam kawalan akustik kejuruteraan menggunakan bahan teras kenaf masih belum terdapat penyelidikan yang dijalankan. Justeru itu, kajian ini menggunakan bahan semulajadi kenaf daripada teras dan gentian kulit kenaf adalah bahan tambahan untuk membuat papan serpai. Pekali penyerapan bunyi papan serpai tersebut ditentukan bagi mengetahui tahap penggunaannya dalam menyelesaikan masalah kebisingan serta produk akustik.

2. SOROTAN KAJIAN

2.1 Kenaf

Pokok kenaf atau nama saintifiknya iaitu Hibiscus Cannabinus adalah tanaman yang berasal dari Afrika dan sudah wujud sejak 4,000 tahun lalu (Mohd Zulkifli Zainuddin, 2015). Tumbuhan ini bukan sahaja mampu menghasilkan gentian yang berkualiti, malah turut dapat menampung beberapa sektor pembuatan lain seperti tilam dan perabot, serta bertindak sebagai gentian penguat industri komponen plastik di samping boleh dijadikan sumber makanan haiwan ternakan. Makanan ternakan ini menumpukan kepada pengeluaran berkos rendah dan yang berasaskan bahan buangan kenaf (MPIC, 2011)

Terdapat dua jenis gentian kenaf iaitu gentian panjang adalah diekstrak dari kulit batang pokok kenaf dan gentian pendek diekstrak dari teras pokok (Ramesh, 2016). Kedua-dua ciri gentian kulit dan bahan teras kenaf nyata berbeza(Tahir PM, Ahmed AB, SaifulAzry SOA, 2011). Gentian kulit lebih keras dan mempunyai nilai pembasahan yang lebih rendah berbanding dengan bahan teras kenaf yang sangat lemah dan mempunyai ciri penyerapan yang baik (Tahir PM, Ahmed AB, SaifulAzry SOA, 2011).

Potensi kenaf di Malaysia dimulakan pada tahun 2000 dan penyelidikan terhadap kenaf masih diteruskan. Aspek lain dalam membandingkan bahan bangunan adalah dengan

mempertimbangkan unit fungsinya (Berardi & Iannace, 2015). Penilaian bahan binaan adalah dengan mempertimbangkan satu isipadu (1m^3) atau berat (1kg). Terdapat kajian yang dijalankan menunjukkan kesan ketebalan dengan ketumpatan setiap sampel malar iaitu 93.5 kg/m3 gentian kenaf adalah pekali penyerapan bunyi meningkat bersamaan dengan peningkatan ketebalan (Lim et al., 2018). Lebar jalur penyerapan menunjukkan peningkatan dengan ketara ke arah frekuensi yang lebih rendah iaitu semakin tebal penyerap, semakin banyak komponen frekuensi rendah yang dapat diserap (Lim et al., 2018). Manakala kajian lain menyatakan kaedah tiub Impedans adalah digunakan dalam memperoleh pekali penyerapan bunyi sampel gentian kenaf dan hasil pekali penyerapan bunyi gentian kenaf dengan ketebalan 10mm, 20mm dan 30mm (Yahya & Sheng Chin, 2017). Jadual 2.1 juga menunjukkan rumusan keputusan pekali penyerapan bunyi gentian kenaf yang diperolehi dalam kajian lepas yang telah dilaksanakan. Ketebalan sampel gentian kenaf yang semakin besar menjadikan semakin besar pekali penyerapan suara pada frekuensi yang lebih rendah (Yahya & Sheng Chin, 2017).

Jadual 2.1: Pekali Penyerapan Bunyi Gentian Kenaf oleh Kajian Lepas

Ketebalan sampel gentian kenaf (100% gentian kenaf)	Pekali Penyerapan Bunyi gentian kenaf
10mm	0.5 (>3500Hz)
20mm	0.8 (>3000Hz)
30mm	0.8 (2000Hz)

(Sumber:Yahya & Sheng Chin, 2017)

Berdasarkan konfigurasi mikroskopik menunjukkan bahawa bahan penyerap berliang telah diklasifikasikan sebagai selular, berserat dan berbutir (Berardi & Iannace, 2015). Kedua-dua gentian dan teras mempunyai komposisi kimia yang berbeza (Aisyah et al., 2013). Teras kenaf adalah ringan dan berpori berbanding dengan kulit kenaf di mana ketumpatan pukal 0.10 g /cm^3 (Tahir PM, Ahmed AB, SaifulAzry SOA, 2011).Di antara dua jenis gentian, teras kenaf dilaporkan mempunyai kemampuan ikatan yang jauh lebih baik. Kajian yang menyatakan sifat papan gentian berketumpatan sederhana dari kenaf sebagai fungsi untuk memperbaiki keadaan (Aisyah et al., 2013). Dalam kajian ini, gentian dan teras kenaf digunakan dalam penyediaan sampel secara lapisan dan keketumpatan malar setiap sampel iaitu 0.3 g / cm^3.

2.2 Pekali Penyerapan Bunyi

Bahan akustik memainkan beberapa peranan penting dalam kejuruteraan akustik seperti kawalan akustik bilik, kawalan kebisingan industri, akustik studio dan akustik automotif. Terdapat pelbagai bahan penyerap bunyi dan memberikan sifat penyerapan bergantung pada kekerapan, komposisi, ketebalan, kemasan permukaan, dan kaedah pemasangan. Walau bagaimanapun, bahan yang mempunyai nilai pekali penyerapan bunyi yang tinggi biasanya berliang. Bahan penyerap berliang adalah pepejal yang mengandungi rongga, saluran atau celahan sehingga gelombang bunyi dapat masuk melaluinya. Adalah mungkin untuk mengklasifikasikan bahan berliang mengikut ketersediaannya kepada cecair luaran seperti udara. Pori-pori yang benar-benar terasing disebut liang tertutup. Ia mempunyai kesan terhadap beberapa sifat makroskopik bahan seperti ketumpatan pukal, kekuatan mekanikal dan kekonduksian terma. Walau bagaimanapun, liang tertutup pada dasarnya kurang cekap daripada liang terbuka dalam menyerap tenaga bunyi. Sebaliknya, liang terbuka mempunyai saluran komunikasi berterusan dengan permukaan luaran badan, dan mereka mempunyai pengaruh besar terhadap penyerapan bunyi. Pori terbuka juga boleh menjadi "buta" iaitu terbuka hanya pada satu hujung atau "melalui" iaitu terbuka pada dua hujung (Norton & Karczub, 2010).

Sering kali, tahap kebisingan di kawasan bersebelahan dengan punca bunyi dapat dikurangkan dengan ketara dengan menggunakan bahan penyerap bunyi di dinding dan siling. Walau bagaimanapun, jumlah pengurangan yang dekat dengan mesin mungkin sedikit kerana sebahagian besar tenaga pendedahan bunyi secara langsung dari mesin dan

bukan dari permukaan pantulan. Jenis, jumlah, konfigurasi dan penempatan bahan penyerapan bergantung pada aplikasi tertentu. Namun, pilihan bahan penyerapan dapat dipandu oleh pekali penyerapan yang disenaraikan dalam sesuatu jadual penyerapan bunyi. Jadual 2.2 menunjukkan bahan dan pekali penyerapan bunyi yang dikeluarkan dalam Garis Panduan Kawalan Kebisingan Pekerjaan. Pekali penyerapan 1.0 bermaksud bahan akan menyerap semua bunyi yang tersekat secara rawak di permukaan manakala pekali penyerapan hampir kepada 0 bermaksud bahan akan menyerap sedikit tenaga akustik (DOSH, 2005).

Jadual 2.2 menunjukkan bahawa gentian kaca dengan ketebalan 3 inci mempunyai pekali penyerapan bunyi yang tinggi iaitu mencapai 0.93% pada 4000Hz. Namun, gentian semula jadi lignoselulosa seperti sisal, sabut, rami, ramie, daun nanas (PALF), dan kenaf berpotensi untuk digunakan sebagai pengganti kaca atau bahan pengukuhan tradisional lain dalam komposit (Sgriccia et al., 2008).

Jadual 2.2: Garis Panduan Kawalan Kebisingan Pekerjaan (2005) , Jabatan Keselamatan dan Kesihatan Pekerjaan, Malaysia

	Frequency (Hz)					
Material	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**
Brick: Glazed	0.01	0.01	0.01	0.01	0.02	0.02
Unglazed	0.03	0.03	0.03	0.04	0.05	0.06
Unglazed, painted	0.01	0.01	0.02	0.02	0.02	0.03
Carpet: Heavy (on concrete)	0.02	0.06	0.14	0.37	0.60	0.65
On 40 oz. hairfelt or foam rubber (carpet has coarse backing)	0.08	0.24	0.57	0.69	0.71	0.73
With impermeable latex backing on 40 oz. hairfelt or foam rubber	0.08	0.27	0.39	0.34	0.48	0.63
Concrete block: Coarse	0.36	0.44	0.31	0.29	0.39	0.25
Painted	0.10	0.05	0.06	0.07	0.09	0.08
Poured	0.01	0.01	0.02	0.02	0.02	0.03
Fabrics: Light velour: 10 oz/yard², hung straight, in contact with wall	0.03	0.04	0.11	0.17	0.24	0.35
Medium velour: 14 oz/yard² draped to half-area	0.07	0.31	0.49	0.75	0.70	0.60
Heavy velour: 18 oz/yard² draped to half-area	0.14	0.35	0.55	0.72	0.70	0.65
Floors: Concrete or terrazo	0.01	0.01	0.015	0.02	0.02	0.02
Linoleum, asphalt, rubber, or cork tile on concrete	0.02	0.03	0.03	0.03	0.03	0.02
Wood	0.15	0.11	0.10	0.07	0.06	0.07
Wood parquet in asphalt on concrete	0.04	0.04	0.07	0.06	0.06	0.07
Glass: Ordinary window glass	0.35	0.25	0.18	0.12	0.07	0.04
Large panes of heavy plate glass	0.18	0.06	0.04	0.03	0.02	0.02
Glass fibre: Mounted with impervious backing, 3 lb/ft³, 1 in. thick	0.14	0.55	0.67	0.97	0.90	0.85
Mounted with impervious backing, 3 lb/ft³, 2 in. thick	0.39	0.78	0.94	0.96	0.85	0.84
Mounted with impervious backing, 3 lb/ft³, 3 in. thick	0.43	0.91	0.99	0.98	0.95	0.93
Gypsum board: 1/2 in. thick nailed to 2" x 4" s, 16" on centre	0.29	0.10	0.05	0.04	0.07	0.09
Marble	0.01	0.01	0.01	0.01	0.02	0.02
Plaster: Gypsum or lime, smooth finish on tile or brick	0.013	0.015	0.02	0.03	0.04	0.05
Gypsum or lime, rough finish on lath	0.14	0.10	0.06	0.05	0.04	0.05
Gypsum or lime, with smooth finish	0.14	0.10	0.06	0.04	0.04	0.03
Plywood paneling, 3/8 in. thick	0.28	0.22	0.17	0.09	0.10	0.11
Sand: Dry, 4 in. thick	0.15	0.35	0.4	0.5	0.55	0.8
Sand: Dry, 12 in. thick	0.2	0.3	0.4	0.5	0.6	0.75
Sand: Wet, 14 lb. H_2O/ft³, 4 in thick	0.05	0.05	0.05	0.05	0.05	0.15
Water	0.01	0.01	0.01	0.01	0.02	0.02
Air, per 10m³ at 50% RH (for larger spaces, air attenuates sound — particularly the higher frequencies)				0.32	0.81	2.56

(Sumber: DOSH, 2005)

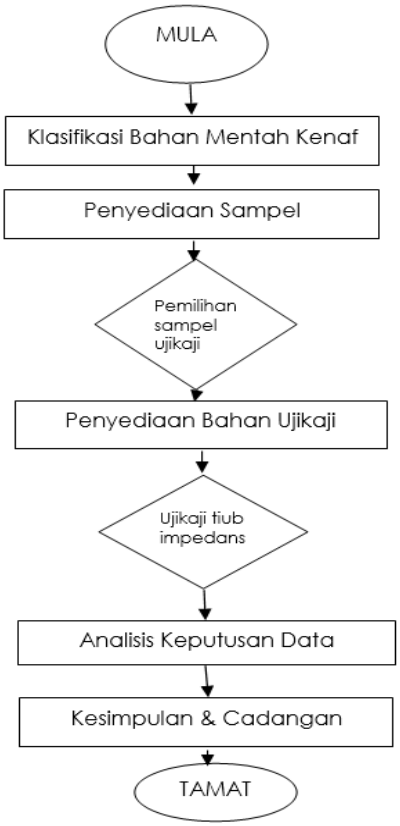
2.3 Papan Serpai

Papan serpai digunakan sebagai bahan utama masa kini untuk membuat perabut seperti meja, rak, laci, kabinet dan lain-lain. Papan serpai juga dikenali sebagai papan partikel (Chipboard), papan gentian ketumpatan rendah (LDF) dan papan serpih. Papan serpai adalah produk kayu kejuruteraan yang diperbuat daripada kerepek kayu, serat papan kincir, atau habuk papan, dan resin sintetik atau pengikat yang sesuai dan dimampatkan.

Pada tahun 2011, LKTN menggalakkan aktiviti pemprosesan kenaf bagi menghasilkan batang kenaf kering, empulur (teras) dan serat (gentian) (MPIC, 2011). Berdasarkan seruan kerajaan yang, penggunaan teras kenaf adalah sesuai untuk meghasilkan papan serpai yang mana cirinya adalah ringan dan mudah untuk dihasilkan. Bahan penyerap bunyi yang baik adalah berserabut, ringan dan berliang (DOSH, 2005). Papan serpai juga mempunyai kelemahan iaitu tidak tahan kepada air. Pekali penyerapan tidak hanya bergantung pada bahan tetapi juga pada bahan di depan dan di belakangnya (DOSH, 2005). Papan serpai yang dihasilkan dalam kajian ini mempunyai permukaan khas iaitu berliang. Bagi meningkatkan ketahanan terhadap gris dan air yang akan menyumbat liang, penutup plastik tipis sering digunakan. Filem seperti itu, serta lapisan vinil atau logam lembaran berlubang, cenderung]menghasilkan maksimum dalam pekali penyerapan frekuensi pertengahan (DOSH, 2005).

3. PROSES PENYEDIAAN DAN PENGUJIAN SAMPEL

Gentian kenaf yang digunakan dalam kajian ini dibekalkan oleh Lembaga Tembakau Negara (Lembaga Tembakau Negara), Malaysia yang bertempat di Kelantan. Dalam kajian ini, gentian kenaf dan teras kenaf digunakan dalam sampel. Manakala perekat atau resin yang digunakan untuk proses penyediaan sampel dibekalkan oleh perusahaan tempatan iaitu dari Syarikat. Gentian kenaf (GK) dan teras kenaf (TK) dikumpulkan di "Pusat Pengumpulan, pemprosesan dan pemasaran (CPMC), Lembaga Kenaf Dan Tembakau Negara, Kg Air Tawar, Tok Bali, 16800 Pasir Puteh, Kelantan, Malaysia. Rajah 3.1 menunjukkan carta alir kaedah kajian dijalankan.



Rajah 3.1 : Carta Alir Kaedah Kajian

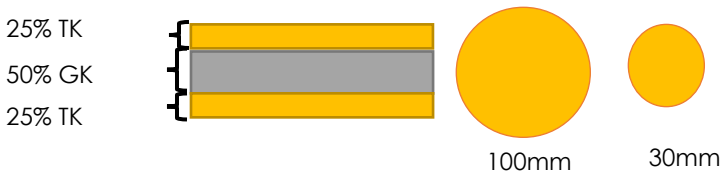
3.1 Spesifikasi Sampel

Dalam kajian Umberto Berardi dan Gino Lannace (2015), pencirian akustik gentian semula jadi untuk aplikasi penyerapan bunyi mendapati bahawa parameter yang penting untuk membandingkan ciri penyerapan bunyi atau untuk meramalkan tingkah laku gentian adalah diameter, panjang, ketebalan dan keteraturan serat. Pekali penyerapan bunyi meningkat dengan peningkatan jumlah ketumpatan pada frekuensi tinggi (Berardi & Iannace, 2015). Kajian ini juga disokong di mana ketebalan sampel masih bergantung pada kepadatan serat yang sesuai (Or et al., 2017). Dengan meningkatkan ketebalan sambil mengekalkan ketumpatan, ia dapat meningkatkan prestasi pekali penyerapan bunyi. Oleh kerana pernyataan tersebut, ketumpatan ditetapkan 0.3g/cm^3 dengan ketebalan sampel yang berbeza-beza iaitu 20mm, 40mm dan 60mm dianalisis dalam penyediaan sampel ini. Jadual 3.1 menunjukkan spesifikasi sampel papan serpai yang mengandungi teras kenaf dan gentian kulit kenaf yang digunakan dalam kajian ini.

Jadual 3. 1 : Spesifikasi Sampel Papan Serpai MengandungKajian

Jenis Sampel	Spesifikasi Sampel				
	Ketumpatan (g/cm^3)	Komposisi		Ketebalan, t (mm)	Diameter Sampel (mm)
		Teras Kenaf	Gentian Kenaf		
TB3S1-1	0.3	50%	50%	20	30
TB3S2-2	0.3	50%	50%	40	30
TB3S3-1	0.3	50%	50%	60	30
TA3S1-2	0.3	50%	50%	20	100
TA3S2-2	0.3	50%	50%	40	100
TA3S3-2	0.3	50%	50%	60	100
TB1S1-2	0.3	100%	-	20	30
TB1S2-2	0.3	100%	-	40	30
TB1S3-1	0.3	100%	-	60	30
TA1S1-2	0.3	100%	-	20	100
TA1S2-2	0.3	100%	-	40	100
TA1S3-1	0.3	100%	-	60	100

Rajah 3.2 menunjukkan komposisi sampel menggunakan kaedah lapisan (sandwich) dalam menghaslkan papan serpai kenaf teras dan gentian kenaf. Papan serpai dengan kaedah lapisan (sandwich) mengandungi tiga lapisan iaitu dua lapisan 25% teras kenaf yang mengapit satu lapisan 50% gentian kenaf di bahagian tengah.



Rajah 3.2: Komposisi Sampel TB3S1-1, TB3S2-1, TB3S3-1, TA3S1-1, TA3S2-1 dan TA3S3-1

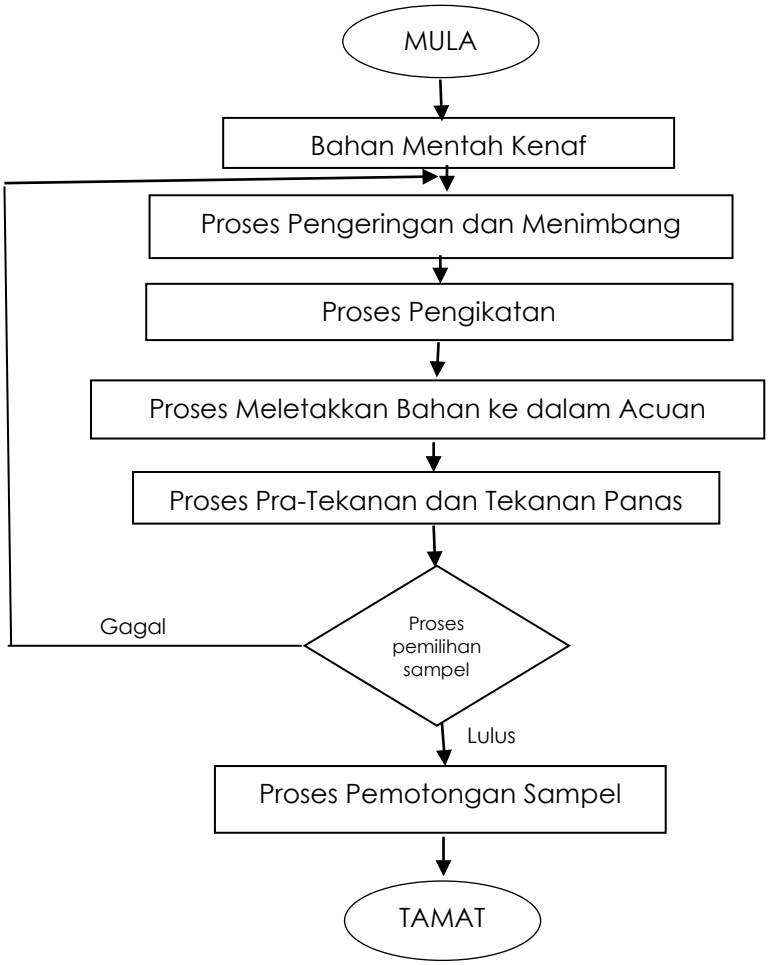
Manakala Rajah 3.3 menunjukkan komposisi sampel yang mengandungi komposisi 100% teras kenaf. Sampel dengan ketebalan berbeza dipotong dengan diameter 100mm dan 30mm.



Rajah 3.3: Komposisi Sampel TB1S1-1, TB1S2-1, TB1S3-1, TA1S1-1, TA1S2-1 dan TA1S3-1

3.2 Proses Penyediaan Sampel

Proses yang terlibat adalah pengeringan, penimbangan, pengikatan, memindahkan sampel ke dalam acuan, tekanan panas dan pemotongan sampel. Rajah 3.4 menunjukkan proses-proses yang dilaksanakan dalam penyediaan sampel.



Rajah 3.4: Proses Penyediaan Sampel

Penyediaan pertama adalah memastikan teras kenaf dan gentian kenaf dikeringkan di dalam ketuhar dengan suhu 60^{0}C hingga 120^{0}C selama 12 jam untuk mencapai kadar kelembapan 8% hingga15%. Gentian kenaf kering (GK) dan teras kenaf (TK) dipisahkan dan proses seterusnya yang perlu dilakukan ialah proses penimbangan. Penambahan 10% teras kenaf dari jumlah yang digunakan harus digunakan disebabkan oleh pembaziran mesin.

Dalam proses pengikatan, kesan kandungan lembapan pada spesimen juga signifikan kerana menyebabkan lekatan resin gentian dan penembusan resin ke dalam sel dinding gentian. Untuk eksperimen ini, Urea formaldehid (UF) dengan 7% resin digunakan. Sebaliknya kos dan ketersediaan penggunaan MUF lebih tinggi daripada menggunakan Urea formaldehid. Kaedah ini juga dilakukan oleh pengkaji lain di mana menggunakan Urea formaldehid (UF) dalam menghasilkan sampel (Aisyah et al., 2013). Teras Kenaf (TK) dan

gentian kenaf (GK) dicampur secara berasingan dengan Urea formaldehid (UF) yang mengandungi 7% resin dalam mesin pengadun dalam beberapa minit (sasaran 5minit hingga 10 minit). Selepas proses pencampuran diselesaikan perlu memasukkan bahan ke dalam acuan 340mm x 340mm.

Proses berikut adalah menekan bahan dengan menggunakan mesin pra-tekanan. Dalam keadaan ini, tekanan yang telah dipilih untuk proses pra-tekanan adalah 20kg/cm^2 atau 19.6 ×10^5 Pa. Tujuan proses pra-tekan adalah memampatkan sampel menjadi pra-dimensi sampel agar bentuk lebih mudah dipasang dengan mesin tekanan panas. Dalam proses ini tidak dibekalkan haba kepada bahan. Proses tekanan panas dilakukan dengan menggunakan mesin tekanan panas. Penggunaan filem teflon adalah penting untuk memastikan sampel tidak terbakar pada masa penekanan. Suhu untuk mesin tekan panas ialah 180^{0}C. Tekanan yang dipilih dikurangkan dari 90 Psi hingga 70 Psi dan 50Psi. Pemilihan masa untuk tekanan adalah 3 minit, 2 minit dan 1 minit. Contoh untuk jumlah masa kitaran untuk sampel 1 adalah sekitar 6 minit. Masa untuk setiap sampel meningkat dengan tekanan dan suhu yang berterusan.

Proses pemotongan diperlukan untuk menghasilkan spesimen dengan diameter 30mm dan 100mm (pengurangan 1mm) yang bersesuaian dengan ukuran tiub impedans. Rajah 3.5 menunjukkan ukuran sampel yang lengkap dihasilkan.



Rajah 3.5: Sampel Diameter 100mm dan 30mm

3.3 Pengujian Sampel

Eksperimen dilakukan dengan menggunakan tiub impedans dengan ukuran diameter 30 mm dan 100mm. Pemilihan frekuensi adalah antara 125 Hz hingga 5000Hz. Rajah 3.6 menunjukkan tiub impedans yang digunakan untuk eksperimen ini. Peralatan ini mematuhi prosedur ujian standard DIN EN ISO 10534-2: Oktober 2001 untuk mengenal pasti pekali penyerapan bunyi.



Rajah 3: Tiub Impedans

4. ANALISIS DAN KEPUTUSAN

4.1 Pekali Penyerapan Bunyi Papan Serpai Kajian

Eksperimen yang dijalankan menggunakan tiub impedans bagi papan serpai 100% teras kenaf dan papan serpai 3 lapisan (2 lapisan 25% teras kenaf dan 50% gentian kulit kenaf) adalah menunjukkan pekali penyerapan bunyi dalam keadaan frekuensi dan penyerapan bunyi pada bacaan jalur oktaf 1/3. Jadual 4.1 ditunjukkan data nilai pekali penyerapan bunyi bagi frekuensi 125Hz, 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz dan 5000Hz.

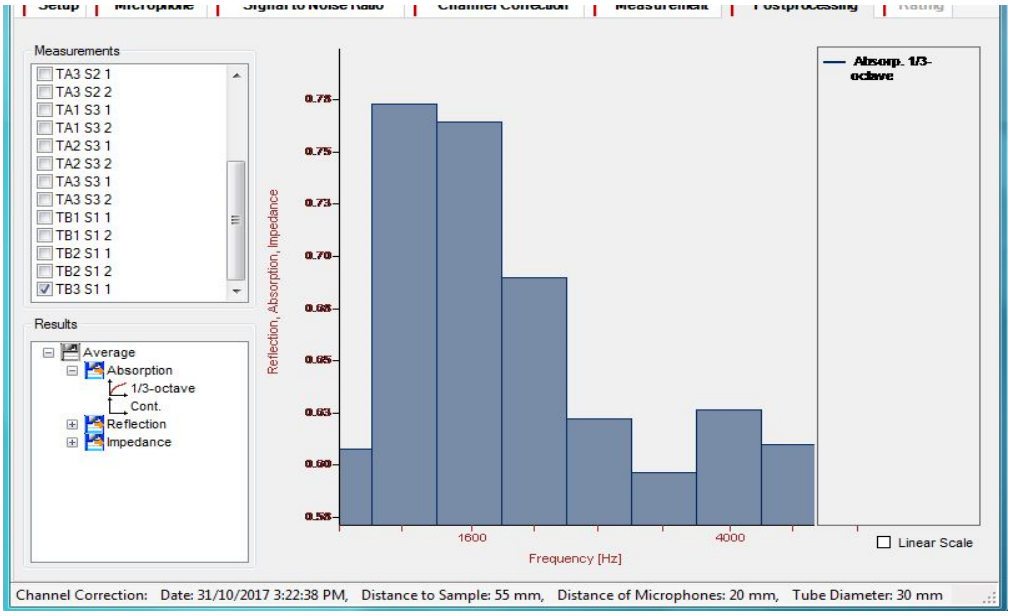
Jadual 4.1 : Nilai Pekali Penyerapan Bunyi Sampel Kajian

Sampel	Diameter Sampel (mm)	Komposisi		Ketebalan t (mm)	Pekali Penyerapan Bunyi						
		Teras Kenaf	Gentian Kenaf		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	5000 Hz
TB3S1-1	30	50%	50%	20	0.129	0.086	0.322	0.668	0.691	0.659	0.608
TB3S2-2	30	50%	50%	40	0.594	0.311	0.635	0.808	0.732	0.676	0.712
TB3S3-1	30	50%	50%	60	0.302	0.558	0.771	0.701	0.582	0.703	0.669
TA3S1-2	100	50%	50%	20	0.493	0.142	0.214	0.672	0.834	0.976	-
TA3S2-2	100	50%	50%	40	0.467	0.365	0.613	0.690	0.620	0.957	-
TA3S3-2	100	50%	50%	60	0.479	0.583	0.708	0.703	0.606	0.981	-
TB1S1-2	30	100%	-	20	0.755	0.121	0.336	0.608	0.446	0.448	0.449
TB1S2-2	30	100%	-	40	0.776	0.383	0.555	0.637	0.426	0.467	0.459
TB1S3-1	30	100%	-	60	0.714	0.596	0.778	0.606	0.613	0.649	0.625
TA1S1-2	100	100%	-	20	0.158	0.185	0.347	0.504	0.360	0.946	-
TA1S2-2	100	100%	-	40	0.514	0.373	0.575	0.582	0.404	0.947	-
TA1S3-1	100	100%	-	60	0.711	0.643	0.477	0.548	0.541	0.948	-

Jadual 4.1 menunjukkan nilai pekali penyerapan bunyi bagi sampel papan serpai yang mengandungi 100% teras kenaf adalah tinggi pada frekuensi rendah iaitu 500Hz iaitu 0.778 dengan ketebalan 60mm. Manakala nilai pekali penyerapan bunyi papan serpai 100% teras kenaf paling tinggi pada frekuensi tinggi iaitu 0.649 (4000Hz) serta 0.625 (5000Hz) dengan ketebalan 60mm dan pada frekuensi sederhana antara 1000Hz dan 2000Hz adalah 0.637 pada ketebalan 40mm. Ini menunjukkan bahawa papan serpai dengan 100% boleh menyerap bunyi pada frekuensi rendah dan tinggi. Bagi papan serpai 3 lapisan yang ditambah 50% gentian kulit kenaf menunjukkan nilai pekali penyerapan tinggi pada frekuensi sederhana 1000Hz iaitu 0.808 dengan ketebalan 40mm. Manakala pada ketebalan 60mm papan serpai 3 lapisan dengan 50% gentian kulit kenaf menunjukkan tinggi pada frekuensi 500Hz iaitu 0.771. Papan serpai 3 lapisan dengan 50% gentian kulit kenaf tinggi menyerap bunyi dari frekuensi 500Hz ke 5000Hz. Pada papan serpai ketebalan 20mm menunjukkan nilai pekali penyerapan bunyi adalah rendah pada frekuensi 500Hz. Gentian kenaf akan mengatasi sisa semula jadi gentian dalam menyerap bunyi, terutamanya pada julat frekuensi rendah (Yahya & Sheng Chin, 2017). Berdasarkan daripada garis panduan kawalan kebisingan pekerjaan, keberkesanan penyerapan bunyi bukan sahaja pada frekuensi tinggi tetapi sepatutnya juga pada frekuensi rendah dan sederhana (DOSH, 2005). Ini menyatakan bahawa bahan teras kenaf adalah bersesuaian sebagai bahan penyerap bunyi.

Dalam garis panduan kawalan kebisingan pekerjaan juga menyatakan bahawa bahan penyerap akustik yang berguna secara industri mempunyai pekali melebihi 60% atau 0.6 dalam julat frekuensi dari 500 Hz ke atas (DOSH, 2005). Berdasarkan data yang diperolehi menunjukkan terdapat nilai pekali penyerapan bunyi yang melebihi 60% pada frekuensi 500Hz hingga 5000Hz bagi papan serpai 100% teras kenaf iaitu sampel TB1S3-1 iaitu dari 0.778 ke 0.625 dengan ketebalan 60mm. Papan serpai 3 lapisan dengan 50% gentian kenaf juga melebihi nilai 0.6. Namun, nilai pekali penyerapan bunyi keseluruhan sampel adalah tidak konsisten. Nilai yang tidak konsisten ini juga berlaku dalam kajian yang dijalankan oleh

pengkaji lain yang dimana terdapat nilai pekali penyerapan bunyi yang berkurang di beberapa frekuensi pada sampel ketebalan 75mm (Lim et al., 2018).



Rajah 4.1: Jalur Oktaf 1/3 Frekuensi Ujikaji TB3S1-1

Keadaan pekali penyerapan bunyi yang berlaku tidak konsisten seperti dalam Rajah 4.1 menunjukkan keliangan papan serpai sampel yang pelbagai keadaan (buta dan berlubang) iaitu berkurang 0.086 pada frekuensi 250Hz. Pori terbuka "buta" (terbuka hanya pada satu hujung) atau "melalui" (terbuka di dua hujung) mempunyai pengaruh besar terhadap penyerapan bunyi seperti yang dinyatakan oleh (Norton & Karczub, 2010). Merancang lubang kecil, misalnya penggerudian pada satu titik sahaja dapat meningkatkan pekali penyerapan bunyi. Keadaan tersebut terjadi adalah disebabkan oleh bentuk kenaf atau bahan mentah gentian dan teras kenaf tidak diubahsuai kepada bentuk yang sesuai supaya papan serpai yang dihasilkan mempunyai pekali penyerapan bunyi yang sekata pada semua permukaan. Walau bagaimanapun, prestasi penyerapan bunyi gentian semula jadi dapat ditingkatkan dengan parameter seperti ketumpatan, ketebalan, dan diameter yang sesuai (Yahya & Sheng Chin, 2017).

4.2 Kesan Penambahan 50% Gentian Kenaf (GK) dan 50% Teras Kenaf (TK) Dalam Penghasilan Papan Serpai Berlapis

Dalam kajian ini dapat mengenalpasti pekali penyerapan bunyi tiga lapisan papan serpai dengan 50% gentian kenaf pada ketetapan ketumpatan 0.3g/cm^3. Jadual 4.2 menunjukkan perubahan nilai pekali penyerapan bunyi bagi papan serpai dengan 100% teras kenaf dan pertambahan 50% gentian kulit kenaf.

Jadual 4.2: Kesan Pekali Penyerapan Bunyi Sampel dan Kategori Frekuensi

Sampel	Ketebalan (mm)	Komposisi kenaf	Pekali Penyerapan Bunyi Tahap Rendah (F<500Hz)	Pekali Penyerapan Bunyi Tahap Sederhana 1000Hz<F< 2000Hz	Pekali Penyerapan Bunyi Tahap Tinggi 4000Hz<F< 5000Hz
TB3S1-1 (100mm)	20	50% gentian dan 50% teras	0.283	0.753	0.488
TB3S2-2 (100mm)	40	50% gentian dan 50% teras	0.482	0.655	0.479

TB3S3-1 (100mm)	60	50% gentian dan 50% teras	0.590	0.655	0.491
TA3S1-2 (30mm)	20	50% gentian dan 50% teras	0.179	0.680	0.634
TA3S2-2 (30mm)	40	50% gentian dan 50% teras	0.513	0.770	0.694
TA3S3-2 (30mm)	60	50% gentian dan 50% teras	0.544	0.642	0.686
TB1S1-2 (100mm)	20	100% teras	0.230	0.432	0.473
TB1S2-2 (100mm)	40	100% teras	0.487	0.493	0.474
TB1S3-1 (100mm)	60	100% teras	0.610	0.545	0.474
TA1S1-2 (30mm)	20	100% teras	0.404	0.527	0.449
TA1S2-2 (30mm)	40	100% teras	0.571	0.532	0.463
TA1S3-1 (30mm)	60	100% teras	0.696	0.610	0.637

Keseluruhan nilai pekali penyerapan bunyi adalah semakin tinggi apabila ketebalan adalah bertambah seperti yang berlaku pada semua sampel. Ia bersamaan dengan kajian pengkaji lain iaitu semakin besar ketebalan sampel gentian kenaf, semakin besar pekali penyerapan suara pada frekuensi yang lebih rendah (Yahya & Sheng Chin, 2017). Perbandingan antara dua belas sampel dan pekali penyerapan bunyi dalam Jadual 4.2 menunjukkan sampel TA3S2-2 dengan ketebalan 40mm mempunyai pekali penyerapan bunyi paling tinggi iaitu 0.770 pada julat frekuensi antara 1000Hz hingga 2000Hz dan pada ketebalan 60mm mempunyai 0.694 pekali penyerapan bunyi dengan julat frekuensi yang tinggi antara 1000Hz hingga 5000Hz. Ini menunjukkan bahawa pertambahan 50% gentian kulit kenaf dengan dilapisi dua lapisan 25% teras kenaf di bahagian atas dan bawah adalah mempengaruhi nilai pekali penyerapan bunyi bahan tersebut. Manakala ketebalan sesuatu bahan pula mempengaruhi keadaan frekuensi yang diserap dan tahap pekali penyerapan bunyi yang terjadi. Pekali penyerapan bunyi bahan kenaf adalah tinggi pada frekuensi sederhana 1000Hz hingga 2000Hz iaitu antara 0.432 hingga 0.770. Namun pengurangan nilai pekali penyerapan bunyi papan serpai yang mengandungi 100% teras kenaf adalah tidak banyak perbezaan nilai pekali penyerapan bunyi yang berlaku dengan papan serpai yang ditambah dengan gentian kulit kenaf.

5. KESIMPULAN

Dengan kajian ini, dapat disimpulkan bahawa papan sepai teras kenaf (TK) atau gentian kenaf (GK) dapat dikenal pasti sesuai untuk tujuan mengurangkan kebisingan pada frekuensi rendah dan tinggi. Selain itu, papan serpai yang mengandungi 100% teras kenaf mampu menjadi bahan penyerap bunyi bagi aplikasi industri dengan menambahkan bahan lain di bahagian depan atau belakang bersesuaian dengan fungsinya. Bagi mendapatkan hasil yang lebih baik untuk bahan penyerapan bunyi, beberapa kesan harus dikaji lebih jauh. Sebagai cadangan, beberapa kajian harus dijalankan agar dapat memaksimumkan penggunaan gentian semula jadi seperti kenaf di Malaysia. Skop kajian lain yang dapat dilaksanakan untuk kenaf adalah seperti kesan sela udara antara sampel dan penyokong perlu dibina jika menggunakan ujikaji tiub impedans agar mempunyai penyerapan yang lebih baik dalam frekuensi rendah dan tinggi. Ia merupakan kaedah yang paling baik dalam memasang bahan penyerap bunyi kenaf. Manakala penambahan peratusan gentian kenaf mestilah dikaji lebih terperinci untuk menghasilkan keliangan yang lebih baik. Di samping itu, penyelidikan sampel dengan menggunakan ruang gema untuk mengenalpasti pekali penyerapan bunyi dari sumber bunyi secara rawak terhadap bahan.

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PREPARING ENGINEERING GRADUATES FOR JOB MARKET: HOW JOB-HUNTING MECHANISM ASSISTS THEM

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Abstract. Prior research indicates that some forms of intervention and preparation are vital in preparing students to be able to survive in the job market. Industries today also demand for new employees to be equipped with certain skills to be successful in their career. Technical skills and communicative competence of polytechnic graduates has always been a major concern of potential employers and stakeholders of the polytechnic system and education. The skills demanded by industries must align with the nature of the company's need and skills that the graduates possess. This paper investigates the role of job-hunting mechanism, one of the Communicative English 3 components in preparing students before they embark into the working world. A survey study is carried out to engineering graduates where they are required to provide data on whether the inputs that they obtained are of any assistance to them in the process of getting hired by companies. A set of questionnaires has been distributed to get graduates' responses on the implementation of strategies learnt in job-hunting mechanism. It is hoped that this paper will help educators in preparing, delivering and facilitating students with appropriate and adequate job-hunting skills to enhance their marketability and employability.

Keywords: employability, communicative competence, technical skills, job-hunting mechanisms, industries

1. INTRODUCTION

The subject of graduates' employability has become an issue of concern over the past recent years. Quite a number of prospective employers complain that more than 50% of fresh graduates are deemed to be unsatisfactory in various skills especially of the prerequisite attributes such as communication skills and yet, many of these young, inexperienced jobseekers expect unrealistically high starting salaries (Mohamed Khaled Nordin, 2012).

Based on the Malaysia Monthly Principal Statistics of Labour Force released in July 2020, the unemployment rate rose 0.3 percentage point to 5.3 percent in May 2020 compared to 5.0 percent in April 2020 and the labour force participation rate declined by 0.1 percentage point to 68.0 percent in May 2020 compared to the previous month at 68.1 percent. This decline was due to many threats posed by the implementation of different stages of Movement Control Order in Malaysia (Department of Statistics Malaysia, 2020).

It was also reported that graduates emerging from the Malaysian education system are failing to meet the expectations of prospective employers due to a lack of critical thinking skills and poor communication (Ministry of Higher Education, 2012). According to the JobStreet.com Fresh Graduate Report 2018 (Jobstreet.com, 2018), top 5 reasons for fresh graduate unemployment include 1) asking for unrealistic salary/benefits (66%), 2) being choosy about the job or company (58%), 3) poor character, attitude or personality (58%), 4) poor command of the English language (52%), and 5) poor communication skills (49%).

Haggag (The Star Online, 2012) states that there is a distinct gap between what the Malaysian education system is producing and what employers are looking for. This has resulted in out 6 out of 10 graduates taking as much as six months to be hired and the remaining 40% take even longer time. The inability to produce graduates with adequate requisite skills to enter the workforce has been a challenge to all higher learning institutions.

The lack of communication skills especially in English Language is also found to be a hindering point that contributes to the unemployment rate. The lack of proficiency in English limits their ability to communicate beyond the borders of Malaysia and this lowers their confidence and curtails their ability to add value in the workplace, according to Haggag.

Malaysia is faced with the challenge of a more competitive employability landscape and the increased need for 21st century skills especially for the graduates of higher learning institutions. The education system of higher learning institutions must be responsive to the growing demand for more employable graduates to continue in propelling the various industries with creativity and innovations. The roles of higher education institutions are not only restricted to produce graduates with specific areas of specialization, but also to develop graduate employability skills that are demanding in the 21st century (Lee and Tan, 2003).

Polytechnics, as the main institutions for technical and vocational education are responsible in preparing the graduates for the current employment market; as stated in the vision of Polytechnic Education, which is to be the main catalyst in providing innovative human capitals through academic and transformational training in catering the requirements of global manpower by 2015. Hence, the polytechnic education players must be fully aware of the supply-demand equation and knowledgeable of the realities of the real working world.

The job-hunting mechanics section of Communicative English 3 course implemented in polytechnic education covers skills which are needed by students seeking employment. The section focuses on self-assessment and job search strategies. Students will be able to select jobs and positions which match their qualifications, retrieve relevant information regarding the positions available and request for job interview. This section also aims to prepare students with skills to write effective resumes with accompanying cover letter and students are also trained to prepare for and handle a job interview confidently. Students are facilitated in this area for about 24 hours with the intention of aiding them to be well prepared before joining the workforce. Students are also evaluated on their ability to produce resume accompanied by cover letter and in attending mock job interview session.

Looking at the time spent, and numerous activities carried out in covering the section throughout the semester, students are hoped to perform effectively in applying the inputs and knowledge shared with them when they undergo the process of job search and application. However, based on the students' performance in their assessment of resume and cover letter writing as well as attending mock interview, more than 50% of the candidates score between 0-20 marks which indicate that despite of having adequate exposure on the job hunting mechanics, students do not perform well in the simulation process.

This study attempts to identify whether the inputs that they obtained are of any assistance to them in the process of getting hired by companies. It is hoped that this paper will help educators in preparing, delivering and facilitating students with appropriate and adequate job-hunting skills to enhance their marketability and employability.

2. LITERATURE REVIEW

2.1 Job-Hunting Mechanism in Communicative English 3

Students learn basics of job-hunting mechanics which include using various job search strategies, making enquiries, and preparing relevant resumes and cover letters. The students

will develop communication skills to introduce themselves, highlight their strengths and abilities, present ideas, express opinions and respond appropriately during job interviews.

Students are guided in preparing a high impact resume and a cover letter, highlighting competencies and strengths that meet employer's expectations. Students are also taught to demonstrate effective communication and social skills in handling job interviews confidently.

Table 1: Subtopics under Job-Hunting Mechanism

SUBTOPIC	SPECIFICATIONS
2.1 Synthesize job advertisement	2.1.1 Prepare relevant job advertisements 2.1.2 Clarify words related to job advertisements 2.1.3 Study information on company's background, job requirements and specifications
2.2 Prepare for job enquiries	2.2.1 Adhere to appropriate telephone etiquette 2.2.2 Organize appropriate questions to elicit information on identified job advertisement 2.2.3 Clarify job enquiries over the telephone, in person and online about job vacancies such as job requirements and specifications 2.2.4 Arrange an appointment for an interview via the telephone, in person or online 2.2.5 Arrange for an alternative arrangements for date and time of interview
2.3 Prepare High Impact Resumes	2.3.1 Identify characteristics of a high impact resume 2.3.2 Integrate relevant qualifications, experiences, skills and personal information using an appropriate resume format and language 2.3.3 Modify resume using editing tools for editing grammatical, spelling and typing errors 2.3.4 Highlight own strengths in relation to the position applied that meet employer's expectations
2.4 Prepare Cover Letters	2.4.1 Organise the contents of the letter in a logical manner 2.4.2 Prepare cover letter using appropriate formal letter format/email, highlighting qualifications, experience and personal information that address employers' needs 2.4.3 Verify language accuracy of cover letter by eliminating grammatical spelling and typing errors
2.5 Demonstrate the abilities to handle job interviews	2.5.1 Display appropriate personal presentation (outfits, grooming and accessories) 2.5.2 Prepare an effective introduction of oneself, highlighting one's suitability (motivation, work preferences, interpersonal skills, etc) and eligibility (education, knowledge, experiences, training etc) 2.5.3 Select relevant documents (such as academic certificates, folio etc) 2.5.4 Study the company's background by gathering information regarding job specifications, the company/firm/ institution and the industry involved 2.5.5 Prepare interview questions and responses that relate to company's requirements 2.5.6 Display effective communication and social skills during interviews 2.5.7 Respond appropriately, fluently, audibly and confidently to questions in a job interview 2.5.8 Organize competencies and strengths that meet employer's expectations 2.5.9 Ask appropriate questions in a job interview

Source: Department of Polytechnic and Community College Education (2019)

2.2 Issues and Challenges regarding Graduate Employability

There are ongoing issues and challenges raised regarding graduate employability which need to be taken care of not only by the higher learning institutions but also the industries and graduates. The unknown market size and needs required in transforming the country to be of higher income economy, is visible due to the non-existence of an authority responsible for collecting, assessing, analysing and forecasting the exact number of jobs available or required in the private and public sector. Limited knowledge in true market need will lead higher learning institutions to face with dilemma of preparing curriculum which is based on assumptions rather than facts. It is possible to have a coordinating body that will serve as a permanent entity in conducting ongoing monitoring and keep tracking on the changes in industry that may require the curricula to be amended and improved.

Industries are also recommended to produce the list of required attributes to enable training providers and higher learning institutions in designing a curriculum that addresses the specified needs. The learning process should clearly link the theory and practice so that it will be clearly culminates in the practical outcome to enhance the employability. According to Ministry of Higher Education (2012), several major predicaments faced by employers are:

i. Imbalance of number of graduates compared to job opportunities available in the market. Most private companies demanded for more science and technical graduates, while majority of graduates are from the arts and social science discipline
ii. Local graduates are found to be highly qualified but are not proficient in English
iii. In relation to the country's move towards a high-technology-driven economy, science and industrial skills are highly sought. Nonetheless, local graduates are found to be lacking with the necessary technical skills and knowledge
iv. Establishment of National Job Monitoring Agency is possible to monitor the exact total of needed jobs

Higher learning institutions are responsible to produce the products (graduates) that meet the expectations and demands of the customers (the employment market). The issues of poor intake attributes should be considered where students should be encouraged to question, debate, create and innovate, through discussion and research. Students should also be encouraged to be independent individuals, to think out of the box and also to acquire belief in the critical importance of lifelong learning.

Higher learning institutions are also encouraged to initiate and offer "tailor-made" courses to suit industry requirements, thus should be complemented by the right attributes which should be instilled and nurtured prior joining the workforce. Opportunities should be given to graduates for constant exposure to the latest developments and updates on information and technology as well as to inculcate a philosophy of lifelong learning.

Higher learning institutions should take measures to minimise or eliminate the offer of unsellable programmes. Offering unsellable programmes to students with poorer academic achievement affects the passion towards their profession. Employers are highly looking forward to hire workers, who are passionate about their jobs, therefore higher learning institutions should retool, repackage and revamp the programmes by including aptitude test rather than focusing on the academic qualifications.

3. RESEARCH METHODOLGY

3.1 Population and Sample

The research methodology used in the present study is a cross-sectional survey in which it "collects information from a predetermined population. Furthermore, the information is collected at just one point in time" (Fraenkel, Wallen & Hyun, 2012, p. 394). The target population of the study is PSAS graduates from engineering department. The questionnaires are distributed during convocation and the graduates are encouraged to participate in the survey.

Table 2 shows the demographic of the total sample (n: 131) which consists of 106 male and 25 female students:

Table 2: Demographic Information of Respondents

	Category	Frequency	Percentage (%)
Gender	Male	106	80.9
	Female	25	19.1
Ethnicity	Malay	89	67.9
	Chinese	3	2.3
	Indian	16	12.2
	Others	1	0.8
	Undisclosed	22	16.8
Employment Status	Employed	66	50.4
	Unemployed	35	26.7
	Self-employed	3	2.3
	Study	17	13.0
	Undisclosed	10	7.6

As mentioned earlier, the respondents have graduated which means they have also completed all the Communicative English courses.

Based on the table, 50.4% of the respondents are employed and 26.7% are unemployed and 13.0% of them are furthering their study to local universities. Whereas self employed and undisclosed make up the remaining percentage; 2.3% and 7.6% respectively.

3.2 Instrument

The instrument used for data collection in this study is a set of questionnaires consisting 25 questions which was adopted from Killen, 1992. The questionnaire was used to evaluate the effectiveness and monitor the learning outcomes of the Job Mechanics which the students have learnt in their Communicative English 3 course.

Each form contains 25 statements for which the respondents are asked to record on a scale of 1-5; 1-Strongly Disagree, 2-Dsiagree, 3-Undecided or Not Applicable, 4-Agree, 5-Strongly Agree, the extent of their agreement. Killeen et al. (1992) describes the learning areas addressed by the MGI are the four categories; Decision making, opportunity awareness, transition skills and self- awareness.

The data were analysed using descriptive analysis. Mean score was used to identify the level of anxiety of the polytechnic students. All the data which was gathered through the questionnaire was loaded into SPSS version 20. In order to check the reliability of the questionnaire, reliability tests were run and the Cronbach's Alpha values as in Table 3 were obtained.

Table 3: Reliability Test of Questionnaire

Section	Cronbach's Alpha
Decision Making (Item 1-6)	.815
Opportunity Awareness (Item 7-12)	.850
Transition Skills (Item 13-18)	.755
Self-Awareness (Item 19-25)	.840

4. RESULTS AND DISCUSSION

The Measure of Guidance Impact (MGI) form were distributed to graduates from engineering departments with the intention to identify their perceptions on the effectiveness of Job-

Hunting Mechanics section of the Communicative English in preparing them for their future careers. The findings of the data collections are as follows:

Table 4: Decision Making

No.	Statement	Percentage (%)					Total Response	Mean	Standard Deviation
		Strongly Disagree	Disagree	Undecided / Not Applicable	Agree	Strongly Agree			
		(Disagree)			**(Agree)**				
1	I have a good idea of the jobs that will suit me.	0 **(1.5)**	1.5	19.8	68.7 **(78.6)**	9.9	131	3.87	.587
2	I have the information I need about education, training and/or job opportunities.	0 **(0.8)**	0.8	16.0	74.8 **(83.2)**	8.4	131	3.91	.518
3	I feel able to make a decision about the job or career that I want to do.	0 **(1.5)**	1.5	22.1	63.4 **(76.4)**	13.0	131	3.88	.633
4	I do not feel completely in charge of what is happening to me.	1.5 **(5.3)**	3.8	32.1	54.2 **(62.6)**	8.4	131	3.86	.755
5	I know how I can find out about education or training.	0 **(0)**	0	26.7	60.3 **(73.3)**	13.0	131	3.87	.617
6	I know how I can find out about jobs.	0 **(0)**	0	22.1	68.7 **(77.9)**	9.2	131	3.82	.546

Table 4 shows the respondents perceptions on their decision-making ability after going through the teaching and learning process of Job-Hunting Mechanics. 78.6% of the respondents agree that they have a good idea of the jobs that sill suit them and 73.3% of the respondents agree that they know how they can find out about education or training after completing the section.

For the statement of identifying their ability to make a decision about the job or career that they want to do, 76.4% agree to the statement and 83.2% of the respondents agree that they have the information they need about education, training and/or opportunities. However, 62.2% of the respondents agree that they do not feel completely in charge of what is happening to them regarding decision making pertaining to job search activities. It can be concluded that most majority of the respondents are able to participate actively in the decision-making process pertaining to job search activities.

The data presented in Table 5 shows the level of opportunity awareness among the respondents of the study. Almost all the respondents are aware that they would need to get into the education or training which interests them as 80.9% of the respondents agree to the statement. 80.2% of the respondents agree that they know what they want from a job while 79.4% of the respondents stated that they have planned for their future working life. 79.4% of the respondents agree that they would need to get into the jobs which interest them, and they know what they want from education or training. In conclusion, majority or almost all the respondents are aware of the opportunity pertaining to job search activities and they can identify and take action accordingly.

Table 5: Opportunity Awareness

No.	Statement	Percentage (%)					Total Response	Mean	Standard Deviation
		Strongly Disagree	Disagree	Undecided / Not Applicable	Agree	Strongly Agree			
		(Disagree)			**(Agree)**				
7	I have found out about opportunities that might suit me.	0	3.8	21.4	64.1	10.7	131	3.82	.666
		(3.8)			**(74.8)**				
8	I have made a plan for my future working life.	0	0.8	19.8	66.4	13.0	131	3.92	.595
		(0.8)			**(79.4)**				
9	I know what I want from education or training.	0	0	14.6	70.0	15.4	130	4.01	.550
		(0)			**(85.4)**				
10	I know what I want from a job.	0	0.8	19.1	67.2	13.0	131	3.92	.590
		(0.8)			**(80.2)**				
11	I know what I would need to get into the education or training which interests me.	0	0.8	18.3	66.4	14.5	131	3.95	.599
		(0.8)			**(80.9)**				
12	I know what I would need to get into the job which interests me.	0	0	20.6	66.4	13.0	131	3.92	.577
		(0)			**(79.4)**				

Table 6 shows the findings of respondents' ability in applying transition skills from education system to future working world. The statements in this section seek to identify the respondents' awareness of their transition skill regarding job search activities.

74.0% of the respondents agree that they can see the steps they must go through to decide and 75.5% are confident of their ability in making a good impression at an interview. The table also highlights that 74.0% of the respondents agree that they have found out what they will learn in education and /or training courses. However, two statements mark moderately low percentage where 68.7% of the respondents, respectively agree that they are worried about the decisions they need to make, and they do not know enough about how to prepare for an interview.

The findings show that respondents may have some doubts over what they must do after completing the section especially when they must portray their ability independently and with less guidance and supervision from their instructors/ lecturers.

Table 7 highlights the respondents' self-awareness after completion of the job hunting sections. 79.4% of the respondents agree that they know what their real interests are and 76.3% stated that they know themselves well enough to know what kinds of help they want pertaining to job search activities. Thus, 75.5% of the respondents feel that they never know what to write on an application form which asks about them.

Table 6: Transition Skills

No.	Statement	Percentage (%)					Total Response	Mean	Standard Deviation
		Strongly Disagree	Disagree	Undecided / Not Applicable	Agree	Strongly Agree			
		(Disagree)			**(Agree)**				
13	I can see the steps I must go through to make a decision.	0 **(0.8)**	0.8	21.4	71.8 **(77.9)**	6.1	131	3.83	.528
14	I know what work is involved in doing jobs I have been considering.	0 **(0.8)**	0.8	21.4	65.6 **(77.8)**	12.2	131	3.89	.598
15	I have found out what I will learn in education and/or training courses.	0 **(0)**	0	26.0	58.0 **(74.0)**	16.0	131	3.90	.643
16	I am worried about the decisions I need to make.	0.8 **(7.7)**	6.9	23.7	56.5 **(68.7)**	12.2	131	3.73	.795
17	I do not know enough about how to prepare for an interview.	0.8 **(7.7)**	6.9	23.7	58.8 **(68.7)**	9.9	131	3.70	.772
18	I am confident of making a good impression at an interview.	0 **(0)**	0	24.4	61.8 **(75.5)**	13.7	131	3.89	.611

Table 7: Self Awareness

No.	Statement	Percentage (%)					Total Response	Mean	Standard Deviation
		Strongly Disagree	Disagree	Undecided / Not Applicable	Agree	Strongly Agree			
		(Disagree)			**(Agree)**				
19	I know myself well enough to know what kinds of help I want.	0 **(1.5)**	1.5	22.1	64.1 **(76.3)**	12.2	131	3.87	.625
20	I need to know more about what I really want.	0.8 **(2.3)**	1.5	23.7	61.1 **(74.1)**	13.0	131	3.84	.689
21	I know what my real interests are.	0 **(0)**	0	20.6	63.4 **(79.4)**	16.0	131	3.95	.606
22	I feel positive about making applications.	0 **(0)**	0	19.2	64.6 **(80.8)**	16.2	130	3.97	.596
23	I never know what to write on an application form where it asks you about yourself.	0.8 **(3.9)**	3.1	20.6	65.6 **(75.5)**	9.9	131	3.81	.681
24	I feel that there is more to find out before I decide.	0.8 **(1.6)**	0.8	23.7	61.8 **(74.8)**	13.0	131	3.85	.669
25	I know where I can get the information I will need.	0 **(1.5)**	1.5	24.4	63.4 **(74.1)**	10.7	131	3.83	.622

5. CONCLUSION

The results of this research clearly indicate the positive trends in students' perception regarding how much Job-Hunting Mechanics assist in preparing them for job market. It can be concluded that students may have problems in applying what they have learnt into real situations. Students show good understanding in the area of decision making, opportunity awareness and self-awareness, however, display some discrepancies in the area of transition skills. As this is a pilot study, the researchers agree that amendments should be made to some of the items in the covered areas.

The findings of the study are limited to the sample of 131 respondents who participated in the survey. Thus, the data cannot truly represent all graduates of PSAS. The researchers hope that the study can serve as a starting point to identify students' responses towards the effectiveness of Job-Hunting Mechanics. Focus-group interviews could also be done to obtain students' responses in greater details. It is also hoped that a larger scale study involving the Centre of Corporate Industrial Services and Employment (CISEC) where data on all the graduates' employability can be obtained.

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KESAN FAKTOR GUNA TANAH TERHADAP TAHAP KUALITI AIR SUNGAI KUANTAN DI SUNGAI LEMBING

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Abstrak. Aktiviti pembangunan merupakan aspek penting dalam peningkatan ekonomi dan memberi kesan positif kepada masyarakat. Namun begitu, pembangunan yang dilaksanakan biasanya melibatkan perubahan kepada aktiviti guna tanah di mana ia sering meninggalkan kesan kepada kawasan persekitaran dan mengakibatkan kemerosotan sumber alam khususnya sumber air. Kajian ini dijalankan bagi menentukan akibat faktor guna tanah kepada kualiti air Sungai Kuantan di Kawasan Sungai Lembing. Bentuk perubahan guna tanah di kawasan kajian dikaji berdasarkan kajian literatur kajian terdahulu. Kajian dijalankan dengan pengambilan sampel air di tiga stesen terpilih iaitu di hulu sungai, di tengah sungai dan di hilir sungai. Kualiti air sungai di lokasi kajian dikelaskan berdasarkan Indeks Kualiti Air (IKA). Parameter yang diuji adalah kadar Oksigen Terlarut (DO), pH, Ammonical Nitrogen (NH_3-N), Keperluan Oksigen Biokimia (BOD), Keperluan Oksigen Kimia (COD) dan Jumlah Pepejal Terampai (TSS). Seterusnya kesesuaian penggunaan air di kawasan kajian ditentukan menerusi Piawaian Interim Kualiti Air Kebangsaan (INWQS). Dapatan kajian menunjukkan kualiti air Sungai Kuantan di Sungai Lembing pada masa ini berada dalam Kelas II yang dikategorikan sebagai sungai sedikit tercemar. Secara kesimpulannya, aktiviti guna tanah di kawasan kajian memberi sedikit kesan langsung kepada kualiti air Sungai Kuantan. Namun begitu kajian lanjut perlu dijalankan untuk menilai kesan guna tanah di kawasan kajian terhadap luahan sungai yang mungkin menyebabkan masalah bencana alam di kawasan kajian.

Kata Kunci: Sungai Kuantan, Sungai Lembing, guna tanah, kualiti air.

1. PENGENALAN

Pelbagai inisiatif telah dilaksanakan oleh kerajaan Malaysia bagi meningkatkan taraf hidup masyarakat. Namun begitu, aktiviti pembangunan yang berterusan sedikit sebanyak meninggalkan kesan terhadap alam sekitar dan seterusnya mampu menyebabkan masalah bencana alam berlaku. Berdasarkan kenyataan oleh Pensyarah Pusat Pengajian Sosial, Persekitaran dan Pembangunan Fakulti Sains Sosial dan Kemanusiaan, Universiti Kebangsaan Malaysia (UKM), Prof Datuk Dr Mohd Ekhwan Toriman, berdasarkan data yang dikeluarkan oleh Jabatan Alam Sekitar berhubung tahap pencemaran bagi 120 lembangan sungai utama di Malaysia dari tahun 2005 sehingga tahun 2018 agak merunsingkan dimana terdapat 38 sungai tercemar pada tahun 2016, meningkat kepada 52 sungai pada tahun 2017 dan terus meningkat kepada 63 sungai dikategorikan tercemar pada tahun 2018 (Astro Awani, 23 September 2019).

Sungai Kuantan terletak di Negeri Pahang. Sungai Kuantan mengalir dari Sungai Lembing melalui Bandaraya Kuantan sebelum mengalir keluar ke Laut China Selatan. Sungai Lembing suatu ketika dulu dikenali sebagai 'El Dorado Timur', menjadi pusat industri perlombongan bijih timah pada tahun 1886. Namun begitu, pada tahun 1986 kegemilangannya sebagai lombong bijih timah berakhir dan ia kini menjadi pusat perlancongan dari kesan tinggalan

aktiviti melombong bijih timah yang masih ada sehingga kini (www.heritageMalaysia.my, 2020).

Pada tahun 2018, New Straits Times Publication (NSTP) mendedahkan bahawa kira-kira 500 hektar hutan di Hulu Sungai Lembing ditebang secara berleluasa tanpa mengambil kira kesan alam sekitar dan impak kepada industri pelancongan di kawasan sekitar. Siasatan oleh Jabatan Alam Sekitar (JAS) Pahang mendapati syarikat yang memegang lesen pembalakan di Hulu Sungai Lembing iaitu Syarikat Mentiga Corporation Sdn Bhd telah melakukan perlanggaran syarat EIA (*Environmental Impact Assessment)* iaitu tiada langkah-langkah pengawalan hakisan dan kelodak diambil (NSTP, 23 November 2018). Oleh yang demikian, tindakan yang mencemarkan kualiti air sungai perlu diberi perhatian dan dibendung bagi mengelakkan kemungkinan berlakunya konflik kekurangan sumber air bersih pada masa hadapan. Objektif kajian ini adalah untuk:

a. Menentukan kelas Sungai Kuantan, di Sungai Lembing berdasarkan pengukuran nilai parameter Indeks Kualiti Air (IKA) terhadap enam parameter yang disarankan oleh Jabatan Alam Sekitar iaitu DO, BOD, COD, NH_3N, pH dan TSS.
b. Menentukan kesesuaian penggunaan air sungai di lokasi kajian berdasarkan Piawai Interim Kualiti Air Kebangsaan Malaysia (INWQS).
c. Membincangkan kesan pembangunan guna tanah terhadap kualiti air di lokasi kajian berdasarkan kajian terdahulu.

2. SOROTAN KAJIAN DAN PEMBINAAN HIPOTESIS

Malaysia merupakan sebuah negara membangun yang mampu bersaing dengan negara-negara yang maju seperti Jepun, Singapura dan Korea Selatan. Pembangunan ini secara tidak langsung menyumbang kepada pertambahan aktiviti guna tanah di sesuatu kawasan termasuklah kawasan berhampiran sungai. Kepelbagaian aktiviti guna tanah seperti penebangan hutan, pembinaan jalan dan bangunan boleh mengakibatkan penurunan tahap kualiti air seperti yang berlaku di Sungai Telom dan Sungai Bertam di Cameron Highlands (Weng et al., 2011).

Akta Kualiti Alam Sekeliling 1974 merupakan suatu akta yang digunapakai bagi merujuk sebarang peraturan dan piawai yang berkaitan dengan pencemaran air daratan di Malaysia. Berdasarkan akta ini, pencemaran dapat dinyatakan sebagai "*perubahan kepada sifat-sifat fizikal, kimia, atau biologi pada bahagian alam sekitar melalui aktiviti melepaskan, mengeluarkan, meletakkan benda-benda berbahaya, pencemar atau bahan buangan yang memberi kesan negatif kepada kesihatan, keselamatan atau kebajikan hidupan bumi atau perlanggaran syarat terhadap lesen yang dikeluarkan"* (Akta Kualiti Alam Sekeliling 1974).

2.1Indeks Kualiti Air (IKA)
Indeks Kualiti Air (IKA) atau *Water Quality Index (WQI)* merupakan ukuran penilaian terhadap tahap kualiti air di Malaysia. Jabatan Alam Sekitar (JAS) telah menggunakan IKA sebagai garis panduan pengelasan status air sungai di Malaysia.

Terdapat enam parameter utama dalam pengelasan IKA iaitu DO, BOD, COD, NH_3N, pH dan TSS. Nilai yang diperolehi bagi setiap parameter dianalisa tahap kualitinya mengikut kelas. Kelas Indeks Kualiti Air dan status pencemarannya ditunjukkan di dalam Jadual 1 berikut.

IKA sungai akan dikira berdasarkan rumus berikut:

IKA = (0.22*SIDO) + (0.19*SIBOD) + (0.16*SICOD) + (0.15* SIAN) + (0.16* SISS) + (0.12 *SIpH)

(*Sumber: Portal Jabatan Alam Sekitar)*

Petunjuk;
SIDO = Subindeks DO
SIBOD = Subindeks BOD

SICOD = Subindeks COD
SIAN = Subindeks NH_3N
SISS = Subindeks SS
SIpH = Subindeks pH

0≤ IKA ≥ 100

Jadual 1: Kelas Indeks Kualiti Air dan Status Pencemaran

Kelas / parameter	Kelas I	Kelas II	Kelas III	Kelas IV	Kelas V
Nitrogen ammonia (mg/l)	<0.1	0.1 – 0.3	0.3 – 0.9	0.9 – 2.7	>2.7
BOD (mg/l)	<1	1-3	3-6	6-12	>12
COD (mg/l)	<10	10-25	25-50	50-100	>100
DO (mg/l)	>7	5-7	3-5	1-3	<1
pH	>7	6-7	5-6	<5	<5
TSS (mg/l)	<25	25-50	50-150	150-300	>300
Indeks Kualiti Air (IKA)	>92.7	76.5-92.7	51.9-76.5	31-51.9	<31
Status pencemaran	Tidak tercemar	Sedikit tercemar	Sederhana tercemar	Tercemar	Sangat tercemar

(*Sumber: Jabatan Alam Sekitar, 2003)*

2.2 Piawai Interim Kualiti Air Kebangsaan Malaysia (INWQS)

Jadual 2 menunjukkan Piawaian Interim Kualiti Air Kebangsaan INWQS (JAS, 2003) terdiri daripada enam kelas iaitu Kelas I, IIA, IIB, III, IV dan V yang merujuk kepada pengelasan sungai-sungai di Malaysia. Kualiti air sungai dianggap sesuai digunakan untuk penggunaan khusus selagi ianya berada dalam julat yang dinyatakan bagi setiap kelas yang ditetapkan

Jadual 2: Kelas Indeks Kualiti Air Berdasarkan INWQS

Parameter	Unit	Kelas					
		I	IIA	IIB	III	IV	v
pH		6.5-8.5	6-9	6-9	5-9	5-9	-
DO	mg/L	>7	5-7	5-7	3-5	<3	<1
BOD	mg/L	1	3	3	6	12	>12
COD	mg/L	10	25	25	50	100	>100
TSS	mg/L	25	50	50	150	300	300
Ammonia	mg/L N	0.1	0.3	0.3	0.9	2.7	>2.7

(*Sumber: Jabatan Alam Sekitar, 2003)*

Kelas I Pemeliharaan untuk persekitaran semulajadi
Bekalan air I – secara praktikalnya tidak memerlukan rawatan
Perikanan I – untuk spesis akuatik yang sangat sensitif

Kelas IIA Bekalan air II –memerlukan rawatan konvensional
Perikanan II – untuk spesis akuatik yang sensitif
Kelas IIB Sesuai untuk aktiviti rekreasi yang melibatkan sentuhan badan

Kelas III Bekalan air III –memerlukan rawatan yang sensitif
Perikanan III – untuk minuman binatang ternakan

Kelas IV Pengairan
(*Sumber: Jabatan Alam Sekitar, 2003)*

2.3 Ujikaji Makmal

2.3.1 Ujian Oksigen Terlarut (DO)

DO ialah penentu ukuran jumlah oksigen terlarut di dalam air atau air sisa. Bakteria aerobik dan hidupan akuatik menggunakan DO untuk terus hidup. Tahap kepekatan DO merupakan satu parameter penting untuk mengukur kelangsungan hidup hidupan akuatik. Rozali et al.,

2006 di dalam kajiannya mendapati ikan keli atau nama saintifknya *Ictalurs punctatus* dan spesis tilapia memerlukan sekurang-kurangnya 3mg/l oksigen terlarut untuk hidup.

2.3.2 Ujian Indeks Kealkalian (pH)

Nilai Indeks Kealkalian (pH) merujuk kepada ukuran kepekatan ion hidrogen dalam larutan dan ditakrifkan sebagai log negatif H+ ion kepekatan dalam air sisa. Nilai pH 0 hingga sedikit kurang dari 7 disebut sebagai berasid dan nilai pH sedikit di atas 7 hingga 14 disebut sebagai alkali apabila kepekatan ion H+ dan ion OH- adalah sama maka ia disebut sebagai pH neutral.

Nilai pH dapat menentukan sama ada tindak balas kimia atau biologi telah berlaku, serta berfungsi menentukan tahap ketoksidan bahan cemar di dalam air. Nilai pH yang rendah sejajar dengan penurunan nilai DO dan hubungkait ini berkaitan dengan pertambahan nilai BOD dan COD (Suhaimi, 2016).

2.3.3 Ujian Ammonikal Nitrogen (NH_3N)

Tahap pencemaran yang diakibatkan oleh oleh baja tanaman (pertanian), najis haiwan dan juga sisa kumbahan domestik dapat diukur melalui ujian Nitrogen Ammonia (NH_3N). Ammonical Nitrogen merupakan material tidak organik yang terjana hasil daripada tindak balas nitrogen yang ada pada racun rumpai, sisa kumbahan, racun serangga, baja dan sisa ternakan yang tidak dirawat mengikut prosedur yang tepat (Mokhtar & Karim, 2008). Rozali et al. (2006) dalam kajiannya menyatakan kandungan ammonia pada kepekatan yang tinggi dapat memberi kesan toksik kepada hidupan akuatik dan hal ini akan bertambah buruk sekiranya kualiti air tersebut mempunyai nilai pH yang tinggi.

2.3.4 Ujian Permintaan Oksigen Biokimia (BOD)

Nilai permintaan oksigen biokimia (BOD) digunakan untuk menentukan tahap pencemaran organik dalam air. Nilai BOD adalah berkadar songsang dengan nilai DO iaitu semakin tinggi nilai BOD maka nilai DO akan semakin rendah (Metcalf & Eddy, 2003)

Kadar oksigen yang diperlukan oleh mikroorganisma untuk mengoksidakan atau menstabilkan bahan organik dalam keadaan aerob ditunujukkan oleh Nilai BOD. Nilai BOD adalah bergantung kepada pelbagai faktor yang diuukur seperti permintaan oksigen hasil daripada alga dalam air dan pengoksidaan ammonia (kehadiran bakteria penitritan) (Rozali, 2006). Nilai BOD boleh menjadi rendah dengan kehadiran bahan toksik dalam air dimana ia mampu mengurangkan mikroorganisma di dalam air (D. Chapman, 1992).

2.3.5 Ujian Permintaan Oksigen Kimia (COD)

Sawyer et al. (1994) di dalam kajiannya menyatakan bahawa nilai permintaan oksigen kimia (COD) bertujuan menilai kadar oksigen yang diperlukan bagi mengoksida unsur kimia organik sampel kepada karbon dioksida dan air. Nilai COD adalah berkadar langsung dengan nilai BOD kerana terdapat hubungkait di antara kedua-dua parameter ini dengan penguraian unsur organik dalam air (Suhaimi, 2016).

Nilai COD adalah merupakan ukuran keperluan oksigen terhadap sebahagian dari bahan organik di dalam sampel air. Bahan ini boleh dioksidakan oleh agen pengoksida seperti permangganat dan dikromat di dalam larutan yang berasid. Pada kebiasaannya, nilai COD adalah melebihi nilai BOD kerana hampir keseluruhan bahan organik dioksida dalam ujian COD sedangkan hanya sebahagian bahan organik terurai dalam ujian BOD.

2.3.6 Ujian Pepejal Terampai (TSS)

Ujian Pepejal Terampai mengukur jumlah kepekatan (tidak larut) pepejal dalam pengudaraan penstabilan lembangan sungai atau dalam air sisa. Jumlah data pepejal terampai (TSS) adalah penting dalam menentukan tingkah laku operasi sistem rawatan sisa. Kandungan pepejal terampai sangat berkait rapat dengan tahap kekeruhan dan warna air (Rozali et al., 2006).

2.4 Kesan Pembangunan Guna Tanah Terhadap Kualiti air di Lokasi Kajian

Noorazuan (2011) di dalam kajiannya telah menilai perubahan ruang lembangan Sungai Kuantan berdasarkan perubahan guna tanah di antara tahun 1990 sehingga 2002. Data berkaitan jenis guna tanah di lokasi kajian telah diambil dari ibu pejabat Jabatan Pertanian Kuala Lumpur. Data yang diperolehi adalah dalam bentuk digital (*shapefiles*) itu merangkumi seluruh kawasan Pahang Utara.

Perubahan drastik guna tanah hutan di Sungai Lembing telah mengakibatkan pertambahan luas sempadan guna tanah hutan dengan jenis guna tanah yang lain. Jadual 3 menunjukkan terdapat penurunan keluasan kawasan hutan berpunca dari kegiatan pembalakan di sekitar kawasan Hutan Simpan Reman-Cereh dan terdapat peningkatan keluasan kawasan pertanian, terutamanya di kawasan hulu Sg. Kenau (Noorazuan et al., 2011).

Jadual 3: Gunatanah Lembangan Sungai Kuantan 1990-2002

Gunatanah Lembangan Sungai Kuantan 1990 - 2002				
Jenis Gunatanah	**1990 (ha)**	**1995 (ha**	**2000 (ha)**	**2002 (ha)**
Bandar dan kawasan berkaitan	120	120	513	482
Perkebunan / Dusun	295	218	269	262
Penanaman kekal / komersial	-	107	2,238	2,223
Rumput	574	481	700	727
Cerang baru	340	-	227	496
Hutan	51,066	50,802	43,978	41,603
Belukar	486	598	4,905	7,061
Kawasan terbiar / berpaya	22	577	73	49
Jumlah	52,903	52,903	52,903	52,903

(*Sumber:* Noorazuan et al., 2011*)*

Berdasarkan Jadual 3, didapati bahawa pertambahan aktiviti bandar dan kawasan berkaitan telah bertambah sehingga 482 hektar pada tahun 2002 berbanding 120 hektar pada tahun 1990. Hal ini menunjukkan telah banyak pembinaan di sekitar Sungai Lembing seperti restoren, kawasan rekreasi, perkampungan-perkampungan kecil dan kawasan perumahan di mana aktiviti harian dari penduduk telah sedikit sebanyak akan menjejaskan kualiti air di lokasi kajian.

Jadual 4 menunjukkan analisis metrics Lembangan Sungai Kuantan dari tahun 1990 sehingga tahun 2002. Berdasarkan Jadual 4, dapat dilihat terdapat peningkatan pada nilai *Edge Density (ED)* dan *Shanon Diversity Index (SDI)* di mana nilai ini menunjukkan lembangan Sungai Kuantan telah mengalami perubahan guna tanah, khususnya guna tanah hutan sehingga mengakibatkan jumlah *patch* yang terhasil menjadi bertambah banyak dan bersempadan dengan jenis guna tanah yang lain (Noorazuan et al., 2011).

Jadual 4: Analisis Metriks Lembangan Sungai Kuantan 1990-2002

Statistik ruang	1990	1995	2000	2002
Edge Density (ED) (unit m/ha)	5.89	7.76	18.42	21.19
Shannon Diversity Index (SDI)	0.20	0.25	0.70	0.79

(*Sumber:* Noorazuan et al., 2011*)*

Selain itu, aktiviti penanaman kekal dan komersial juga telah mengalami pertambahan keluasan sehingga 2223 hektar pada tahun 2002 berbanding hanya 107 hektar pada tahun 1995. Penanaman kekal yang terdapat di lokasi kajian adalah kawasan penanaman sawit

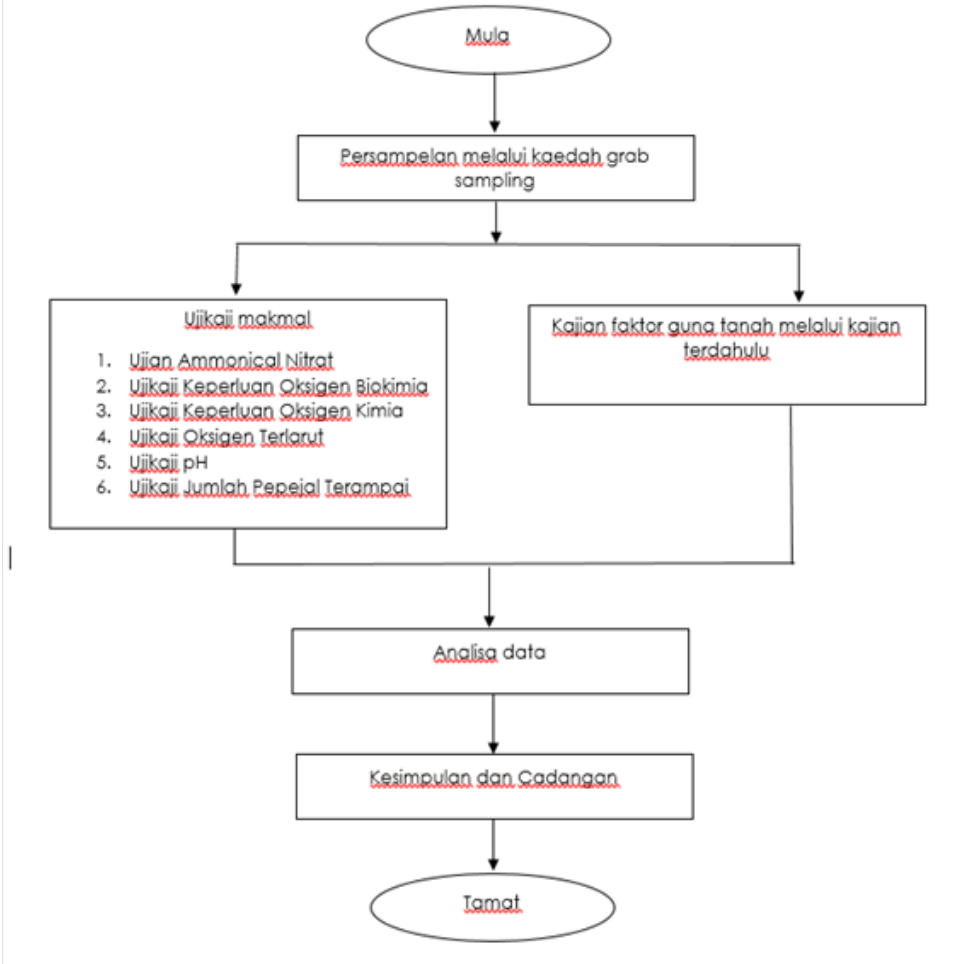
dan aktiviti pertanian ini dilihat memberi kesan terhadap peningkatan kandungan ammonia di Sungai Kuantan di lokasi kajian.

3. METODOLOGI KAJIAN

3.1 Carta Alir Metodologi Kajian
Rajah 1 menunjukkan carta alir metodologi kajian yang digunakan dalam mendapatkan data bagi kajian ini.

3.2 Persampelan
Kawasan kajian yang dipilih adalah di Sungai Kuantan yang terletak di Sungai Lembing, Pahang Darul Makmur. Ia terletak di koordinat 3.9046°N dan 103.0327° E. Persampelan telah dilakukan sebanyak tiga sampel di setiap stesen terpilih iaitu hulu sungai, tengah sungai dan hilir sungai. Kaedah persampelan adalah menggunakan teknik *grab sampling* dan diisi ke dalam botol kaca dan botol polietilena. Sampel yang telah diambil kemudiannya disimpan di dalam peti tahan sejuk sebelum dibawa ke makmal secepat mungkin untuk diuji bagi mengelakkan perubahan parameter terjadi terhadap sampel. Setiap sampel yang diambil telah dilabel dengan jelas bagi mengelakkan kekeliruan.

3.3 Parameter Kajian
Parameter kajian yang dianalisa adalah berdasarkan keperluan IKA iaitu oksigen terlarut (DO), pH, Ammonical Nitrogen (NH_3N), keperluan oksigen kimia (COD), keperluan oksigen biokimia (BOD), dan jumlah pepejal terampai (TSS). Berberapa parameter fizikal iaitu suhu, pH dan warna ketara telah direkodkan dengan menggunakan peralatan yang telah dikalibrasi terlebih dahulu.



Rajah 1: Carta Alir Metodologi Kajian

3.4 Ujikaji Makmal

Rajah 2, Rajah 3, Rajah 4, Rajah 5 dan Rajah 6 berikut adalah ditunjukkan sebahagian proses ujikaji makmal yang dijalankan dalam proses mendapatkan data kajian.



Rajah 2: Alat Ujikaji BOD



Rajah 3: Pengujian COD



Rajah 4: Pengujian TSS



Rajah 5: Meter Ammonical Nitrogen



Rajah 6: Pengujian pH

4. ANALISIS DAN KEPUTUSAN

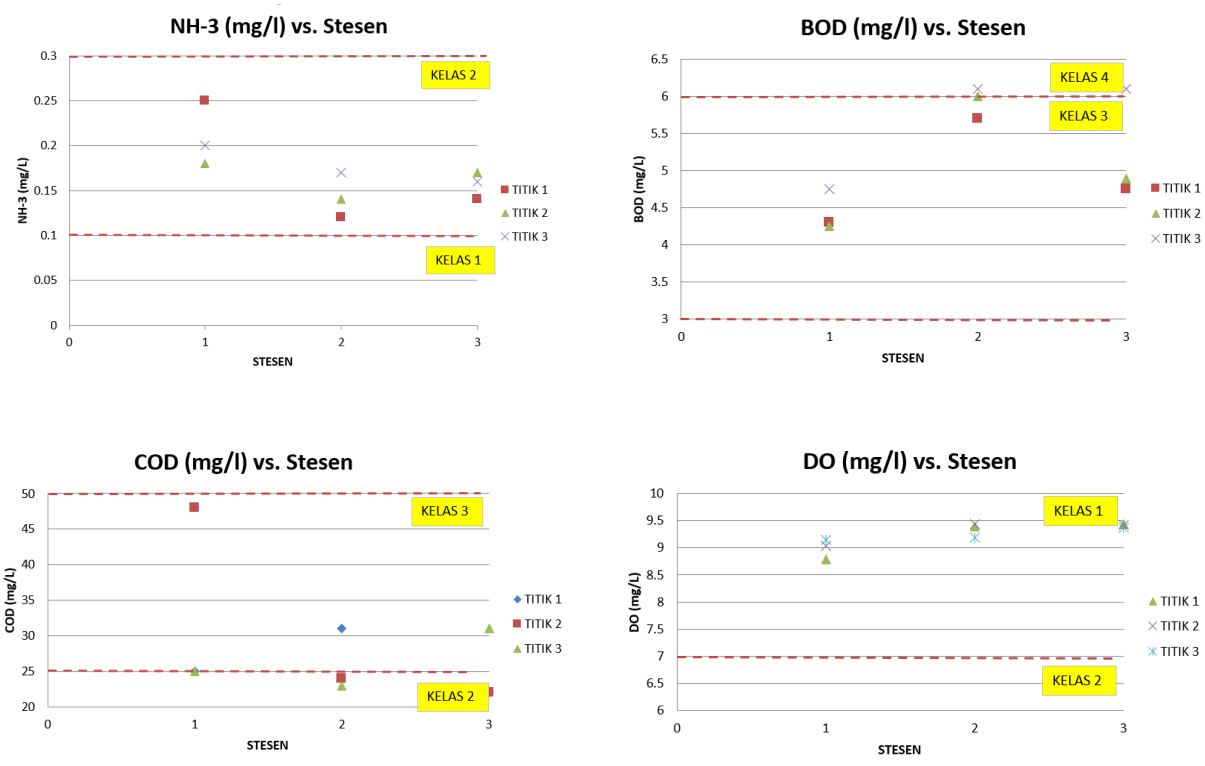
4.1Indeks Kualiti Air (IKA)

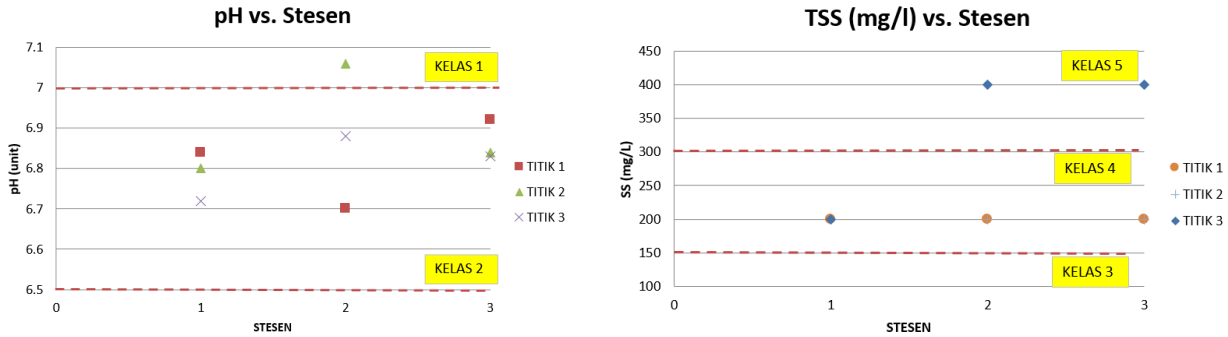
Jadual 5 menunjukkan nilai parameter-parameter yang diperolehii di setiap lokasi persampelan.

Jadual 5: Nilai Bacaan Parameter Kualiti Air Sungai Kuantan di Sungai Lembing

Parameter	Unit	Stesen								
		Stesen 1: S1 (hulu)			Stesen 2: S2 (tengah)			Stesen 3: S3 (hilir)		
		Titik 1	Titik 2	Titik 3	Titik 1	Titik 2	Titik 3	Titik 1	Titik 2	Titik 3
1. Suhu	°C	26.6	25.8	25.6	25	25.2	25.4	25.1	25.0	25.5
2. NH_3N	mg/l	0.25	0.18	0.20	0.12	0.14	0.17	0.14	0.17	0.16
3. BOD	mg/l	4.3	4.25	4.75	5.7	6.0	6.1	4.75	4.9	6.1
4. COD	mg/l	25	48	25	31	24	23	22	22	31
5. DO	mg/l	8.78	9.04	9.14	9.39	9.44	9.19	9.43	9.42	9.37
6. pH	pH	6.84	6.80	6.72	6.7	7.06	6.88	6.92	6.84	6.83
7. TSS	mg/l	200	200	200	200	200	400	200	200	400

Analisa data (rujuk Rajah 7) telah dibuat dengan membandingkan nilai yang diperolehi dengan nilai piawai seperti di Jadual 1.





Rajah 7: Perbandingan Nilai Bacaan Parameter Kualiti Air Sungai Kuantan di Sungai Lembing dengan Nilai Piawai (IKA)

Berdasarkan kajian dilakukan, purata kepekatan nitrogen ammonia adalah 0.17mg/l iaitu pada kelas II. Kategori air yang sesuai untuk hidupan akuatik bagi kandungan NH_3N adalah 0.02mg/l (D. Chapman, 1992). Nilai 0.17mg/l dipengaruhi oleh aktiviti-aktiviti pertanian dari ladang sawit yang berada di sekitar Sungai Lembing seperti dari kesan baja pertanian dan lumut-lumut yang banyak terdapat pada longgokan kayu dan pelepah sawit yang terdampar di tebingan sungai. Selain itu kewujudan haiwan ternakan seperti lembu dan kambing berdekatan kawasan kajian turut mempengaruhi nilai bacaan ammonia bernitrogen di kawasan tersebut. Pertembungan aliran sungai kecil dan Sungai Kuantan di hulu sungai menyebabkan peningkatan nilai nitrogen ammonia kerana sungai-sungai kecil membawa *effluent* dari sisa pembuangan domestik dari kawasan perkampungan dan restoren berhampiran.

Nilai parameter BOD untuk semua stesen persampelan pula adalah di antara 4.25mg/l sehingga 6.1mg/l. Nilai purata BOD untuk Stesen 1 menunjukkan BOD yang terendah iaitu 4.3mg/l sehingga 4.75mg/l kerana kegiatan guna tanah yang relatif lebih rendah di mana guna tanah utama adalah penempatan perkampungan. Secara keseluruhan, nilai purata BOD bagi semua stesen kajian adalah melebihi 4.25mg/l (kelas III). Menurut JAS, industri makanan banyak menyumbang kepada bebanan BOD kepada air sungai (Mazlin et al., 2001).

Berdasarkan data dari Ujian Permintaan Oksigen Kimia (COD) pula, nilai purata kepekatan COD untuk semua stesen persampelan kajian adalah 27.8mg/l iaitu berada pada kelas III. Nilai COD ini menunjukkan kualiti air sungai di lokasi kajian adalah sederhana tercemar di mana ia diakibatkan oleh faktor buangan *effluent* sisa domestic dari kawasan perkampungan dan restoren berhampiran lokasi kajian.

Berdasarkan Rajah 7 juga, julat kepekatan DO di semua stesen persampelan adalah di antara 8.78 hingga 9.44mg/l iaitu melebihi nilai 7mg/l untuk Kelas I. Nilai DO yang tinggi ini adalah disebabkan faktor air sungai yang cetek dan deras serta mempunyai batuan sungai. Nilai DO yang tinggi ini secara tidak langsung menyebabkan air sungai tersebut selamat untuk hidupan akuatik dan manusia.

Nilai pH merupakan parameter penting yang digunapakai untuk menentukan indeks keasidan atau kealkalian dari bahan organik dalam air sungai. Keasidan yang tinggi di dalam air sungai boleh menyebabkan penyakit seperti gout, kencing manis, penyakit jantung dan darah tinggi. Jika air sungai terlalu beralkali pula, ia akan mengakibatkan insiden pembentukan batu di dalam hempedu dan ginjal (Nurain, 2015). Berdasarkan nilai pH yang diperolehi daripada ujian pH setiap sampel air, didapati sampel air mempunyai nilai pH yang menghampiri nilai neutral. Nilai pH purata iaitu 6.84 menunjukkan air Sungai Kuantan di Sungai Lembing berada dalam kelas II. Oleh yang demikian, dapat dinyatakan bahawa air sungai di lokasi kajian masih lagi selamat dan tidak berbahaya kepada hidupan akuatik dan

manusia. Jelas bahawa aktiviti guna tanah di sekitar kawasan kajian tidak banyak mempengaruhi nilai keasidan air sungai tersebut.

Jumlah pepejal terampai (TSS) adalah partikel-partikel bukan organik dalam air yang bersaiz lebih besar daripada 0.001mm. Kandungan TSS biasanya terdiri dari lumpur, pasir, bahan organik dan bahan bukan organik. Berdasarkan data TSS yang ditunjukkan di dalam Jadual 6, purata kandungan pepejal terampai bagi semua stesen persampelan adalah 245mg/l iaitu di dalam kelas IV. Nilai pepejal terampai yang tinggi di lokasi kajian mungkin dipengaruhi oleh faktor waktu pengambilan sampel air sungai selepas hujan. Selain itu nilai TSS ini turut dipengaruhi oleh faktor kawasan ini yang merupakan bekas tapak aktiviti perlombongan bijih timah. Longgokan dari dahan dan kayu reput di tebing sungai turut mempengaruhi nilai TSS di lokasi kajian.

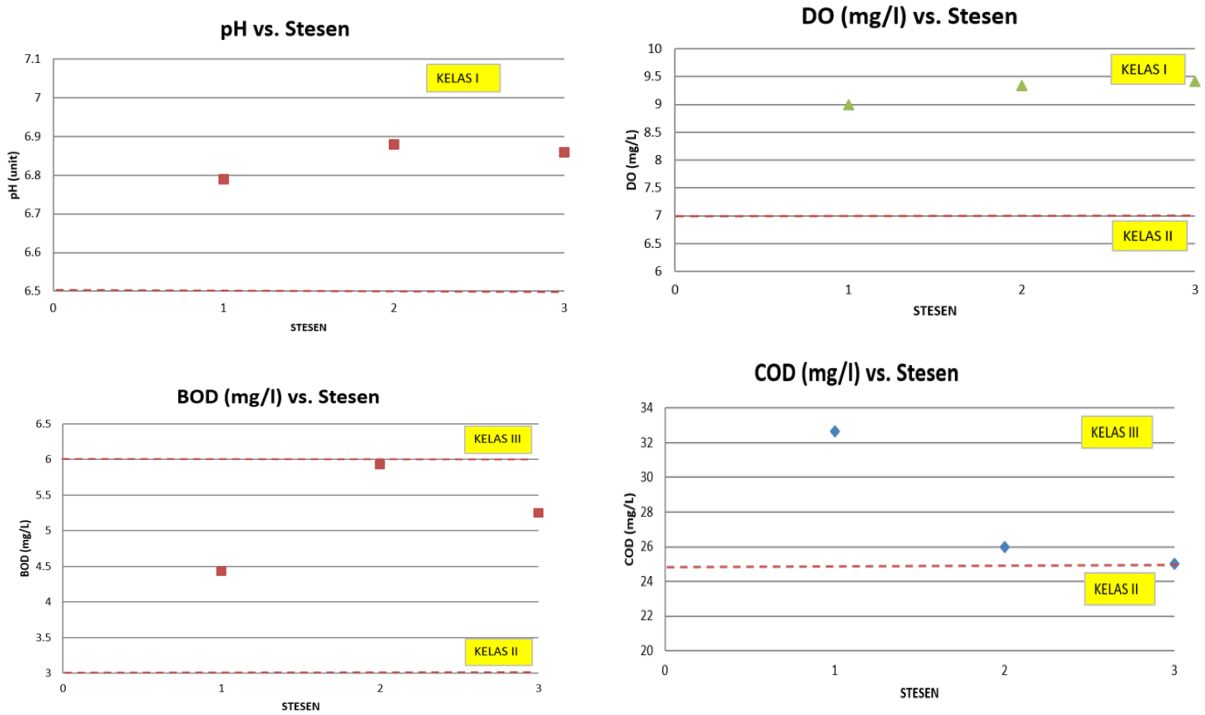
Jadual 6 menunjukkan data Indeks Kualiti Air (IKA) bagi stesen-stesen persampelan kajian ini. Berdasarkan Jadual 3, didapati nilai indeks kualiti air bagi Sungai Kuantan di Sungai Lembing adalah di antara 64.85% sehingga 96.04% iaitu stesen I dan 3 berada pada kelas II (sedikit tercemar) manakala stesen 2 berada pada kelas I (tidak tercemar).

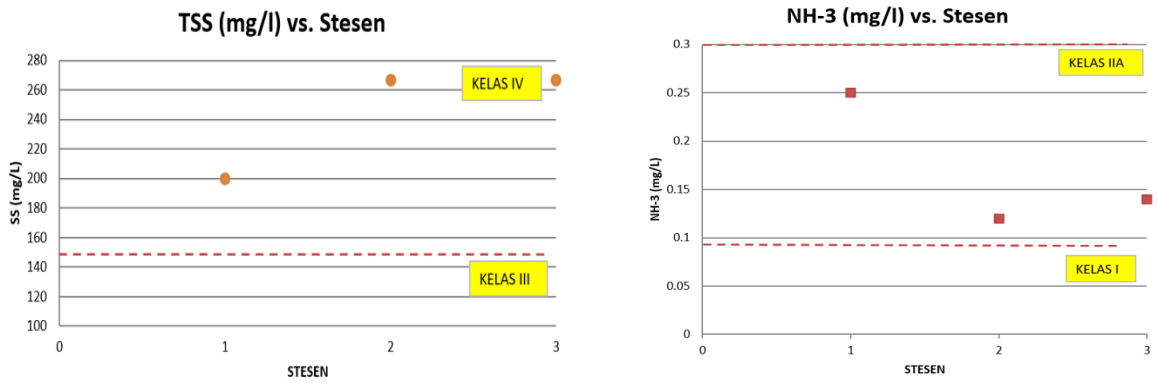
Jadual 6: Indeks Kualiti Air (IKA) bagi stesen-stesen persampelan kajian

	Stesen 1	Stesen 2	Stesen 3
IKA %	78.67	96.04	64.85
Kelas	II	I	II
Status Pencemaran	Sedikit tercemar	Tidak tercemar	Sedikit tercemar

4.2 Kesesuaian Penggunaan Air Sungai Di Lokasi Kajian Berdasarkan Piawai Interim Kualiti Air Kebangsaan Malaysia (INWQS)

Seterusnya, data parameter bacaan IKA di lokasi kajian telah dibandingkan dengan jadual pengelasan kualiti air berdasarkan Piawaian Interim Kualiti Air Kebangsaan INWQS (JAS, 2003) seperti ditunjukkan di dalam Jadual 2 bagi tujuan pengkelasan sungai berkenaan (Rajah 8).





Rajah 8: Perbandingan Nilai Bacaan Purata Parameter Kualiti Air Sungai Kuantan di Sungai Lembing dengan Nilai Piawai INWQS

Berdasarkan perbandingan yang dibuat di antara nilai bacaan purata parameter kualiti air dan Piawaian Interim Kualiti Air Kebangsaan INWQS (JAS, 2009) yang ditunjukkan di pada Rajah 8, kualiti air di lokasi kajian adalah paling hampir berada pada kelas IIA iaitu air di lokasi kajian adalah bersesuaian untuk bekalan air namun memerlukan rawatan konvensional. Selain itu air di lokasi kajian juga sesuai untuk dijadikan kawasan aktiviti perikanan spesifik akuatik yang sensitif.

5. KESIMPULAN

Pengukuran tahap kualiti air sungai perlu dilaksanakan secara berkala kerana sumber air bersih sangat penting kepada seluruh benda hidup. Tahap kualiti air sungai yang terjejas teruk akan memberi kesan negatif terhadap pengguna dari aspek kekurangan bekalan air bersih dan kesan penyakit dari penggunaan sumber air tercemar.

Berdasarkan kajian yang telah dijalankan, ketiga-tiga objektif kajian telah dapat dicapai. Bagi objektif pertama, didapati nilai indeks kualiti air bagi Sungai Kuantan di Sungai Lembing adalah di antara 64.85% sehingga 96.04% iaitu berada pada kelas II. Status pencemaran kualiti air Sungai Kuantan di kawasan Sungai Lembing adalah berada pada tahap sedikit tercemar.

Seterusnya bagi objektif kedua, berdasarkan perbandingan yang dibuat di antara nilai bacaan purata parameter kualiti air dan Piawaian Interim Kualiti Air Kebangsaan INWQS (JAS, 2009) didapati bahawa kualiti air di lokasi kajian adalah paling hampir berada pada kelas IIA iaitu air di lokasi kajian adalah bersesuaian untuk bekalan air namun memerlukan rawatan konvensional. Selain itu air di lokasi kajian juga sesuai untuk dijadikan kawasan untuk aktiviti perikanan spesifik akuatik yang sensitif.

Bagi objektif ketiga pula, pertambahan aktiviti perbandaran dan penanaman komersial di Sungai Lembing sedikit sebanyak telah memberi kesan terhadap kualiti air Sungai Kuantan di Sungai Lembing. Aktiviti perbandaran merangkumi pembinaan di sekitar Sungai Lembing seperti restoren, kawasan rekreasi, perkampungan-perkampungan kecil dan kawasan perumahan di mana aktiviti harian dari penduduk telah sedikit sebanyak akan menjejaskan kualiti air di lokasi kajian. Selain itu, penanaman sawit di lokasi kajian dilihat memberi kesan terhadap peningkatan kandungan ammonia di Sungai Kuantan.

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THE DEVELOPMENT OF POWER SUPPLY TRAINER ELECTRONIC CIRCUITS USING TRIZ MODEL

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Abstract. The Power Supply Trainer Electronic Circuits (PSTEC) was built using the SMT (Surface-Mount Technology). This trainer is an either one of the teaching aids for the laboratories, especially in the Electronic Circuits course. PSTEC was developed to solve the component management problem, whereas a lot of students who used the same components, which cause damages to the components when used repeatedly without proper handling. Thus, the resulting in inaccurate output produced, if used during the practical session. PSTEC objectives to Increase component management in the laboratories, saving time on constructing the circuit, and to get the accurate output. This trainer comes with three kits, namely Transformer Kit, Power Supply Kit, and Load Kit. The transformer kit uses a 240V AC power supply as an input. The Power Supply Kit is designed according to a block diagram for Linear DC Power Supply using some types of Rectifier, Filter, Voltage Regulator, and Voltage Divider Circuit. Meanwhile, the Load Kit is used as a load. All these circuits are combined on three kits and are labeled so that students can see the applications and differences found in each of these circuits. The PSTEC development process based on the TRIZ model designed by using Altium Designer Summer 09 software and ninety percent (90%) of the components used for this trainer is based on SMD (Surface-Mount Device). The component layout is user-friendly and clearly label to help students construct the circuits during the practical work. In conclusion, PSTEC is a simple trainer and has an easy circuit for student understanding. Its portable design, so that it can be used anywhere.

Keywords: Power Supply Trainer Electronic Circuits, Three Kit, TRIZ Model

1. INTRODUCTION

The Electronic Circuits course is a compulsory course for students during the 3rd semester of the Electrical Engineering Department in Polytechnics Malaysia. The electronic circuits course emphasizes the concept of electronic devices applications. This course covers the fundamentals of electronic circuit applications which include Linear DC Power Supply Unit, Oscillators, Operational Amplifiers, Timers, Filters, and AD/DA converters. The contents cover circuit configuration, operation, and application of the electronic circuits (Electrical Eng Curiculum Division, 2019).

Based on the findings of observations made in the Electronic Circuits course, information was obtained that the learning process applied by the lecturer was still not optimum. This can be seen when a practical work process takes place, the student still uses the breadboard to install the components separately as a learning medium which has constraints that is the practical work proses become less interesting. Student interest in learning can be seen when the teaching and learning process takes place, many students enter the room, play-playing while studying and takes a long time when using the media. This also results in the learning process becoming less than optimum. Besides the disadvantages of using this breadboard and components are sometimes when the circuits are tested, the circuit does not work. This is

because the cable is not tightly attached to each terminal or the student uses a damage component.

Based on the problems encountered, the researchers noticed the potential of trainers that could be used as the learning media. The Power Supply Trainer Electronic Circuits (PSTEC) was developed to solve the component management problem, whereas there are a lot of students who used the same components, which cause damages to the components when used repeatedly without proper handling. Therefore, resulting in inaccurate or incorrect output produced, if used during conducting the practical work session.

PSTEC was built using SMT (Surface-Mount Technology) is one of the teaching aids for the laboratories especially in the Electronic Circuits course. This trainer is expected to make easier for students to understand the lesson on Electronic Circuits course about measuring accurate output (current, voltage, and waveform), increase component management in the laboratories, saving time on constructing circuit and support students' practical work activities so that the teaching and learning process can be carried out more optimal. PSTEC also can be used in six (6) Practical Work in Electronic Circuits courses.

The PSTEC development process based on the TRIZ model designed by using Altium Designer Summer 09 software and ninety percent (90%) of the components used for this trainer is based on SMD (Surface-Mount Device). The Surface-Mount Technology (SMT) is a method in which the electrical components are mounted directly onto the surface of a printed circuit board (PCB). An electrical component mounted in this manner is referred to as a Surface-Mount Device (SMD). In industry, this approach has largely replaced the through-hole technology construction method of fit components, in large part because SMT allows for increased manufacturing automation. Both technologies can be used on the same board, with the through-hole technology often used for component not suitable for surface mounting such as large transformers and heatsinked power semiconductors. The SMT component is usually smaller than its through-hole counterpart because it has either smaller leads or no leads at all. It may have short pins or leads of various styles, flat contacts, a matrix of solder balls (BGAs), or terminations on the body of the component.

2. LITERATURE REVIEW

Learning is well-defined as an interactive process between lecturers and students that takes place dynamically. Learning as an alternative used for the old term learning process is not just changing terms, but also changing the role of the lecturer in the learning process. The lecturer does not only teach, but he also educates students to want to learn. Learning has the purpose of changing performance to achieve a certain outcome. Learning is not just giving material but can offer new experiences in the learning process that involves students actively. The new-found experience is in the form of direct experience and skill using props such as trainers(Aswardi et al., 2019).

The trainer is a set of actual components and tools or duplicates of the actual ones that can provide direct experience for students. Trainer means an object that can train, teach, and educate(Hamid et al., 2020). The learning media in the form of trainer kits can be used in the learning process to increase desire and interest in learning, arouse motivation, and stimulation of learning activities, and even influence towards students' psychology (Fivia Eliza & Dwoprima Elvanny Myori, 2017).

The idea of using trainers in practical work sessions is to make it easier for students in the learning process and can achieve Course Learning Outcomes (CLO). The role of this trainer as a learning media has a significant impact on students, creating students active and creative in the learning process.
A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert an electric current from a source to the

correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. The block diagram power supply consists of a transformer, rectifier, filter, a voltage regulator, and voltage divider circuit. The function of this block diagram is to convert Alternating Current, AC input voltage to Direct Current, DC output voltage. The transformer receives a supply of AC 240V, 50Hz, and steps down this voltage to the required value. AC voltage from the transformer is fed to the rectifier, a diode circuit converts AC voltage to a pulsating DC voltage. The pulsating DC voltage is fed to the filter to reduce the ripple in it. Normally, a filter consists of passive components such as resistors, capacitors, and inductors. The next stage is the voltage regulator that produces a stable Direct Current, DC. The final stage is a voltage divider that divides the voltage following the circuit necessity. Figure 1 shows a block diagram of a DC power supply (Malvino & Bates, 2016).

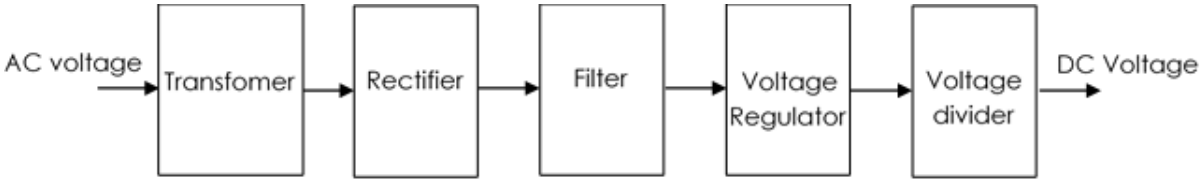


Figure 1: Block Diagram of Linear DC Power Supply

3. METHODOLOGY

The development of a Power Supply Trainer Electronic Circuits process is based on the TRIZ model. TRIZ is a systematic innovation methodology. It is a Russian acronym for "Teoriya Resheniya Izobreatatelskikh Zadatch", equivalent to "Theory of Inventive Problem Solving" in English. TRIZ methodology was founded in 1946 by the Soviet inventor and science-fiction author Genrich Altshuller and his colleagues. TRIZ includes a practical methodology, tool sets, a knowledge base, and model-based technology for generating innovative solutions for problem-solving. It is useful for problem formulation, system analysis, failure analysis, and patterns of system evolution. TRIZ uses 40 inventive principles and 39 parameters to derive many feasible solutions (Altshuller, 1999). The methodology for this project is divided into two parts which are Project Development and Data Collection methods.

3.1 Project Development

First and foremost, research and brainstorming help to identify the original problem to resolve. To get a comparison with the conventional method, which is using breadboard and components, the interview instrument was used to get feedback from the lecturer. Three respondents were answered a few questions via the interview to get a problem that happens when using the conventional method.

Based on the interview instrument, some problem usually happens when using this breadboard and components are sometimes when the circuits are tested, the circuit does not work because of the cable is not tightly attached to each terminal or student uses damage component. Students also take a long time to construct and complete a circuit.

To obtain information on the cause of problems, the interview instrument is referred to as a respondent to identify the weaknesses of existing products based on TRIZ parameters appropriate to engineering specifications. All problems will be analyzed using 39 inventive parameters with 40 inventive principles. Table 1 shows off an Identify inventive principles from existing methods (Norazlinda et al., 2020).

Table 1: Identify Inventive Principle from Existing Methods

No Parameter	System Parameter	Good system parameter	inventive principle
2	Weight of Stationary Object	Shape	15,10,26,3
25	Loss of Time	Ease of Operation	4,28,10,34
37	The difficulty of Detecting and Measuring	Measurement Accuracy	26,24,32,28
34	Ease of Repair	Ease of Operation	1,12,26,32

Once the parameters are detected, the idea of contradiction is identified according to the suitability than the selection process according to the inventive principle is obtained then the problem solution is obtained. Table 2 shows up TRIZ problem-solving suggestion.

Table 2: TRIZ Problem-Solving Suggestions

Number	Inventive Principle	Solution Suggestion
1	Segmentation	Create an object easy to disassemble
4	Asymmetry	Change the shape of an object by increasing the level of asymmetry.
15	Dynamics	Make it an object movable or adaptive
24	Intermediary	Combine one object temporarily with another (which can be easily removed).

As a result of the comparison with the conventional method, the proposed solution is as in Table 2. The idea to develop Power Supply Trainer Electronic Circuits (PSTEC) is sketched as Figure 2.

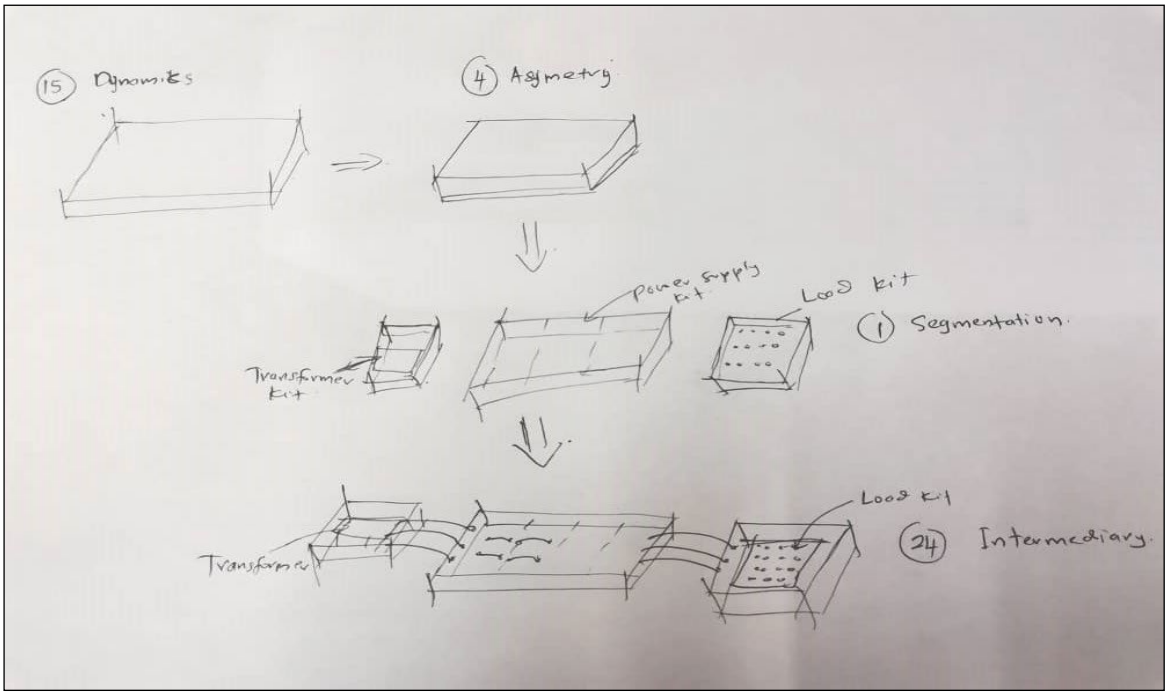


Figure 2: The Design Idea of Power Supply Trainer Electronic Circuits (PSTEC)

The circuit design phase comes with three kits, namely Transformer Kit, Power Supply Kit, and Load Kit. The PSTEC model was designed by using Altium Designer Summer 09 software and components used for this trainer are based on SMD (Surface-Mount Device).

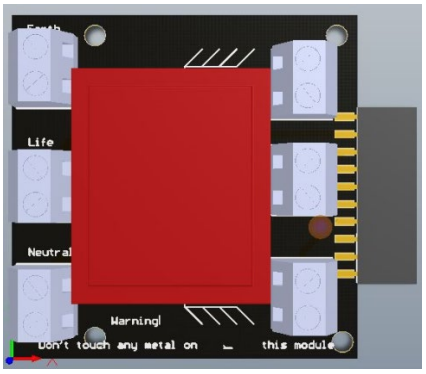


Figure 3: Transformer Kit

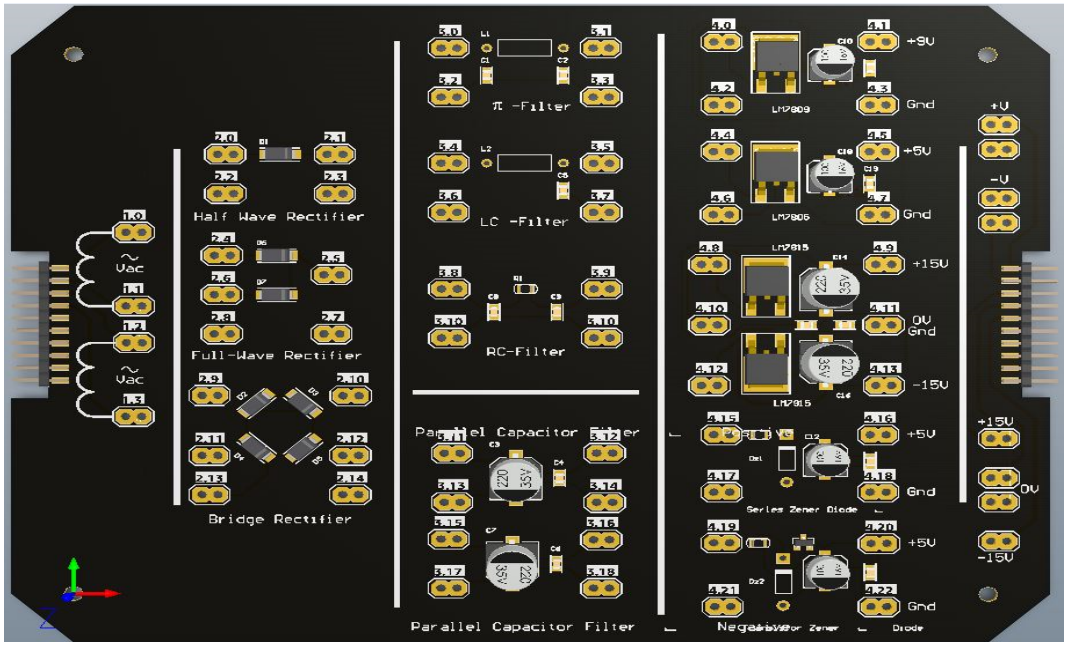


Figure 4: Power Supply Kit

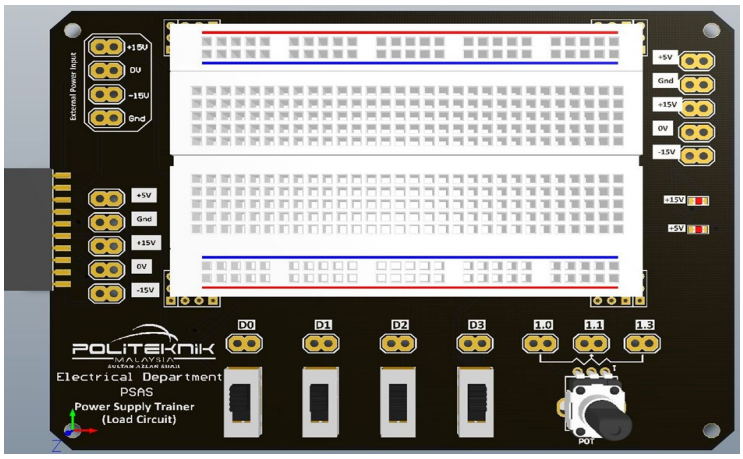


Figure 5: Load Kit

The design phase was considering the arrangement of the circuit, so that six (6) experiment or practical works can be used at Power Supply Trainer Electronic Circuits. The first part which is the Transformer Kit as shown in Figure 3 uses a 240V AC power supply as an input. The second part which is Power Supply Kit as shown in Figure 4 is designed to produce DC Power

supply by using some types of Rectifier, Filter, Voltage Regulator, and Voltage Divider Circuit. Meanwhile, the third part is the Load Kit as shown in Figure 5 stands used as a load or create another circuit. All these circuits are combined on three kits and are labeled so that students can see the applications and differences found in each of these circuits. The component layout is user-friendly to help students constructing a circuit during the practical work.

3.2 Data Collection Methods

Data collection has been conducted using a survey question QR code that is generated from google form. The questionnaire aims to determine the effectiveness of the use and development of "Power Supply Trainer Electronic Circuits". The survey contains twenty (20) questions and divides into four (4) sections, which are Demographic Information, Use of the Conventional Practical Equipment aspect, Use of Power Supply Trainer Electronic circuit aspect, and Design of Power Supply Trainer Electronic Circuits. Thirty-eight (38) respondents are students from the Diploma of Electronic (Computer) Engineering who took the DEE30043: Electronic Circuits course. Each respondent has been given a chance to use the PSTEC for all practical work before they answered the survey questions.

4. ANALYSIS AND RESULTS

Data analysis study is carried out using descriptive statistics using Statistical Package for Social Science (SPSS version20). Where review studies included in a study classified is one of the types of research is descriptive research. Frequency and percentage are used to explain the data distribution and to answer the questions of the study conducted (Mohd. Majid Konting, 2005).

While underperformance means score for this review uses source from Dr. Jamil Ahmad (2002), instilling a research culture among schoolteachers, an assessment of theses. An improved mean-score scale as shown in table 3 below.

Table 3: Interpretation of Mean-Score

Mean-Score	Mean-Score Interpretation	
1.00 until 2.33	LOW	(Less Agree / less assisted / less skilled /less Meeting / uncertain / sometimes / none / part Small
2.34 until 3.66	MEDIUM	(Agree/assist/skilled/fulfillment/half)
3.67 until 5.00	HIGH	(Very agree / very helpful / very skilled / very Meeting / very always / all / most

According to (Keith S. Taber, 2018), The minimum value of Cronbach's Alpha reliability is 0.70 as a sufficient measure of reliability or internal consistency of an instrument. Cronbach's Alpha for usability and user satisfaction was .721, indicating that overall, the scales had acceptable reliability as shown in Table 4.

Table 4: Reliability Statistics

Cronbach's Alpha	N of Items
.721	23

The results of this instrument are in form quantitative data analyzed in table and chart forms. The data is in frequency and percentage values. The instrument covers four main divisions:

Part A: Demographic information of the respondent
Part B: Use of Conventional Practical Equipment
Part C: Use of Power Supply Trainer Electronic Circuits
Part D: Design of Power Supply Trainer Electronic Circuits

Subsequently, researchers present the findings of the study by formulating data and Information obtained from a study conducted.

The sample used in this instrument is about Thirty-eight (38) students Diploma in Electronic (Computer) Engineering Jun 2019 session from the Department of Electrical Engineering, Polytechnic of Sultan Azlan Shah. In this section, Researchers collect information concerning sample backgrounds that are programs, semesters, and gender. Table 5 below displays a sample amount of distribution used in the questionnaire survey.

Table 5: Demographic information

Program	Male		Female		Total sample
	Number	Percentage	Number	Percentage	
DTK	31	81.6	7	18.4	38

Table 6 shows the results that the mean score value of seven (7) items are at a moderate level range from 3.21 to 3.45. Analysis results indicate that a student satisfaction level in the use of conventional practical equipment is at a moderate level with an average mean score obtained is 3.36.

Table 6: Use of Conventional Practical Equipment

No. Item	Item	Mean	Standard Deviation
B1	The learning and teaching process using conventional practical can attract my interest in more detail.	3.42	1.222
B2	The use of conventional practical equipment greatly helps my understanding relating to the theories learned.	3.45	1.108
B3	Construct circuit using conventional practical equipment able to expedite the overall process of convert alternating current to direct current.	3.21	1.094
B4	The use of conventional practical equipment saves time during the circuit connection process.	3.34	1.236
B5	Practical work in the laboratory can be done easier and faster than using a trainer.	3.26	1.267
B6	I like to follow practical work in the DEE30043 course if the lecturer uses conventional practical equipment.	3.45	1.201
B7	I agree with choosing to use the conventional practical for DEE30043 Electronic Circuits practical work.	3.45	1.032
	TOTAL	3.36	1.16

Table 7 below shows the results that the mean score value of seven (7) items is at a high-level range from 4.32 to 4.47. Analysis results indicate that a student satisfaction level in the use of Power Supply Trainer Electronic Circuits is at a high level with an average mean score obtained is 4.41.

Table 7: Use of Power Supply Trainer Electronic Circuits

No. Item	Item	Mean	Standard Deviation
C1	The learning and teaching process of using the Trainer can attract my interest in more detail.	4.32	0.702
C2	The use of Trainer greatly helps my understanding relating to the theories learned.	4.39	0.755
C3	Construct circuit using Trainer able to expedite the overall process of convert alternating current to direct current.	4.42	0.826
C4	The use of Trainer saves time during the circuit connection process.	4.47	0.762

C5	Practical work in the laboratory can be done easier and faster than using a conventional practice.	4.34	0.745
C6	I like to follow practical work in the DEE30043 course if the lecturer uses Trainer.	4.42	0.683
C7	I agree with choosing to use the Power Supply Trainer Electronic Circuits for DEE30043 Electronic Circuits practical work.	4.45	0.760
	TOTAL	4.41	0.747

Table 8 shows the results of the analysis for the electronic power supply trainer design. The data show the mean value of the results. The overall min value indicates that the value is at the highest level of mean score interpretation which is 4.41.

Table 8: Design of Power Supply Trainer Electronic Circuits

No. Item	Item	Mean	Standard Deviation
D1	The Trainer design for the Power Supply Kit is simple, easy to use and has equations with a direct power supply block diagram.	4.45	0.645
D2	The design of the Trainer is easily understood as all circuits have been combined on a trainer and labeled.	4.42	0.642
D3	These Trainer designs make it easy for the students to make a circuit connection using a jumper.	4.45	0.686
D4	The use of a connector and test point pin facilitates students to connect and get release displays.	4.37	0.675
D5	The use of Electronic Supply Trainer Circuits can save time during the circuit connection process and can be done over time.	4.37	0.589
D6	The overall design of the Trainer for the Power Supply Kit can depict the actual process of power supply conversion to the current power supply.	4.39	0.679
	TOTAL	4.41	0.652

From this data analysis, It can be concluded that students agree to the implementation of the use of Power Supply Trainer Electronic Circuit can attract students to learn more deeply. The overall design of the Power Supply Trainer can also describe the whole process of convert alternating current to direct current and is easy to understand.

Figure 6 shows a three (3) kits of Power Supply Trainer Electronic Circuits that connected with the male-female header pin connector. The transformer kit as an input used a switch ON/OFF was designed with a cover for the safety. In Power Supply Trainer Kit, there are several types circuit of Rectifier (Half-Wave, Full-Wave & Bridge), Filter types (π *filter*, LC Filter, RC Filter & Parallel Capacitor Filter), Voltage Regulator (Serial Transistor, Zener Diode & *Integrated Circuits*) and Voltage Divider Circuit (*Fix & Variable)*. The transformer input also can be used as a center tap transformer for a full-wave rectifier. The integrated circuit voltage regulator can be used either LM7805, LM7809, LM7815, and LM7915. All this circuit was labeled and equipped with a female connector and it easy for the student to construct the circuit connection using a jumper.



Figure 6: Power Supply Trainer Electronic Circuits

This trainer is packaged in the form of a rectangle with a rubber stopper to provide stability and avoid movement. At the load kit, there is a mini slide switch, breadboard size 56mm x 83mm x 8mm, and a potential resistor that can be used to complete the circuit for practical work 2 until practical work 6. Towards make it easier for a student, this trainer comes with lab sheet 1until lab sheet 6. Students only need to scan a barcode to access this lab sheet.

6. CONCLUSION

TRIZ is an appropriate method of providing ideas and problem-solving suggestions for new product development. Following the development of ideas should follow the measures that are identified such as identifying parameters, conflict Matrix, and each inventive principle should be evaluated which will be developed. Based on the analysis and result of the development Power Supply Trainer Electronic Circuits, it can be concluded that this trainer is made easier for students to understand the lesson on the Electronic Circuits course about construct the circuit and measuring accurate output (current, voltage and waveform), increase component management in the laboratory, saving time on constructing circuit and support students' practical work activities.

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BIOREMEDIATION OF WATER IN DETENTION POND USING *LIMNOCHARIS FLAVA*

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Abstract. Clean water resources are increasingly affected as the world progresses. Detention pond water bioremediation helps to maintain clean water for the environment. Detention ponds are useful in collecting stormwater and domestic greywater. Limnocharis flava or commonly known as keladi senduk is a kind of aquatic plant which are able to absorb water contaminants, as well as lowering it. This plant is native to Malaysia. In addition to the ability of absorption, this plant also offers an aesthetic value. The ability of bioremediation of grey water by this plant is discussed in this paper in brief. Water samples were planted with this plant and monitored for nine days for five water quality parameters which are dissolved oxygen(DO), total suspended solid(TSS), chemical oxygen demand(COD), turbidity and pH. Through the analysis done, the sample with planted limnocharis flava shows better quality in DO, COD and pH. Not much change occurs in TSS and turbidity monitorization.

Kata Kunci: Bioremeditation, grey water, Limnocharis flava

1. INTRODUCTION

Surface runoff from streets and parking areas brings oil, dirt and pollutants. Every premise normally equipped with stormwater runoff treatment in order to protect surface water from pollution (Shantanu Bhattacharya, 2018). Detention pond is a common stormwater treatment system and also used to help prevent flooding. In detention pond, water is treated through sedimentation and nutrient adsorption.

Limnocharis flava is an aquatic flowering, which may grow in southern and southeastern Asia. This plant is a known vegetable in Malaysia. *Limnocharis flava* has the ability of absorbing heavy metals as well as pollutant (Rachmadiarti A et al., 2012). Planting plants in detention pond in order to sustain the quality of water in it is known as bioremediation of water.
Water quality in surrounding water bodies are improved through nutrient absorption by such type of plant and this will lessen the transfer of pollutants and chemicals into nearby water bodies. Water retained in detention ponds also can be used for irrigation. Placing of plant such as *limnocharis flava* may enhance aesthetics.

Politeknik Sultan Idris Shah equipped with a detention pond as a stormwater treatment system. The detention pond also collects water from drain from cafeteria, hostels and colleges. Since ever, water collected there has become sample for laboratories test and also student's outdoors activities such as canoeing. Laboratories tests normally recorded values of COD at average 100 -150 mg/l and TSS within the range of 0.01 - 0.02 mg/L. The detention ponds water is turbid and the water is slightly alkaline. These findings show that the quality of water needs to be improved because the pond not only acts as a detention pond but at the same time, it become a place for outdoors activities and also maintain the landscape of the polytechnic.

2. LITERATURE REVIEW

The rapid development of the world is causing water pollution to increase. This makes it important to manage water quality by maintaining a level of safety so that water is not wasted (Bhattacharya S. et al., 2018). The need to reduce the pollution by discharge of untreated greywater into freshwater resources has become crucial in order to cope with the future challenges of water scarcity (Oteng-Peprah, 2018). Stormwater runoff overrun sewers and could erode streams and rivers. Detention pond has been identified as a method to overcome this problem (Pettersson, 1998. They are meant to collect the water, and release it at a rate to prevent flooding or erosion.

Limnocharis flava is a plant that has the ability of absorbing heavy metals and pollutant (Rachmadiarti A et al., 2012). *Limnocharis flava* inhabit wetter tropical environments. It can grow well either in freshwater bodies or slow moving waterways such as detention pond. The plant presence is pervasive (Marrugo-Negrete et al., 2017).

Most important source of oxygen comes from the process of photosynthesis by the aquatic plants (P. A. Araoye, 2009). Water quality can be improved through the presence of dissolved oxygen (Kulkarni, 2016). As dissolved oxygen increase, this reflects that the water is fresh.
Total suspended solid, turbidity, pH, and COD are common parameters of water quality to be monitored to compromise the cleanliness of water.

3. METHODOLOGY

To study the ability of limnocharis flava in bioremediation, water sample has been collected from the PSIS detention pond. The samples were separated into two plastic containers. The first container will be planted with *limnocharis flava*, while the second container will be taken as controlled sample. The plants were grown over 9 days. Both containers were fixed with a pipe that has a filter and solid may be separated easily through the filter. Water qualities were monitored towards remedied water which is taken from outlet pipe installed at the tank. The parameters monitored were dissolved oxygen (DO), total suspended solid (TSS), chemical oxygen demand (COD), turbidity and pH.

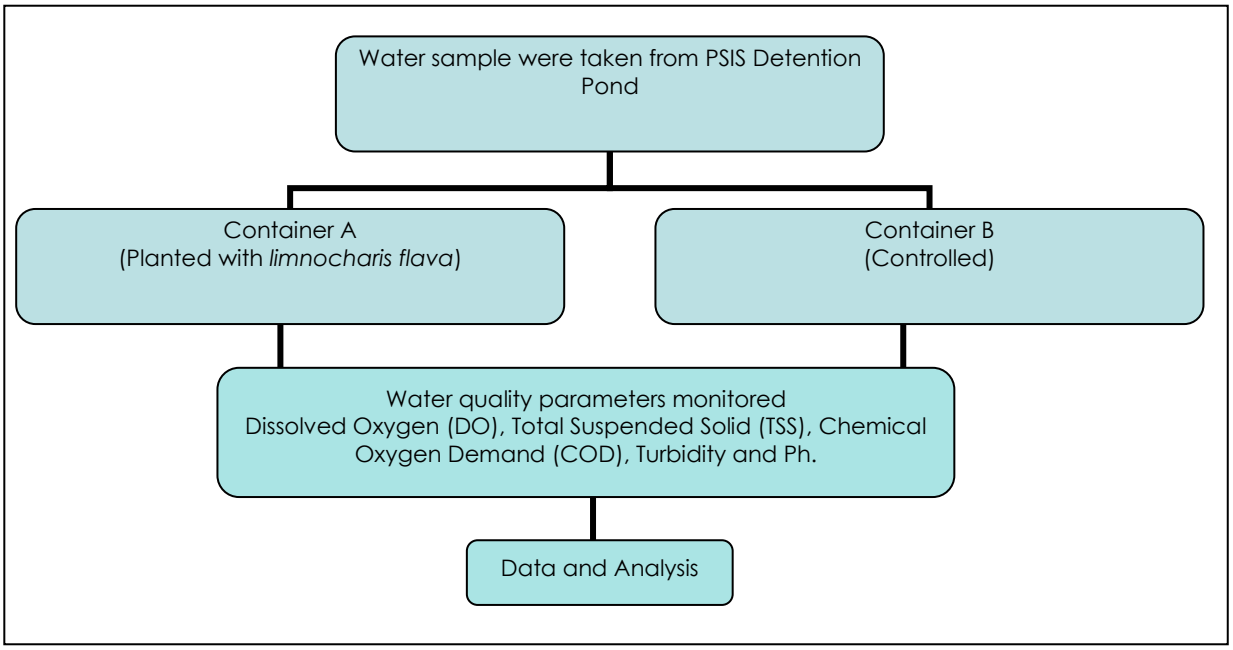


Figure 3.1: Methodology of Research

4. RESULTS AND DISCUSSIONS

The water qualities monitored are presented as in Table 4.1. At 9 days' observation there was slight difference in the reading of dissolved oxygen(DO), total suspended solid(TSS), chemical oxygen demand(COD), turbidity and pH between sample A and sample B. Sample A was Bioremediated using *limnocharis flava* while sample B remain as control.

Table 4.1: COD, Turbidity, TSS, pH and DO Reading in Water Sample.

Observation Day	DO (mg/L)		COD (mg/L)		Turbidity (mg/L)		TSS (mg/L)		pH	
	SAMPLE A	SAMPLE B	SAMPLE A	SAMPLE B	SAMPLE A	SAMPLE B	SAMPLE A	SAMPLE B	SAMPLE A	SAMPLE B
0	11.19	8.28	138	144	166	238	0.111	0.0995	8.17	7.71
1	4.73	6.42	133	138	93.53	77.6	0.0505	0.0975	7.02	7.07
2	5.7	4.54	129	132	71.63	72	0.0385	0.0365	6.8	7
5	9.67	8.13	124	129	24.9	48.37	0.0145	0.0275	6.64	6.97
7	6.11	5.45	119	122	20.57	38.83	0.0135	0.0205	7.03	7.2
9	3.95	5.2	98	113	19.17	25.1	0.0035	0.0165	7.04	7.19

4.1 Dissolved Oxygen

The amount of dissolved oxygen in sample A was 11.19 mg/L at day 0 and at day 9, the amount become 3.95 mg/L. 7.24 mg/l DO had loss from sample A. In sample B the difference of DO amount from day 0 to day 9 is about 3.08 mg/L. Sample A was prepared with plant and the amount of dissolved oxygen could maintain even with losses for nine days. This is because plant release oxygen during respiration. Sample B, without the presence of the plant accumulate less amount of dissolved oxygen.

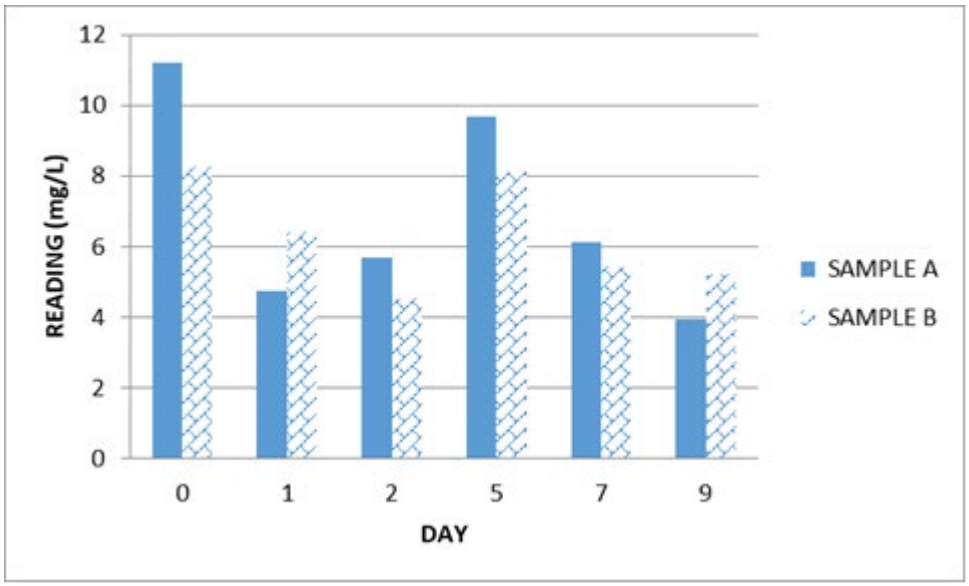


Figure 4.1: Dissolved Oxygen Reading in Water Sample

4.2 Chemical Oxygen Demand (COD)

The reading of COD in sample A was 138 mg/L at day 0 and at day 9, the amount become 98 mg/L. 40 mg/l COD had loss from the sample. In sample B the difference of COD amount from day 0 to day 9 is about 31 mg/l.

COD measures oxygen requirement of a sample that is prone to oxidation using strong chemical oxidation. It can be used to determine the amount of organic pollutants in water. From Figure 4.3, the removal efficiency of COD in planted systems is higher than that in the control systems. The COD reduction achieved is 28.9% in 9 days of experiment in planted sample while in controlled system, the p COD reduction achieved is 21.5%. This shows that the planted system is more efficient as compared to the control system.

$$\text{Percentage of COD} = (COD_{(0)} - COD_{(t)}) / COD_{(0)} \quad \text{(Nwaigwe, 2015)}$$

Where $COD_{(0)}$ is the initial COD or the COD at t = 0, its numerical value is = 138 mg/l; while $COD_{(t)}$ = the COD at any time t.

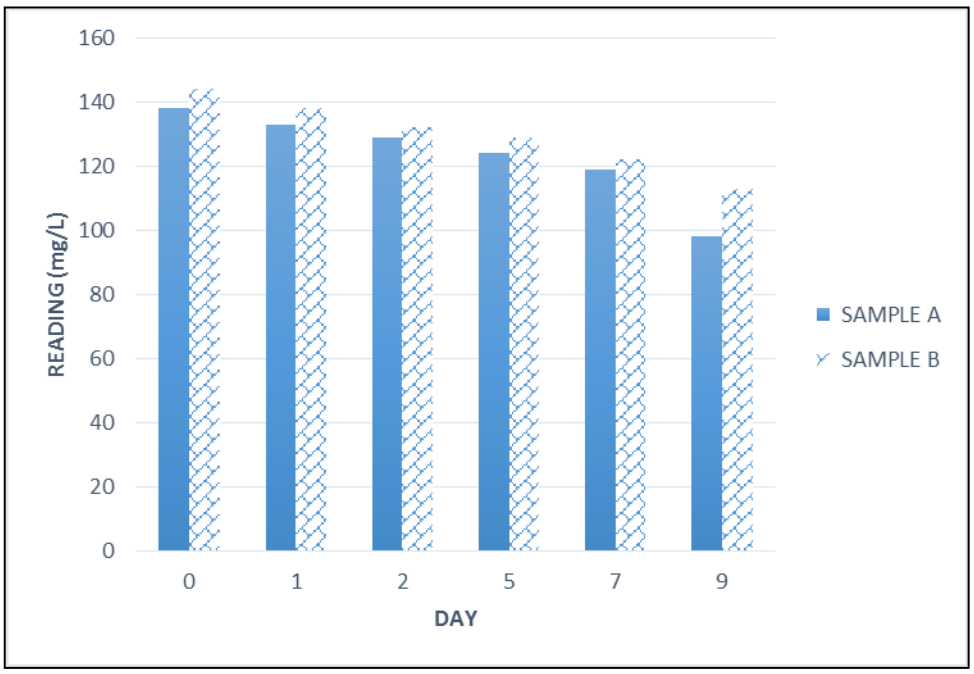


Figure 4.3: Chemical Oxygen Demand Reading in Water Sample

4.3 Turbidity

The reading of turbidity in sample A was 166 NTU at day 0 and at day 9, the amount become 19.17 NTU. 146.83 NTU turbidity had loss from the sample.

Turbidity could come from floating algae or soil eroded from the banks into the water. Since both causes of turbidity in PSIS detention pond are good for aquatic plants life, they are consumed by the plant and this will reduce the turbidity level. Even though, the planted systems could contain some soil particles from the plants root.

In sample B the turbidity amount from day 0 to day 9 had decreased about 202.9NTU. The reading was better due to sedimentation of all particles to the bottom of tank without influence of plants root.

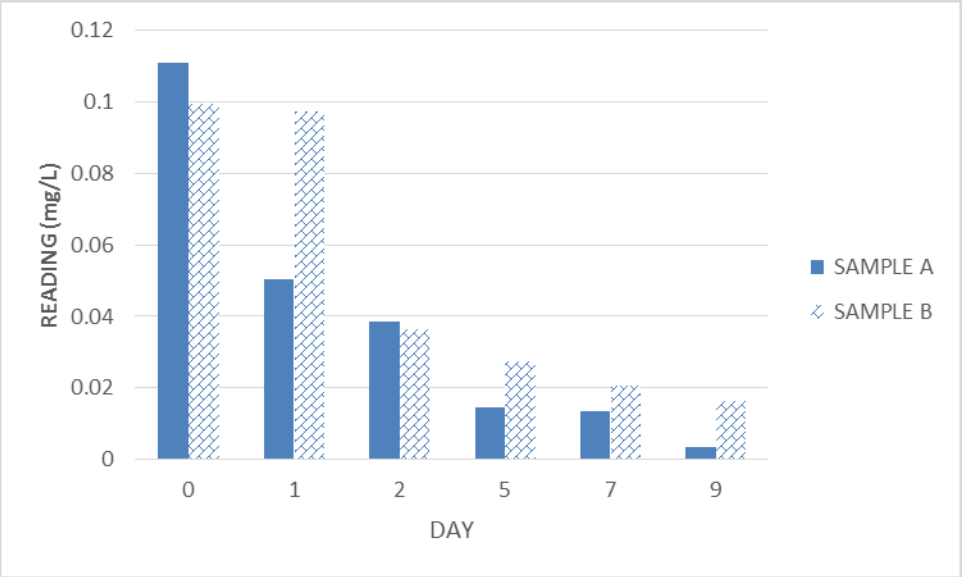


Figure 4.4: Turbidity Reading in Water Sample

4.4 Total Suspended Solid

The amount of TSS in sample A was 0.111mg/L at day 0 and at day 9, the amount become 0.0035 mg/L. 0.1075 mg/l TSS had loss from the sample. In sample B the difference of TSS amount from day 0 to day 9 is about 0.083 mg/L. From the analysis, the planted system remained 0.0245 mg/l TSS as compared to the controlled system.

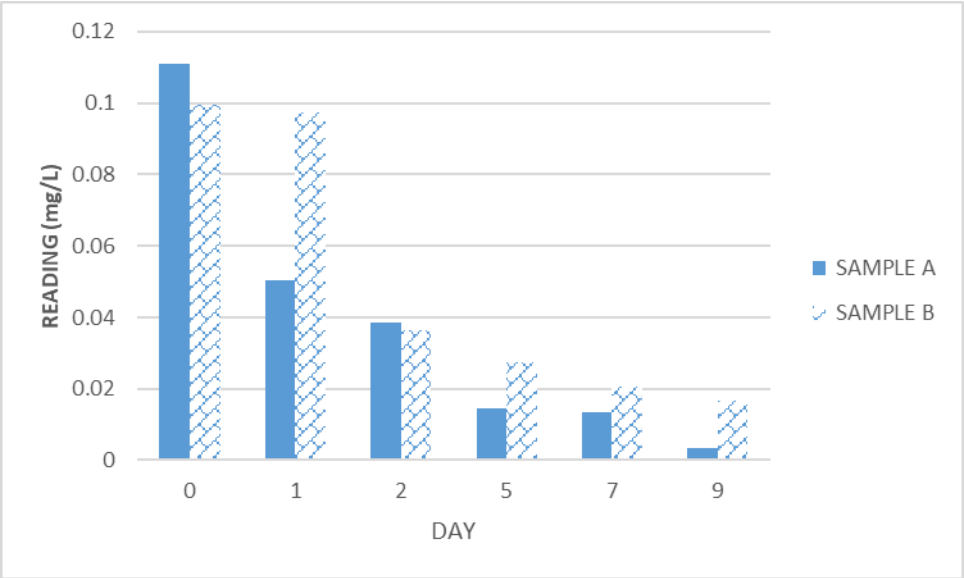


Figure 4.2: Total Suspended Solid Reading in Water Sample

4.5 pH

The pH reading of both samples was between the desirable ranges for fish reproduction. pH value within the range of 6.5 to 9.0 are suitable for fish reproduction (National Water Quality Standards For Malaysia). The values of pH obtained from the samples are between 6.64 to 8.17 and this condition is good for aquatic ecosystems.

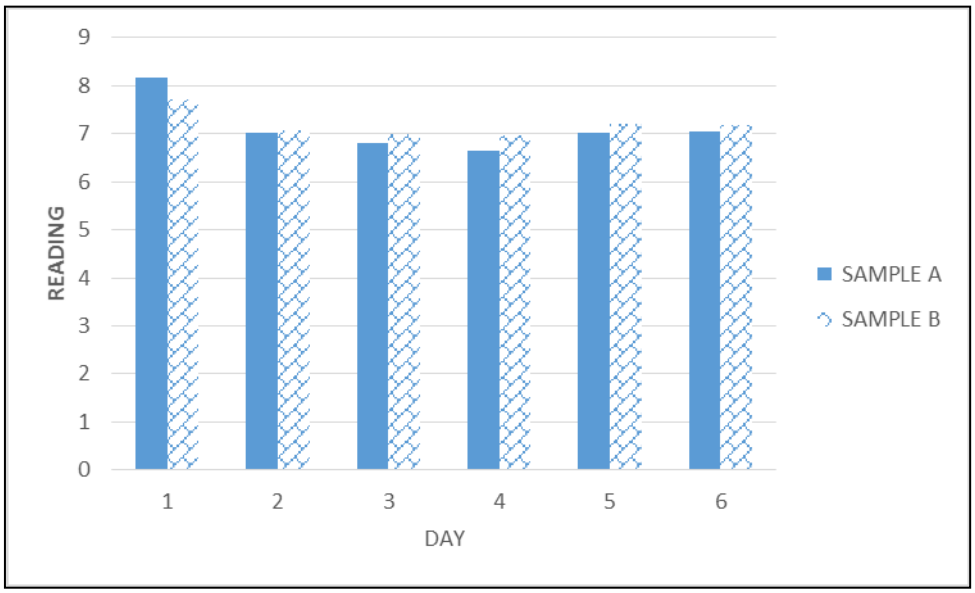


Figure 4.5: pH Reading in Water Sample

5. CONCLUSION

Limnocharis flava is a special plant and inhabit wetter tropical environments. It can grow well either in freshwater bodies or slow moving waterways such as detention pond. It has a potential of remediating water in terms of dissolved oxygen (DO), chemical oxygen demand (COD), and pH. However, the plant did not have much ability in decreasing TSS and turbidity. There will be great opportunities for research in other plants to improve the ability of *limnocharis flava* to deal with TSS and turbidity. For improvements and further study, it is recommended to do research towards this plant in actual conditions.

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THE POTENTIAL OF METAKAOLIN AS PARTIAL SOIL REPLACEMENT IN INTERLOCKING BRICK

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Abstract. Nowadays, brick has become a popular issue in most countries as one of the other alternatives to conventional brick for sustainable housing. It is a challenge for researchers to produce interlocking bricks that are not only light but low cost and able to improve their performance against aggressive environment. Therefore, in this study, metakaolin will be used as partial soil replacement in interlocking brick. The percentage of metakaolin used in this study are 25%, 50% and 75%. The main objectives of this study are to determine the compressive strength and water absorption of interlocking brick by using metakaolin as partial soil replacement as well as to make comparison between minimum requirement of ASTM Standard. There are two tests that has been carried out in this study which are compressive strength test and water absorption test. Compressive strength test is to discover the maximum capacity of the material to withstand loads or force or mass while water absorption test is to determine the percentage of water absorption of bricks. As a result, the compressive strength for 28 days shows that the highest value is 8.31 N/mm^2 for percentage of 75% of matakaolin followed by 6.40 N/mm^2 for percentage of 50% of metakaolin and 5.80 N/mm^2 for percentage of 25% of metakaolin. Therefore, the compressive strength is achieved the minimum requirement for ASTM C129 standard which is 2.5 N/mm^2 for all sample tested. Besides, the results of the study also show that when the percentage of metakaolin increases then its compressive strength also increases. This study also shows that the highest average of water absorption is 8.18% for 75% of metakaolin followed by 5.97% of 25% of metakaolin and 5.96% of 50% of metakaolin. Based on ASTM C62 Standard for water absorption the maximum requirement is 8%. Thus, the water absorption for 25% and 50% of metakaolin in interlocking bricks are achievable except for 75% of metakaolin that exceeded the maximum requirement of the standard. The result also indicate that water absorption will increase if percentage of metakaolin increases. As a conclusion, the metakaolin is suitable to be used as a partial soil replacement of interlocking bricks in construction or structural application with a percentage of 50% and below of metakaolin.

Keywords: Interlocking brick, metakaolin

1. INTRODUCTION

Today, the use of interlocking bricks is not widely used in Malaysia due to the absence of specific standards for this system. In the meantime, this system is seen as still lacking in terms of studies conducted on its production and installation for local needs. Therefore, it is necessary to expedite efforts towards determining the effectiveness of construction using this brick interlocking system. However, in foreign countries interlocking bricks has become a popular phenomenon as an alternative brick compared to conventional brick and this scenario is clearly a challenge for researchers to produce lightweight, low cost and have good performance interlocking brick in aggressive environment. (Watile, Deshmukh & Muley, 2014). Soil is one of the materials used in interlocking brick other than primary materials used for construction of traditional low-cost dwellings and is well suited to local weather conditions

and occupancy patterns. Soil construction methods are used in 80% of urban buildings in Sudan while this figure exceeds 90% in rural areas. Buildings are constructed entirely, or partially of soil, depending on location, climate, available skills, cost, building use and local tradition (Adam and Agib, 2001). Normally, different colours of laterite soil indicate the different chemical compound in the soil which will affect the strength of the laterite soil. However, laterite soil is low in strength (Salman, Al-Qinna and Al Kuisi, 2014).

Therefore, metakaolin which is a supplementary cementing material which is produced from carefully calcining kaolin clay between 600°C and 800°C to make it reactive can be used as partial soil replacement in interlocking brick. In addition, it is known that metakaolin which is generally in the form of $Al_2O_3SiO_2$ consists of its main content of alumina and silica phases with a percentage of about 10% and 8% respectively depending on the source of kaolin. Therefore, when it is blended and mixed with Portland cement in the appropriate amount, which is below 10%, it is not only increasing its strength but also its durability of the concrete (Srinivasu, Sai and Venkata, 2014). In addition, according to Ahmed, Khalil and Frayyeh (2019) also stated that the problem nowadays which is related to sustainability and ecological has attracted more attention from people around the world. It is obviously seen that the construction sector had affected the global warming, natural resources depletion and environmental pollution. Thus, the main objective of this study are to determine the compressive strength and water absorption of interlocking brick by using metakaolin as partial soil replacement as well as to make comparison between minimum requirement of ASTM Standard. This study is significance to solve the problem of sustainability and ecological as well as to improve the compressive strength and water absorption of interlocking brick.

2. LITERATURE REVIEW

Nowadays, brick manufacturing is an important part of the construction industry. However, it contributes to environmental degradation especially in extraction of earth soil. Therefore, many modifications have been made in the composition of the mixture for brick making and to improve the performance against aggressive environment (Tonduba, Mirasa & Asrah, 2019).

Therefore, metakaolin can be used as partial replacement for soil in interlocking brick as it has many advantages as stated by Siddique and Klaus (2008). Among the advantages are as follows:

a) Compressive and flexural strengths can be increased.
b) Permeability can be reduced.
c) Resistance can be increased to chemical attack.
d) Durability can be increased.
e) Effects of alkali-silica reactivity (ASR) can be reduced.
f) Shrinkage due to particle packing, making concrete denser can be reduced.
g) Workability and finishing of concrete can be enhanced.
h) Potential for efflorescence can be reduced.
i) Finish ability, color & appearance can be improved.

According to Patil, Gupta and Deshpande (2013), to increase the high strength concrete, Silica Fume or Micro Silica is used. Therefore, when metakaolin is used as replacement, it produces concrete with equivalent strength as well as developed durability properties along with several additional features such as reduced water permeability, workability and pumpability.

Furthermore, (Srinivasu et al., 2014) concluded that the high interest can be seen in the use of metakaolin in cement mortar and concrete where metakaolin is used in concrete is of 25% in replacement of cement and gave good strength results as well as durability improvement. It is also improve water permeability and absorption which leads to increase in density of concrete.

Besides, the findings of previous studies also found that concrete attains its maximum compressive strength for both M20 and M40 grade concretes when the replacement of cement with metakaolin exceeds 20% and the compressive is found to be decreasing slightly. Despite of that, it is found that 10% replacement of metakaolin is greater than the 30% replacement of metakaolin. This situation can be shown more clearly through the following graph (Sowmya & Kumar, 2015).

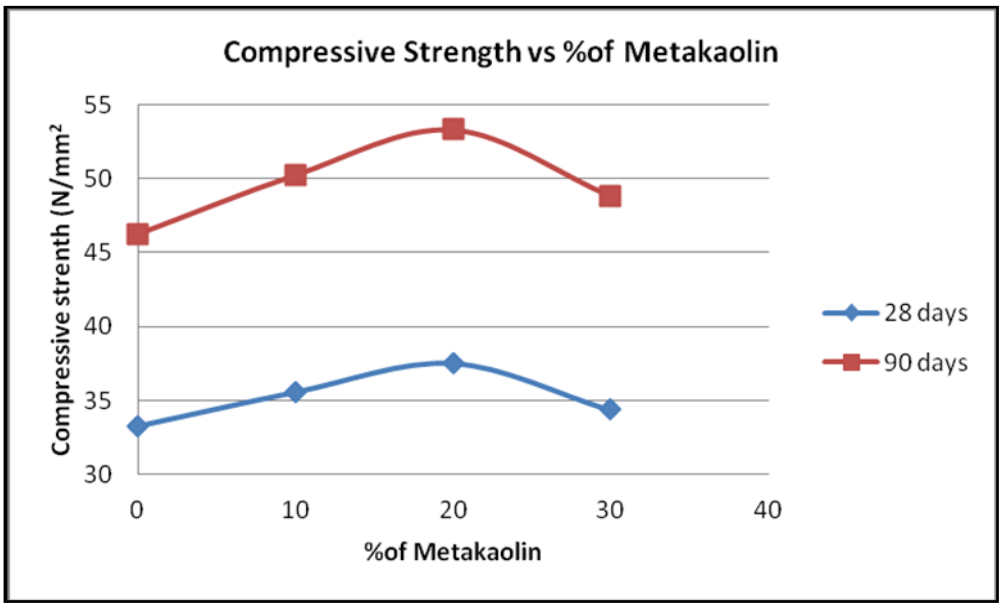


Figure 1: Graph between Compressive Strength of concrete for M20 VS % of metakaolin

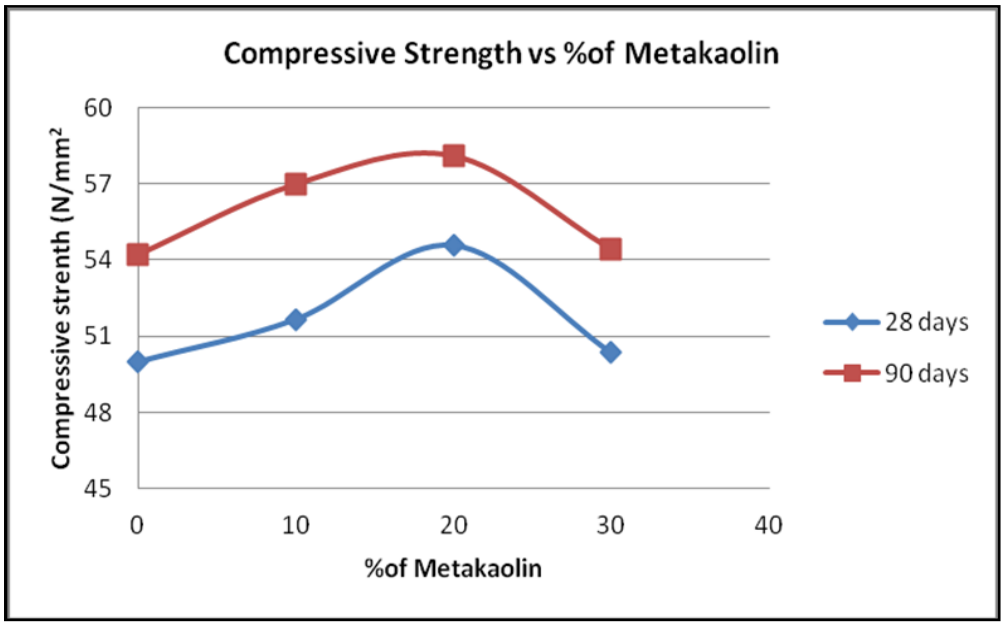


Figure 2: Graph between Compressive Strength of concrete for M40 VS % of metakaolin

3. RESEARCH METHODOLOGY

Metakaolin is used as partial soil replacement to produce interlocking bricks. The percentage of metakaolin that will be used is 25%, 50% and 75%. The total samples of interlocking bricks that will be produced are 48 samples and the mix ratio for this study is 1:4:8. The apparatus that need to be used to produce the interlocking brick is brick compress machine. Besides, there are two types of testing that has been done to determine the effectiveness of interlocking brick which is compressive strength test and water absorption test. Compressive strength test is to discover the maximum capacity of the material to withstand loads or force or mass while water absorption test is to determine the percentage of water absorption of bricks. The methodology flow chart is shown as follows.

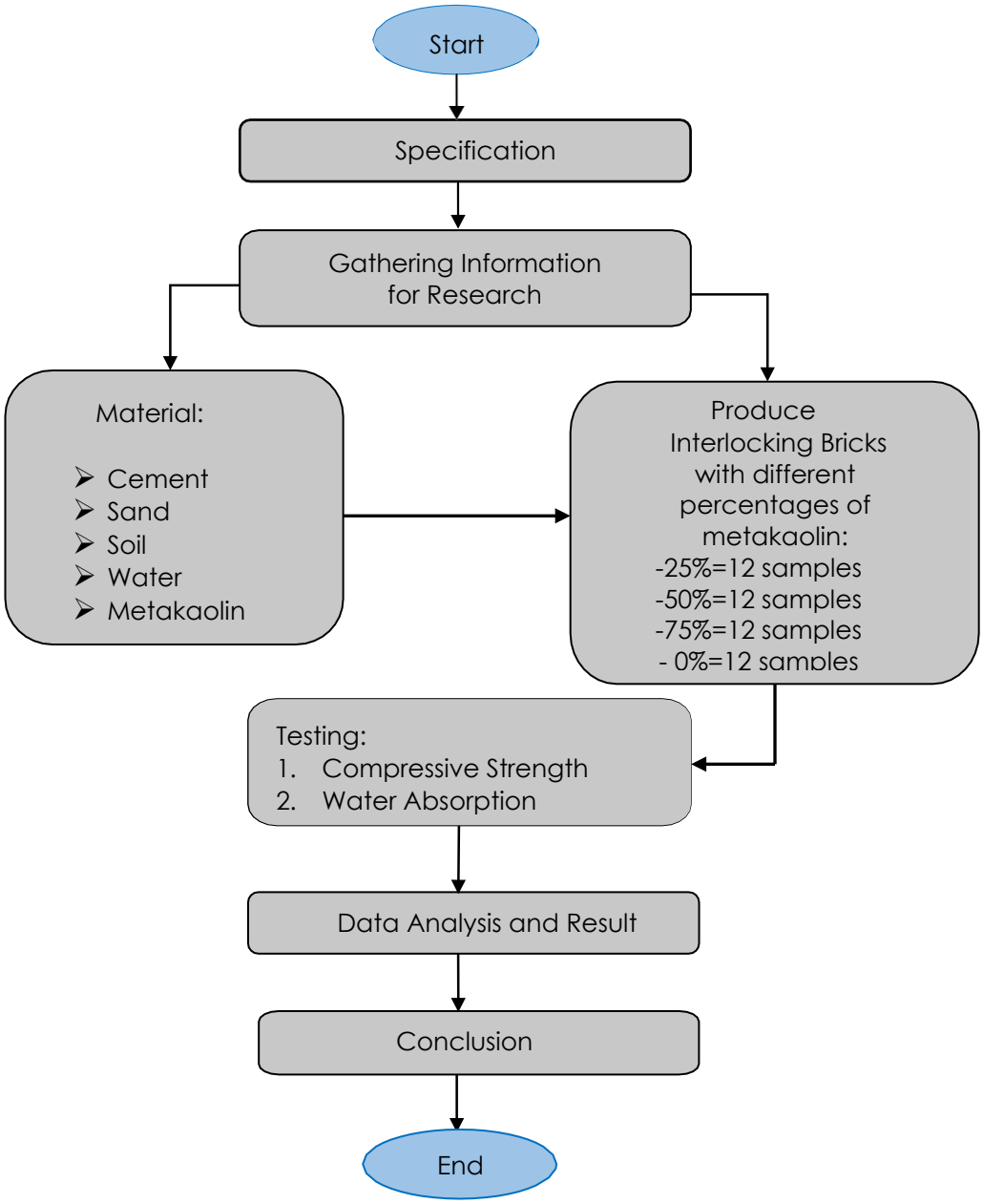


Figure 3: Methodology Flow Chart

4. ANALYSIS AND RESULTS

There are two types of testing that had been done to determine the effectiveness of interlocking brick which is compressive strength test and water absorption test.

4.1 Compressive Strength Test
The compressive strength test for the brick was held according to the ASTM: C67 for 7 days, 14 days as well as 28 days with a percentage of 25%, 50% and 75% of metakaolin. The load was applied up to one half of the expected maximum load after which adjust the machine controls so that the remaining load was applied at uniform rate not less than 1 nor 2 minute. The result is shown as follows.

4.1.1 Compressive Strength Test for 7 days.
The result of compressive strength test for 7 days is shown as follows.

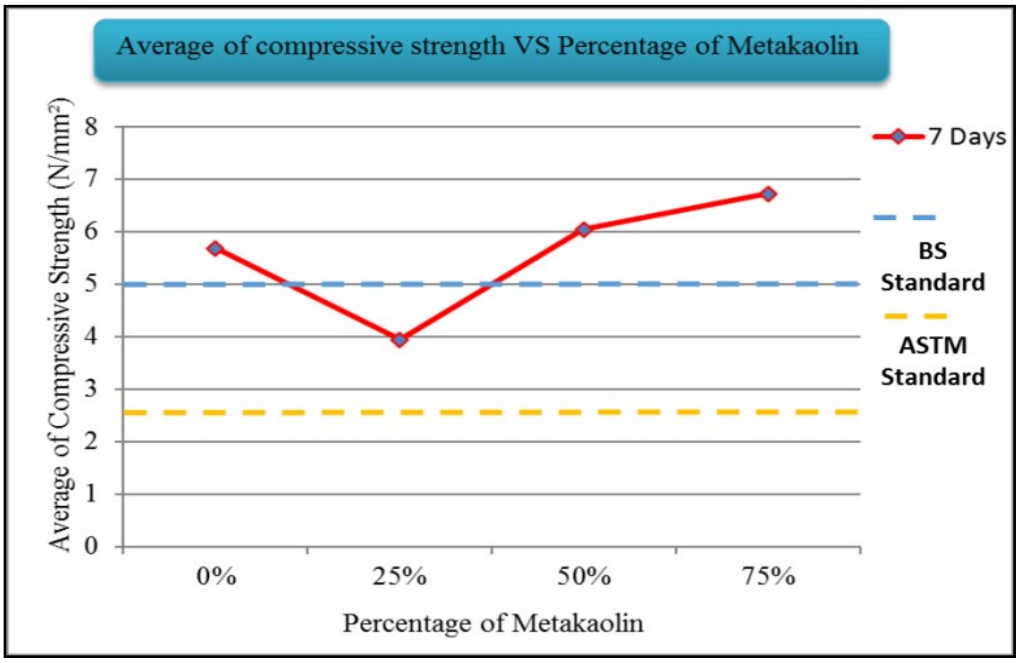


Figure 4: Graph Between Compressive Strength and Percentage of Metakaolin of Interlocking Bricks for 7 Days

In Figure 4, the graph shows that the percentage of metakaolin is 25% replacement metakaolin mixture had exhibited lower strength comparatively than the other metakaolin percentage. Thus, it can be seen that the average compressive strength of brick using metakaolin is 3.94 N/mm^2 with lows variation for 7 days and did not achieved the minimum requirement of BS Standard. The highest value for this compressive strength is 6.72 N/mm^2 at 75% of metakaolin.

4.1.2 Compressive Strength Test for 14 days.
The result of compressive strength test for 14 days is shown in Figure 5. In Figure 5, the graph shows that the highest average of compressive strength is 7.06 N/mm^2 at 50% of metakaolin while the lowest average of compressive strength is 5.61 N/mm^2 at 25% of metakaolin. However, all result had achieved the minimum requirement of BS and ASTM Standards.

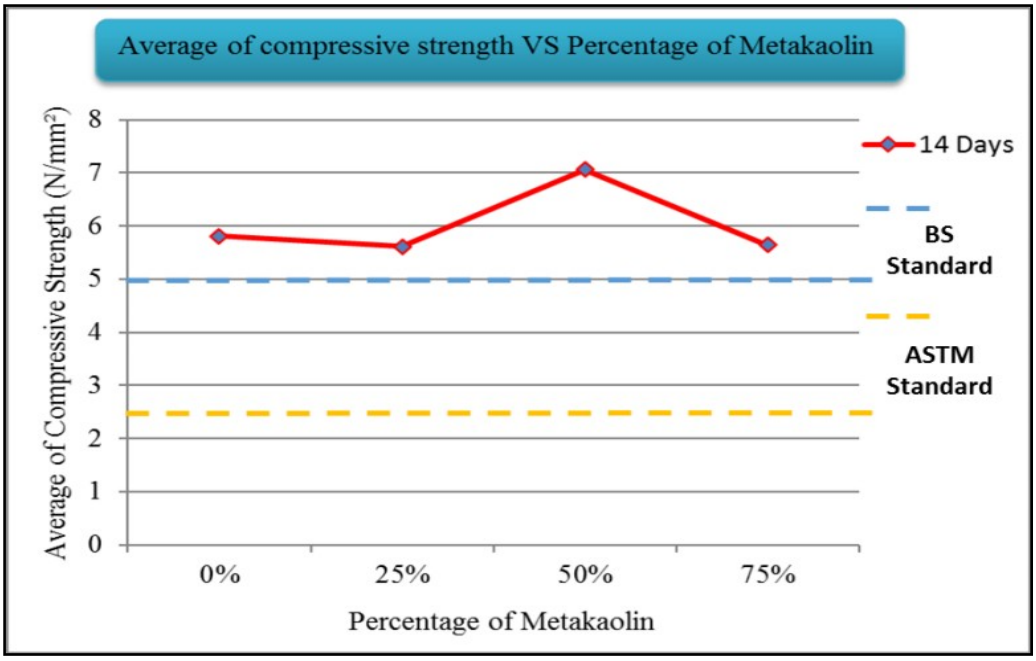


Figure 5: Graph Between Compressive Strength and Percentage of Metakaolin of Interlocking Bricks for 14 Days

4.1.3 Compressive Strength Test for 28 days.
The result of compressive strength test for 28 days is shown as follows.

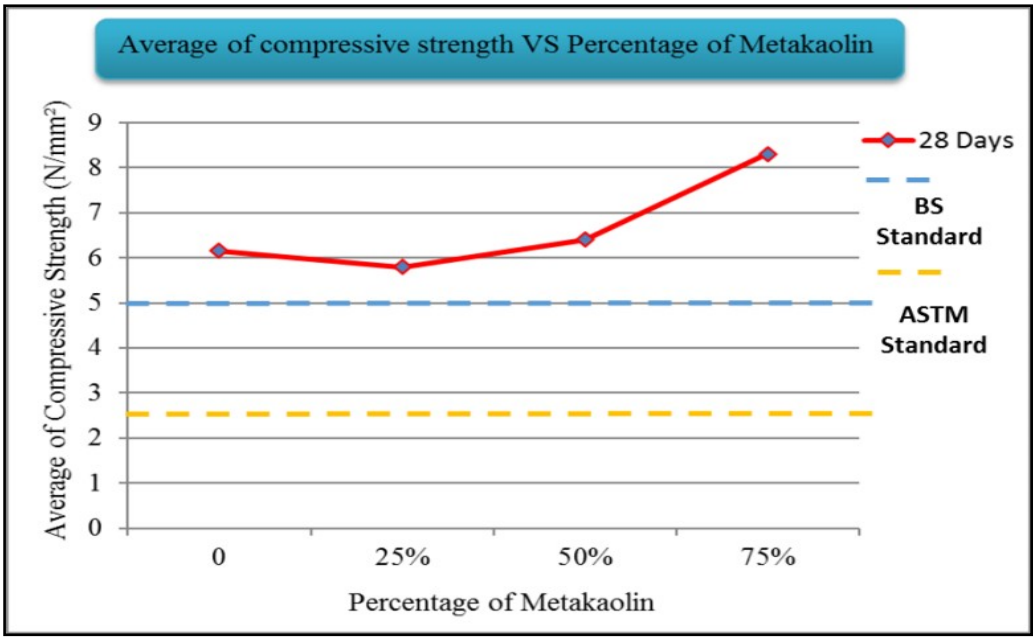


Figure 6: Graph Between Compressive Strength and Percentage of Metakaolin of Interlocking Bricks for 28 Days

In Figure 6, the graph shows the relationships between average of compressive strength and percentage of metakaolin for 28 days. It shows that the highest compressive strength of interlocking bricks is 8.31 N/mm² for 75% of metakaolin and the lowest is 5.80 N/mm² for 25% of metakaolin.

4.2 Water Absorption Test
The result of water absorption test is shown in the graph as follows.

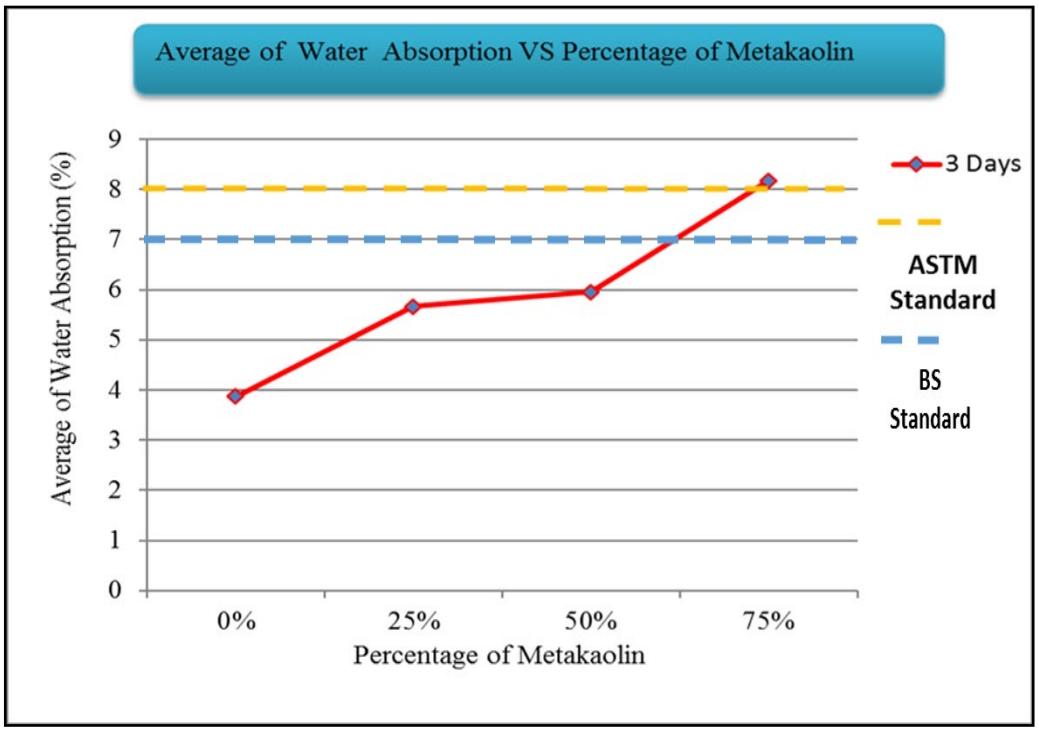


Figure 7: Graph between Average of Water Absorption and Percentage of Metakaolin for 3 Days.

In Figure 7, the graph shows the relationships between percentage of metakaolin and average of water absorption for 3 days of interlocking bricks which is higher than the percentage water absorption of standard interlocking bricks. The highest average of water absorption is 8.18% for 75% of metakaolin and the lowest is 3.87% for 0% of metakaolin followed by 25% of metakaolin which is 5.97%.

5. CONCLUSION

As a conclusion, the metakaolin is suitable to be used as partial soil replacement of interlocking bricks because it will increase the compressive strength and water absorption. Therefore, metakaolin is only suitable to be used with small quantities which are less than 50% of metakaolin. In addition, the compressive strength from this study found that it achieved the minimum requirement for compressive strength according to British Standard (BS 3921:1958) which is 5 N/mm^2 and based on ASTM C19 Standard is 2.5 N/mm^2. Besides, based on the ASTM C62 Standard for water absorption the maximum requirement is 8% while British Standard (BS 3921:1985) is 7%.From this study, the water absorption for 25% and 50% of metakaolin in interlocking bricks is achieveable except for 75% of metakaolin that exceeded the maximum requirement for both standard. Therefore, it can be concluded that the metakaolin with an amount of less than 50% can be used as partial soil replacement for interlocking bricks in construction or structural application.

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CAN AN INTELLIGENT TUTORING SYSTEM INCREASE STUDENTS' MOTIVATION AND LEARNING? A CASE STUDY ASSESSING THE EFFECTIVENESS OF *PROB-IQ* FOR SOLVING PROBABILITY CONCEPTS IN STATISTICS

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Abstract. The study investigates if an intelligent tutoring system (ITS) using Android operating system called PROB-IQ was an effective employment within educational setting for teaching and learning Probability concepts. The case study was conducted among 24 commerce students at Politeknik Sultan Azlan Shah, Perak, Malaysia via longitudinal approach. By analyzing the data using inferential statistics, the study revealed that PROB-IQ has significantly increased students' achievement, their motivation for learning, ability to understand Probability concepts, their attitude toward the topic and achievement perception. This study concludes that educational technologies are significant to be employed in teaching and learning mathematical and statistical concepts as they have an ability to improve students' learning skills. The study provides practical implications where the use of an ITS is highly recommended for lecturers who teach Probability concepts and for students who are beginners to this topic.

Keywords: Intelligent tutoring system; Probability concepts; Smart phone; Statistics; Educational applications.

1. INTRODUCTION

Mathematics and Statistics are two courses that are important as we deal with mathematical application every day in our lives. Hence, it is very crucial for teachers to continuously access learning materials in order to instill students' ability to think mathematically. Successful learning cannot be achieved by feeding students with the lessons alone. It requires teachers to also provide different sets of problems or exercises as these can improve students' knowledge. As these two courses are complex, one-on-one assistance between teachers and students is expected to help students to better understand the concepts and solve problems in their homework. This kind of teaching strategy is significant in teaching and learning process as customized feedback is deemed by students as valuable and helpful (Murray, 2011).

However, to continuously practice this strategy does not come easy. Teachers may not always be around to provide feedback. Sometimes, teachers also take time to provide feedback, hence increase students' waiting time. Students' different cognitive abilities is another issue. In this case, customized feedback could be tough as teachers will have to explain the topic differently to different students. Besides that, it is time-consuming too. To address these concerns, studies showed that educational applications in mobile devices are currently actively being employed as platforms to provide educational resources to students (Bringula et al., 2017; Namukasa, 2016). The concept of 'feedback' is utilized in the development of intelligent tutoring systems (ITS) for Mathematics. Previous research showed that feedback given by teachers on students' inquiries regarding their problem-solving steps contribute to students' effective learning and develop higher motivation to solve a problem

(Corbalan et al., 2010). The ITS is also projected to be able to tackle the 'feedback' issue significantly. Therefore, *PROB-IQ*, an ITS using Android smart phone was developed to assist and motivate students in learning *Probability* concepts in course *DPB1013 - Statistics*.

At Malaysian polytechnics, *DPB1013 – Statistics* is a course offered to third semester students who enroll in education programs offered by Commerce Department such as Diploma in Business Studies, Diploma in Accountancy, Diploma in Retail Management and Diploma in Marketing. There are seven topics in this course including introduction to statistics, data presentation, measures of central tendency, measures of dispersion, correlation and regression, hypothesis testing and probability concepts

In December 2018 session, data from Examination Unit, Politeknik Sultan Azlan Shah showed that 9 out of 28 students scored less than 50 percent of the overall score in their final grade (combination of continuous assessment and final assessment). This indicates that serious attention is needed from the lecturers and institution management. To gather more information on this matter, an interview with 10 students was conducted on 8th July 2019. The objective of the interview was to identify which topic in *DPB1013 – Statistics* that is most difficult for students to get high score. From 10 respondents, 7 of them mentioned they have problems understanding *Probability* concepts while the rest 3 stated they faced greater problems in other topics such as *Hypothesis* and *Data Presentation*. From 7 respondents who stated they have problems in understanding lessons on *Probability* concepts, 5 of them claimed they face difficulties when it comes to drawing a probability tree while the rest 2 stated they have greater problems in calculating the probability value itself. Data gathered from this interview were summarized in the following table:

Table 1: A summary of an interview with students who registered for DPB1013-Statistics for the semester of June 2019 (N=10)

Topic	Subtopic	Number of Respondents	Percentage
Probability	Probability tree	5	50
	Probability calculation	2	20
Hypothesis testing	t-test and z-test	1	10
	Developing H_O and H_A	1	10
Data presentation	Graph	1	10

Probability concepts in *DPB1013 - Statistics* for Malaysia Polytechnic education is assessed via tutorial that carries 10 percent of the continuous assessment and also in a sub-question in the final examination which carries 10 marks of the total marks. However, trend analysis of students' performance on this topic, especially in the final examination, has been overwhelming. Students' average score on this topic was less than 50 percent of the overall score. The low achievement on this topic needs serious attention from the teachers as well as from the institution management. To explore further on this issue, 10 students' answer scripts from 3 consecutive semesters were randomly picked and their score on *Probability* assessment were analyzed. Table 2 below shows the average score of students' achievement on *Probability* concepts for 3 consecutive semesters.

Table 2: Students' average score on *Probability* concepts for three consecutive semesters

Semester	Full marks	Average Score	n
December 2018	10	2.94	10
June 2018	10	3.02	10
December 2017	10	2.76	10

(Source: Examination Unit, Politeknik Sultan Azlan Shah)

From the evidence shown, it can be concluded that students who registered for *DPB1013 – Statistics* faced difficulties in understanding how to draw a probability tree to satisfy the *Probability* concepts. Besides that, the students also faced another problem connected to the topic which is calculating the probability value. To cater this problem and to assist student to understand the topic better while at the same time to give the students immediate feedback on their inquiries, *PROB-IQ* an ITS using Android smart phone, was developed. This study aims to provide evidence if the use of *PROB-IQ* in learning *Probability* concepts will give positive impact on students' achievement, motivation for learning, ability to understand the topic, attitude toward the subject and perception regarding their achievement in the assessment on *Probability* concepts

2. LITERATURE REVIEW

The theory underpinning this study is Self-regulated learning (SRL) theory (e.g Zimmerman & Schunk, 2011). The theory suggests that in order to achieve specific learning goals, students must be able to self-regulate their thoughts, feeling and behaviors. However, the objective of achieving positive and maximum learning outcomes can only be realized if the students could actively engage in SRL processes (Duffy & Azevedo, 2015; Vaessen et al., 2014; Zimmerman & Schunk, 2011). Scholars argued that in learning complex topics such as Science , Mathematical and Statistical concepts students are not able to self-regulate themselves to a high degree of SRL processes but to be struggling more often (Azevedo et al., 2012). One way to promote students' learning rate and to increase self-regulating learning that has been debated in the literature is by designing an intelligent tutoring system (ITS), a computer software to help students by providing context sensitive hints and feedbacks (Abu Naser, 2012; Azevedo et al., 2012; Duffy & Azevedo, 2015; Vaessen et al., 2014).

In this study, the *PROB-IQ*, an ITS to assist the learning process for *Probability* concepts was developed using Android operating system. *PROB-IQ* was published in the Google Play Store and can be downloaded by users for free. It was specifically developed to sketch probability tree calculation and to help boost students' SRL processes.

The impact of ITS on students' learning and performance has been investigated by numerous studies especially in game-based learning (Jackson & McNamara, 2011; Rodrigo & Baker, 2008; Vaessen et al., 2014). Researches have provided evidence indicating that an ITS has increased SRL processes and benefited students in many ways (Duffy & Azevedo, 2015). For example, a longitudinal study conducted among 58 students in Pittsburgh, United States of America showed that an ITS impact students' performance significantly (Roll et al., 2011). The same finding was also shared by Jackson and McNamara (2013) and Erdemir and Ingec (2015) where an ITS have showed significant positive impact on students' performance. In this study, students' achievement in post-test has increased significantly as compared to the score in the pre-test assessment (Erdemir & Ingec, 2015). One possible explanation for this relationship is because an ITS has an ability to reorient students' attention especially in important areas on the ITS interface, thus, promote learning gains (D'Mello et al., 2012).

An ITS has also been postulated to link positively with motivation for learning. When applying ITS in learning activities, students' ability to understand the topic increase significantly via mastery-approach technique (Duffy & Azevedo, 2015). This crucial ability is gradually developed as students' boredom for long learning activities in regular classroom decreases with the adopting of ITS (Jackson & McNamara, 2011; Rodrigo & Baker, 2008). At the same time, positive attitude towards learning can also be seen as the students become more familiar and skillful toward subjects under study (Jackson & McNamara, 2011). Studies also showed that students' feelings, anticipation, motivation and competitive drive were recorded to be much higher when ITS was used as compared to traditional learning processes (D'Mello et al., 2012; Duffy & Azevedo, 2015; Jackson & McNamara, 2011). Furthermore, as an ITS creates experience of delight in learning and enhance learning engagement (Rodrigo & Baker, 2008), it can be argued that students' positive perception

regarding their achievement in the assessment is, at the same time, built (Erdemir & Ingec, 2015). Therefore, based on these justifications, the researchers believe that *PROB-IQ* an ITS for learning *Probability* concepts will have the same effects. Therefore, this study was conducted to investigate the impacts of the use of *PROB-IQ* on:

a) students' achievement,
b) motivation for learning,
c) ability to understand the topic,
d) attitude toward the topic, and
e) perception regarding their achievement in the assessment on *Probability* concepts.

3. METHODOLOGY

This study is a longitudinal study that run for 12 months and involved 3 phases. It was conducted among students who registered for DPB1013 – Statistics at Politeknik Sultan Azlan Shah (PSAS), Perak, Malaysia. The study aims to examine the impact of *PROB-IQ* on students' achievement, motivation for learning the subject, ability to understand the topic, attitude towards the topic and their perception regarding their achievement.

During phase 1, students' score in the assessment on *Probability* concepts in June 2018 session were recorded. After that, in phase 2, students of June 2019 session who registered for the same course and teacher were introduced with *PROB-IQ* of which can be downloaded for free from the Google Play Store. Students were asked to download *PROB-IQ* and were required to use the application when studying *Probability* concepts either during traditional classroom teaching and learning process or during their independent learning activities. Respective lecturer was also asked to conduct the teaching and learning process using *PROB-IQ* to familiarize students with the application. The reason for waiting for one year to conduct the test is because June-session and December-session students were observed to display different attitude and achievement which could lead to bias in data analysis should students of different sessions were taken into the study. The pre-test questionnaire survey assessing the other four categories of ITS impacts was administered during this phase. Finally, in phase 3, students' achievement in *Probability* concepts assessment was collected and recorded. During this phase, the post-test questionnaire was also distributed to the respondents and their responses were collected and analyzed.

In terms of instruments, students' assessment score was recorded and survey questionnaire was employed. In order to examine the impact of PROB-IQ on students' achievement, a formal letter requesting permission to use students' examination data was sent to PSAS administration. After the permission was granted, the data on students' examination score were recorded and taken into the study. To examine the changes in motivation for learning, ability to understand the topic, attitude towards the topic and students' perception regarding their achievement, this study adopted measurement items developed by Garcia and Pintrich (1996). The survey inventory consists of 11 items to assessing students' motivation for learning, 3 items measuring ability to understand the topic, 3 items measuring attitude toward the topic and 4 items measuring achievement perception. The survey was distributed to 24 students twice during phase 3. Pre-test was administered prior to the use of *PROB-IQ* in teaching *Probability* concepts while post-test was administered 2 weeks after *PROB-IQ* was used. The mean scores of data gathered at both times were analyzed by employing paired sample t-test technique.

4. RESULTS AND ANALYSIS

First, to examine the PROB-IQ, impact on students' achievement, students' examination score for two semesters we analyzed and compared. In June 2018, the *Probability* concepts was delivered by the lecturer using normal class lecture and discussion in the classroom. Students' score in the final examination was recorded. In June 2019, when teaching the same topic, by

the same lecturer, *PROB-IQ* was employed. Students' examination score was once again recorded. The comparison was done for the same batch of students (June session) because data from observation showed that there is a significant difference in the achievement of students of June session and December session (Examination Unit, PSAS). Table below summarizes students' achievement for Semester June 2018 and June 2019.

Table 3: Students' average score for two semesters

Semester	Full mark	Average Score	n
June 2018	10	3.02	10
June 2019	10	7.66	10
Change in percentage		153.6%	

(Source: Examination Unit, Politeknik Sultan Azlan Shah)

From Table 3 above, it can be concluded that the use *PROB-IQ* in teaching and learning activities has a significant impact on students' achievement in *Probability* concepts. Students were found to score higher in June 2019 final examination for the *Probability* concepts after *PROB-IQ* was used in the teaching and learning. *PROB-IQ* was also used by the students during their independent learning.

Next, the study analyzed the impact of *PROB-IQ* on another four categories of impacts of which data were gathered via survey. Before the paired sample t-test can be run, the measurement items were checked for its validity and reliability. The Keiser-Mayer Olkin (KMO) analysis of validity showed results of 0.689 for pre-test and 0.612 for post-test respectively. These results indicate that the measures are valid. Furthermore, reliability analysis to determine the reliability of the instrument measuring students' motivation for learning, ability to understand the topic, attitude toward the topic and achievement perception were conducted. Result of the analysis are shown in Table 4. Results indicate that all measurement items are reliable and measure what they are supposed to measure.

Table 4 : Results of reliability analysis

Construct	No of items	Pre-test Cronbach alpha	Post-test Cronbach alpha
Motivation for learning	11	0.876	0.834
Ability to understand the topic	3	0.839	0.901
Attitude towards the topic	3	0.924	0.899
Achievement perception	4	0.820	0.874

Following this, the paired sample test was run in order to identify if there is significant difference between the constructs' mean score before and after the employment of *PROB-IQ*. Result of the paired sample test was summarized in the Table 5.

Paired sample statistics showed that the mean score for pre-test on students' learning motivation was 2.191 (N = 24, SD = 0.493) while the mean score for post-test was 4.450 (N = 24, SD = 0.256). Similarly, the result showed that the mean score for pre-test on students' ability to understand the topic was 2.500 (N = 24, SD = 0.132) while the mean score for post-test was 4.542 (N = 24, SD = 0.352). For attitude toward the topic, mean score for pre-test was 2.583 (N = 24, SD = 0.836) while the mean score for post-test was 4.667 (N = 24, SD = 0.405). Finally, for achievement perception, mean score for pre-test was 2.448 (N = 24, SD = 0.0.599) while the mean score for post-test was 4.667 (N = 24, SD = 0.292).

Table 5: Paired samples test of the pre- and post-test mean score of

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Motivation	2.259	.626	.139	1.966	2.552	16.142	23	.000
Pair 2	Understand	2.042	.763	.156	1.719	2.364	13.103	23	.000
Pair 3	Attitude	2.083	.964	.197	1.676	2.491	10.584	23	.000
Pair 4	Perception	2.219	.677	.138	1.933	2.505	16.057	23	.000

Paired sample test also showed that there is significant difference in mean score of students' motivation for learning, ability to understand the topic, attitude towards the topics and achievement perception before and after using *PROB-IQ* in learning *Probability* concepts. The result provides strong evidence that the use of *PROB-IQ* has significantly increased students' motivation for learning, ability to understand the topic, attitude towards the topics and achievement perception.

5. CONCLUSION

This case study presents the results of a new mobile application tool for students and lecturers in interactive learning environment for *Statistics*. We generally found that *PROB-IQ*, the ITS developed to assist the teaching and learning activities for *Probability* concepts has significant impacts on educational activities. Importantly, *PROB-IQ* was proven to be able to increase students' score in the *Probability* concepts. It serves as a smart tutoring system where the students are able to get immediate feedback on their inquiries regarding the topic. The creation of time saving provided by *PROB-IQ* give rooms for students to spend more time on doing exercises on the topic.

PROB-IQ was also found to be able to increase students' motivation and learning. Aligned with previous study (Duffy & Azevedo, 2015; Rodrigo & Baker, 2008), students were found to be more confident, developed more interest for *Probability* concepts and tend to have more positive evaluation regarding their learning activities on the topic. They become more interested to learn the topic and for some students, especially those who have perceptions that mathematical courses are tedious, has begun to believe that the course is not boring but comfortable to deal with.

Apart from that, *PROB-IQ* was also found to facilitate students' perception of the importance of learning *Probability* concepts as compared to the traditional way of teaching mathematical courses. Significantly engagement was observed within the employment of *PROB-IQ* of which has led to the development of delight experience and lower students' boredom level (Rodrigo & Baker, 2008). This delight-generating feature, high interactivity ability and challenge to solve more difficult questions provided by *PROB-IQ* are hallmarks of the development of positive perception regarding their future achievement (Rodrigo & Baker, 2008).

Interactive learning environment has been rapidly increasing interest with the development of ITS as one of technological educational tools. This study concludes that educational technologies are significant to be employed in teaching and learning mathematical and statistical concepts as they have the ability to improve students' learning skills. The analysis

provides practical implications where the use of the application is highly recommended for lecturers who teach *Probability* concepts and for students who are beginners to this topic. Future research is suggested to explore deeper in examining the types of skills that can be developed from the employment of ITS in educational settings.

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COMPARATIVE STUDY ON GREEN SPACE FEATURES IN PUBLIC PARKS

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Abstract. Green space is land that is partially or completely covered with grass, trees, or vegetation's such as parks, community gardens, or public seating areas. It offers many advantages to urban environments, as it is live able and attracts city-goers. Valuing the features of green space is vital as it contributes to environmental benefits, esthetic quality, conservation of biodiversity and visitation patterns. Research in this field is growing because health and environmental benefits are associated with public green spaces (parks). The significant features of green space represent the important factors influencing the use of the park, giving comprehensive understanding of park environments. This research studies the level of satisfaction of park users regarding the current features of green space in two prominent recreation parks in Ipoh City. Questionnaire survey and statistical analysis are used as the mixed-method approach to measure the criteria that contribute to the effectiveness of green space features and the satisfactory level of park users. Physical characteristics of green space, demographic characteristics of park users and other relevant information related to visits to parks have been studied. Site assessment and observation have been carried out in order to produce an inventory of the preferences of park users for green space features. The main satisfaction of park users is measured in terms of green space features, attractions for visitors and activities for users. The statistics of mean preferences obtained are man-made features (mean 2.78), vegetation (mean 2.78) and water characteristics (mean 2.37) that conform with the principles of recreational facilities. The findings will serve as a performance metric for sustainable green city planning, identifying components of potential features of urban green space in the National Urbanization Strategy of Malaysia.

Keywords: Green space features, sustainable city

1. INTRODUCTION

In this research, urban green space is associated with public parks and the characteristics of the features reflect the physical-environment factors that provide the place's attractions and quality. The features include natural setting, access, facility, design, safety, location, maintenance etc. The functionality of urban green space narrates to the characteristics and features associated with health benefits such as size, visual attractiveness and facilities (Andrew et al., 2015). Park as a nature representation combined the natural and human features with variety of images. Past analysis studies have shown that the availability of attribute features has had a positive and negative effect on park users (McCormack et al., 2010). Therefore, the relationship between the attribute features of parks as part of urban infrastructure, emphasizing physical characteristics such as viewed quality, human being development, flora and water body is crucial to understand. Public parks planning in Malaysia is intended to provide multi-races and multi-cultural attraction to socialize mainly in urban areas (Siti Rashidah et al., 2015). Urban green space with variety of features integrate with the surrounding has an immense effect and represents the community's attractiveness, intensity and efficiency parameters for the ecosystem and recreational values.

2. LITERATURE REVIEW

It is important to study how the characteristics of the design help to establish high-quality green space and serve as a public place for community activities. The dimension of the green space characteristics is an important key that delivers the desired and draws the public. In the 21st century, people appear to be profoundly anxious with their quality of life and their climate.

Hence to attract more park users, local authorities must enhance planning strategies and redesign public green spaces or parks. This study centered on the urban green space of Ipoh, which needs an overview of strategies to help park planners and designers adopt some essential requirements for better park design and usage. As a function of design and layout, greater perception of the specific aspects associated with increased and reduced usage of the park should accommodate user needs. Ozguner (2000) revealed that the factors that give pleasure to users are beautiful aspects of parks such as beautiful landscapes, visual elements, spaciousness, abundance of natural biodiversity, peaceful nature, closeness to water and calm atmosphere. Francis (2003) and Herzele et al. (2003) published the report stating that the degree of satisfaction with park design depends significantly on the variety of activities provided, convenience, socialization and maintenance adequacy.

2.1 Features of Urban Green Space

Features of green space are part of the leisure area's multifunctional green infrastructure which provides users with choices for multiple forms of usage. The feature attribute provides visual richness to the nature of the setting in a broad variety of ways, such as the colour and form, soft and hard landscape components that sustain appealing environments. The features characterize the existence of the park's physical and social environment, which is required to include services for all ages, preferences, races, abilities and levels of community income. Features of green space can be divided into several categories which are vegetation, waterbody, wildlife, trail and man-made features.

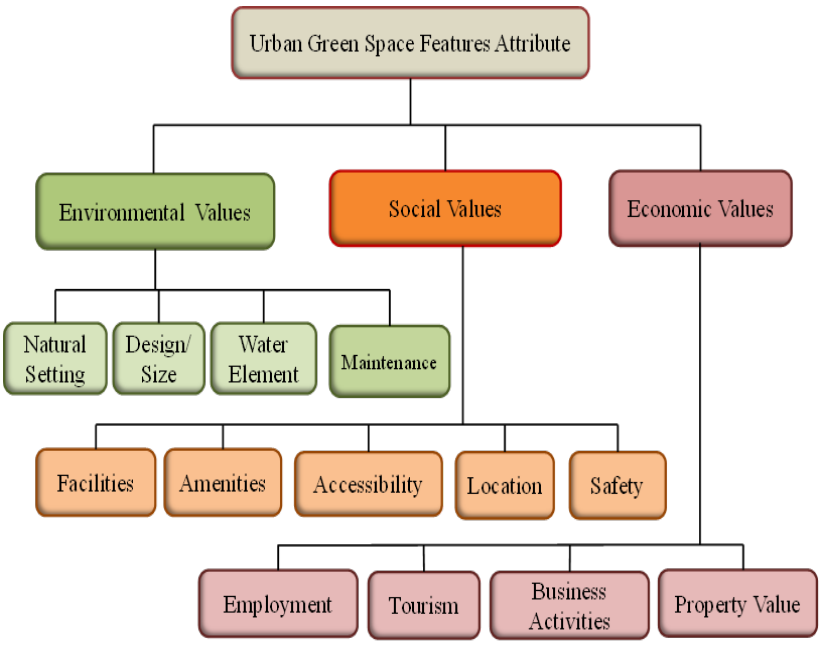


Figure 1: Three main value of green space features (Source: Rabi'ah, 2018)

Three key values (environmental, social, and economic) as shown in Figure 1 must be included in the partnership within the urban green space features in enhancing its functionality related to the interaction and usage of park. The features of the attribute will serve as an indicator that provides users with the level of satisfaction in keeping a sustainable environment and quality lifestyles. The attributes of green space contribute to user desires, their emotions and pleasures. The physical aspect of green spaces needs to be related to the behaviors that people engage in and their attitudes.

Table 1 displays the main concerns people have expressed about their usage and thoughts about the functionality of the green space.

Table 1: Relation of green space features to human life (Source: Simon Bell, 2005)

Physical features of Green Space	Activities found in Green Space	Insights of people on green space features
Information about nature	Relaxation	Spiritual
Accessible	Exercising	Magical
Man made	Stress Relief	Boring
Proximity to home	Meeting people	Peaceful
Signage to direct to site	Walking alone	Feel "free"
Maintenance	Viewing wildlife	Feel "vulnerable"
Well known to individual	Community events	Feel "energetic"
	Education	Close to nature
		Importance
		Adventure
		Vandalism
		Comfortable
		Relevant to lifestyle

Therefore, in this context, it is important to examine the physical characteristics of urban green space, which may differ according to criteria such as layout, size, natural resources, location, accessibility and many others.

2.2 Public Parks in Ipoh City

The vision for "Clean, Green and Developed City" has been introduced for the city of Ipoh. Currently, it has over 1000 parks of varying sizes, but only 500 are big enough for recreational activities (Perak News, 2011). There are, however, two renowned city parks, i.e. Taman DR Seenivasagam (TDrS) and Taman Rekreasi Sultan Abdul Aziz (TRSA) are popular among the locals for their leisure activities. The parks are community green areas built with beautiful landscapes, manmade features and vegetation that are used for leisure, preservation and healing. Both parks are known for their social, physical and environmental advantages that reflect their prominence (Figure 2).

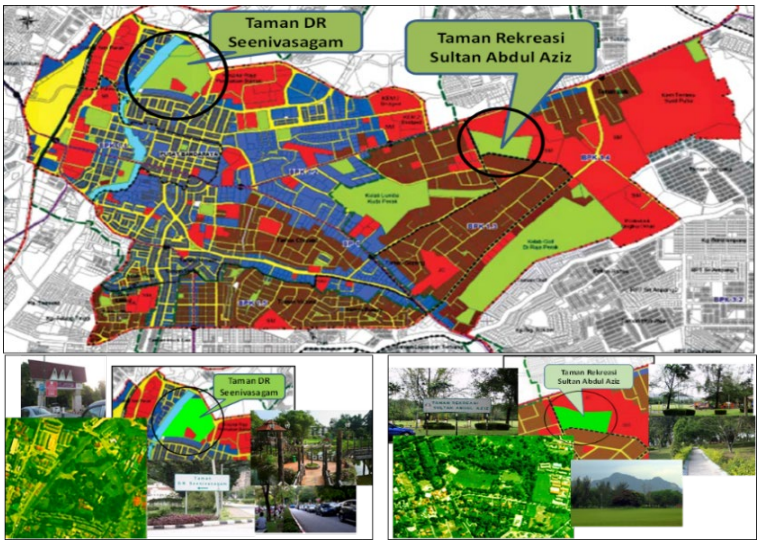


Figure 2: Location of the Public Parks in Ipoh City (Source: Ipoh Local Plan 2010)

The parks were selected based on their geographical location, well connected to the neighborhood's business area and housing areas, accessibility and similarity of community characteristics predominantly inhabited by middle low to upper or high-income population classes. The parks are in the central section of the city that contain a wide range of neighborhoods, including many nearby areas and public buildings, such as hospitals, schools and others. In the areas studied, the components of green infrastructure influence tourism in many respects, including aesthetic awareness, health and well-being. Nevertheless, the parks are currently in a sad state of dereliction and disrepair as maintenance is slow and some of

their facilities are damaged (Jerry, 2015). Assessing the green space of the park on how their features satisfy the preferences, purposes and needs of urban residents in Ipoh city will be valuable.

These parks need to be enhanced for the well-being of the city in the effort to accomplish the goal and effort to achieve "Beautiful Garden Nation by 2020". The government's agenda has always been to enhance the quality of life in the city and it is conscious of the relevance of greening the cities and making sure the parks are at their best. This is also to maintain holistic and sustainable growth by the formation of its own identity for green parks with desirable landscapes.

3. METHODOLOGY

In the earlier research of the author, the study on the satisfaction of the available features of the TDrS and TRSA was carried out by several methods such as survey questionnaire, field observation and site evaluations (Rabi'ah, 2018).The general opinion of the green space area was measured using provided questionnaires to park visitors as respondents. It helps to analyze what people expect from urban green spaces and the degree to which urban green spaces satisfy these criteria. A total of 200 respondents participated in the questionnaire survey (100 for each park). It was undertaken intensively through outdoor and direct interviews with the users from both parks. The attribute characteristics were clustered into four categories namely manmade elements, vegetation, aquatic and waterbodies reflecting the natural blend features of urban environments that attracts people to the parks. The manmade features represent the hard landscape that gives the surroundings numerous functions. Waterbodies are soft landscapes which add appeal to the environment and give people the perception of nature. The study evaluates and analyzed the satisfactory parameters of the current urban features attribute.

The content of the two-part questionnaire consisted of dependent and independent variables that illustrated the study's objective. The first part covers the socio-demographics (age, gender, and place of residence). The second part concentrated on the respondents' views and expectations for the green spaces in their community. It comprised of questions about frequency of park visits, duration of stay, mode of transport, safety, design, facilities, and their desires regarding improvements towards urban green space. Nine public green space feature attributes selected from literatures on park characteristics was assessed. The features were concerning to the satisfaction level of park users namely natural setting, design, facilities, amenities, water element, accessibility, location, safety, maintenance, and property value. They act as the indicator in achieving a sustainable urban green space. The data collection was conducted on weekdays and weekends. Subsequently, they were analyzed using the SPSS software for descriptive statistics (frequencies analysis). These includes the visitors' demographic characteristics (gender and age details), travel means and distance, frequency of visit, length of stay and visitors' safety sense, park activities and facilities for both parks in determining the trend of visitors' preferences (Rabi'ah, 2018).

4. ANALYSIS AND RESULTS

4.1 Taman DR Seenivasagam (TDrS)

TDrS is in the vicinity of Ipoh has provided the communities with opportunities to accomplish leisure activities and avoid urban lifetime pressures from their daily schedule. The mixture of the different attributes of the facilities illustrates the park 's nature and creates rhythm and harmony that makes the green spaces look and feel pleasant.

Green Space Features					
Satisfactory ratings on park delivering system (100 samples)		Less Satisfied	Satisfied	Very Satisfied	Mean
Man-made Features	Hut	0	55	45	2.45
	Route/Trail/Track	1	39	60	2.59
	Signage	1	55	44	2.43
	Children's Play Equipment	2	43	55	2.53
	Benches/Tables	1	38	61	2.60
	Sports courts, field	1	22	77	2.76
	Lighting	4	59	37	2.33
	Litter Bin	7	49	44	2.37
	Washrooms	10	49	41	2.31
	Parking lots	2	18	80	2.78
Vegetation Features	Grassland	2	31	67	2.65
	Open Spaces	3	34	63	2.60
	Flora Features (Trees and Flowers)	0	22	78	2.78
Aquatic	Fauna Features (Fish)	13	39	48	2.35
Waterbody Features	Pond	15	40	45	2.30

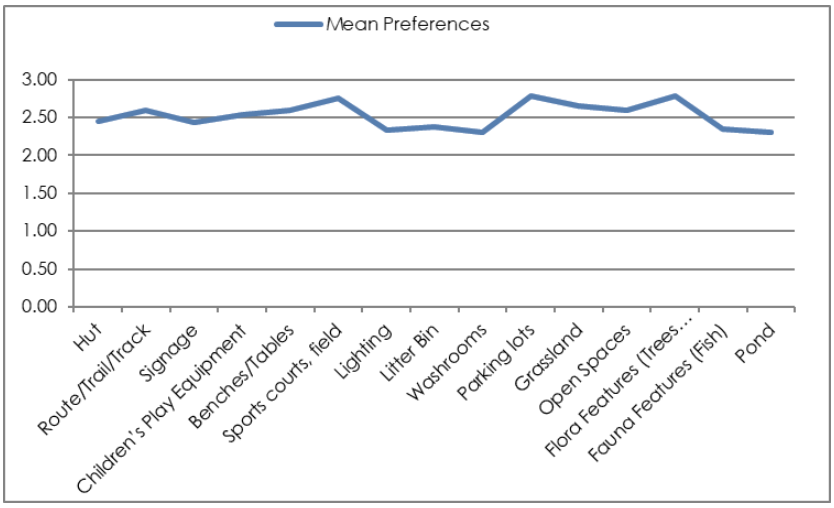


Figure 3: Mean of park users' preferences on TDrS green space features

The mean preferences in Figure 3 indicate the respondents's major satisfaction towards the features in TDrS. The vegetation features are the most favoured character by respondents with mean score of 2.78 as It presents an opportunity for fresh air and a peaceful environment. They are positive qualities that give the environment aesthetic pleasure (McCormack et al., 2010). The location of TDrS in the vicinity of Ipoh city centre, with its embodiment of lush green areas and quiet open space, serves as a serene medium for Ipoh 's residence. The park has many trees and shrubs that provide much of the area with shade (Figure 4). The presence of trees absorbs carbon dioxide (CO2) and the photosynthesis releases oxygen (O2) and indirectly reduces the danger of global warming. It is a great place for picnics and bird watching, as many bird species come to the park. A good mean score by the respondents is also shown by other vegetation features such as grassland and open spaces.



Figure 4: Vegetation features (trees and grassland inventory) in TDrS

Similarly, as stated in Figure 3, the man-made features achieved good satisfaction from the TDrS respondents. They are the elements of green infrastructure that give the users of the park a feeling of peace, dignity of its community and attachment to the area, as well as social networks. The parking lots and the sports courts(fields) features attained mean score of 2.78 and 2.76, respectively (Rabi'ah A, 2018). Other man-made features are also classified as preferred features having score of 2.60 and 2.43. This includes benches and tables, route and track for walking, jogging, and cycling, children playground, hut/shelters and signage. Most of the benches are in the shaded area which offers park users to enjoy the beauty of the atmosphere in the cooling climate. Walking paths/routes and jogging tracks are provided in the park, where people walk and jog in the morning and evening. Bicycle track are also available for park users to enjoy cycling and exercise. Additional features such as litter bins, lighting (lamp post) and washrooms attained score range of 2.37 to 2.31. Respondents are reasonably satisfied with features that require improvement and enhancement. Obviously, the park entry gate is the first visual attraction that provides a physical connection between the park and the surrounding area. It is part of the attraction for visitors and the park 's positive welcoming image.



Figure 5 : Man-made features in TDRS

The water body is the most popular feature of the park as it offers the place a visually relaxed atmosphere and visual pleasure. The water body (Figure 6) has effects on users, such as calmness, cool, refreshment, relaxation, focus, a feeling of pleasure, enthusiasm and excitement. The existence of artificial lakes and streams with variations of vegetation improves TDrS 's visual landscape and additional attractions. The cooler atmosphere and fresh air are generated by this feature, which is an excellent indicator of ecological health and sustainability in the Ipoh community. The mean scores towards aquatic and waterbody features which are the habitat of fish and tortoise seen at the pond ranges from 2.30 and 2.35.



Figure 6 : Waterbody and aquatic features

4.2 Taman Rekreasi Sultan Abdul Aziz (TRSA)

TRSA is the Ipoh City alternative community park that is popular with several attractive features. It has a broad area enclosed by beautiful old trees, a children's playground, fitness facilities and a pond as a water feature in the park. In the evenings and weekends, this park is continuously full of visitors of all ages taking sport, walking and jogging on the tracks and families with their children.

Green Space Features					
Satisfactory ratings on park delivering system (100 samples)		Less Satisfied	Satisfied	Very Satisfied	Mean
Man - Made Features	Hut	2	31	67	2.65
	Route/Trail/Track	1	25	74	2.73
	Signage	7	42	51	2.44
	Children's Play Equipment	2	15	83	2.81
	Benches/Tables	5	28	67	2.62
	Sports courts, field	2	29	69	2.67
	Lighting	4	45	51	2.47
	Litter Bin	1	28	71	2.70
	Washrooms	7	38	55	2.48
	Parking lots	14	51	35	2.21
Vegetation Features	Grassland	1	26	73	2.72
	Open Spaces	2	24	74	2.72
	Flora Features (trees and flowers)	3	34	63	2.60
Aquatic	Fauna Features (Fish)	9	60	31	2.22
Waterbody Features	Pond	27	30	43	2.16

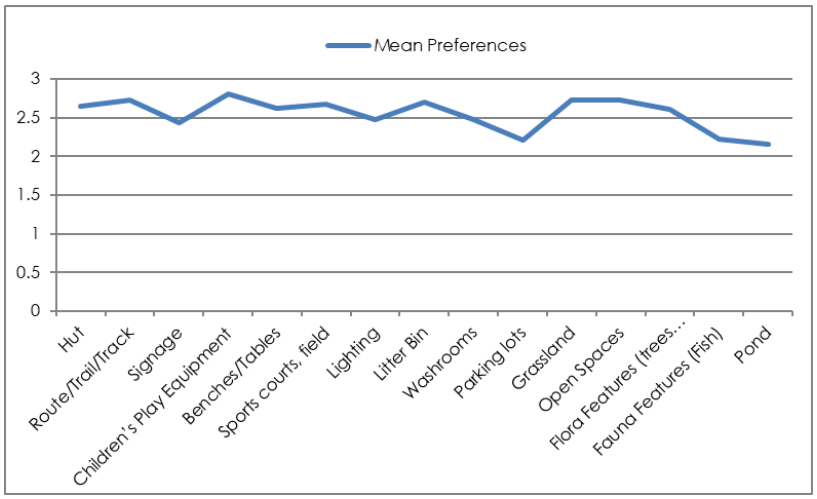


Figure 7: Mean of park users' preferences on TRSA green space features

In Figure 7, the respondent satisfaction level graph illustrates that man-made features such as the playground for children and route (track) had a high mean of 2.81 and 2.73, respectively. One main attraction of green space facilities is the children's playground representing an essential part of green space features. This park has a great circular jogging track, particularly where park users jog and walk around the park. Numerous human reaction features suggest that the respondents were pleased with the facilities provided in the park (Figure 8). The availability of litter bins around the park received the uppermost score from respondents with an average value rating of 2.70. Other human-made features with an acceptable average value between 2.67 and 2.62 are the large green fields for sports and play courts, the huts or sheds for relaxation and passive leisure and also the benches and tables (sitting areas) usually used after completing workouts or for a place to relax. The park's physical features provide an appropriate facility for outdoor activities. A sensible mean level score of 2.48 to 2.44 was obtained for the washrooms, lighting and signage. However, the respondents deliberated their disappointment with the parking spaces, particularly during peak hours, i.e. in the morning and evening. According to the local newspaper (Ipoh Echo), the hawkers' business stall has invaded the parking spaces for their businesses, disrupting the visitors' parking lot and privacy.



Figure 8 : Man-made features In TRSA

Vegetation is natural ecosystem with features that is significant in the environmental balancing of man-made features. The features of the vegetation contribute to rainwater drainage, sewage disposal and provide the urban community with recreational and cultural values. They attained the score of 2.72 for grassland and open spaces (Rabi'ah A, 2018). The spectacular view of the limestone hills and the surrounding greenery from the well-manicured landscape pleases park users in TRSA as shown in Figure 9. Likewise, the respondents were attracted to the scenes of greenness and pleasant colours of the flora. The open spaces of TRSA have also been used for various activities, such as aerobics, health exercise, football, and other games.



Figure 9: Panoramic view of vegetation features (trees, bushes, flora, and fauna) in TRSA

The water body 's characteristics affect the urban park landscape and bring significant benefits to human and environmental needs. When used as a decorative feature, water has an elemental quality that gives it great symbolic importance (Eren & Oya, 2013). The results in Figure 10, showed that water bodies and aquatic features offer moderate satisfaction among respondents. Their mean score is 2.16 and 2.22, respectively. This implies that the water component is important for users of the park and further improvements are required to improve their presence as the park environment's focal point. The aesthetic dimension of water features gives spiritual and calming effects, while its functionality offers recreational uses (Zulfikar & Yoshikawa, 2008). Therefore, it is essential to maintain the waterbody component as people visit the park for enjoyment and relaxation.



Figure 10: Waterbody and aquatic features in TRSA

4.3 Features attributes inventory from visual inspection

This inventory is an observative analysis intended to verify the phenomenon as part of data collection from the researcher's perspective. The combined quantitative and qualitative data research method has been fully recognized in many researches (Cavaye, 1996; Myers, 1999; Myers, 2003 in Jessica L, 2009). Site assessment and field observation were carried out on TDrS and TRSA (Rabi'ah, 2018). Table 2 is the result of the inventory (green feature attributes) based on visual field inspection. The inventory provides an important and effective tool for the environmental and physical assessments of urban green space features for its sustainability development. It accomplishes the feature attributes standards of open space planning and recreational facilities.

Table 2: Inventory of the green space features in TDrS and TRSA (Source: Rabi'ah, 2018)

	Green Features Attributes	TDrS	TRSA
Safety	Layout & Design	√	√
	Visibility & Views	√	√
	Access & Circulation	√	√
	Lights	√	√
	Diversity	√	√
	Signage & Park Information	√	√
Maintenance	Cleanliness	√	√
	Grass Cutting	√	√
	Garbage Collection	√	√
Accessibility	Access by Public Transport	√	√
	Easy movement (physically and visually)	√	√
Property Value	Land Value	√	√
	Business activities	√	√
	Tourism	√	√
Amenities (Lighting & Signage)	Benches/Seating	√	√
	Tables	√	√
	Shelter	√	√
	Signage	√	√
	Lighting	√	√
	Picnic Areas	√	√
	Walking Paths	√	√
	Bike Racks	√	-
	Telephone Booths	√	√
	Kiosks	√	√
Visual Pattern	Park Design	√	√
	Flora & Fauna	√	√
	Beauty/Aesthetic	√	√
	Peace	√	√
	Harmony	√	√
	Size	√	√
Facilities	Sport Field	√	√
	Court	√	√
	Trails (e.g. Bicycle)	√	√
	Jogging Track	√	√
	Playground	√	√
Location	Visibleness	√	√
	Identifiable	√	√
Water bodies	Pond	√	√
	Lake	√	-

5. CONCLUSION

The research paper appropriately assessed the elements of urban green space attributes in two major parks well located in Ipoh City. The adopted mixed method approach (descriptive statistic and comparative analysis) have successfully developed criteria for green space features efficiency, the sequence rate and park user's acceptance. Urban green space features will be of high significance to the urban environment, landscape and public social activity. They have also contributed to the three predominant social, environmental and economic benefits of human life. Their close connections with human life are based on the features, functionality and effects of the appearance of the park. In conclusion, the findings of this research paper provide valuable tools for social and urban community development. It will help to give the characteristics of the implementation of a sustainable policy indicator for future urban green spaces (parks and recreation) the correct priority.

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PELAKSANAAN e-PORTFOLIO SEBAGAI BAHAN PEMBELAJARAN DAN PENGAJARAN PEMBELIAN RUNCIT MENERUSI STRATEGI PEMBELAJARAN KOLABORATIF

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Abstrak. Perintah Kawalan Pergerakan (PKP) akibat dari pandemik Covid – 19 telah mewujudkan kebimbangan dan kegusaran di kalangan warga pendidik terutamanya mereka yang terlibat didalam sistem pendidikan teknikal dan vokasional untuk mengadaptasikan norma baharu pengajaran dan pembelajaran. Turut merasakan kesan perubahan norma baharu ini adalah penilaian subjek Pembelian Runcit yang berbentuk penilaian secara praktikal. Kursus Pembelian Runcit telah dipilih untuk pelaksanaan kajian penggunaan E-Portfolio. Sampel kajian yang dipilih terdiri daripada 24 orang pelajar Diploma Pengurusan Peruncitan (DRM) di Politeknik Sultan Azlan Shah (PSAS). Aspek yang dikaji ialah pengetahuan dan kemahiran pelajar DRM terhadap penggunaan teknologi dalam penyediaan portfolio secara elektronik. Instrumen soal selidik dan pembangunan bahan E-Portfolio digunakan. Hasil dapatan kajian mendapati pelajar menunjukkan (i) kemahiran pencarian maklumat dengan penggunaan teknologi yang tinggi (ii) kemahiran yang tinggi dalam pemilihan, penilaian dan mengintegrasi maklumat bagi penyediaan E-Portfolio yang tinggi (iii) penawaran fasiliti bagi pelaksanaan E-Portfolio adalah memuaskan. Justeru, penggunaan E-Portfolio adalah dikatakan lebih efisien disebabkan peluang dan ruang maya yang diberikan kepada pelajar dalam menilai kerja akademik mereka secara kritis and efektif.

Kata Kunci: e-portfolio, pembelajaran kolaboratif, pembelian runcit, pengurusan peruncitan

1. PENGENALAN

Pandemik COVID - 19 yang telah melanda negara bermula Januari 2020 telah menyebabkan kepada penutupan institusi pendidikan tinggi dan institusi yang mana ianya telah memberi kesan terhadap struktur Pembelajaran dan Pengajaran (PdP) daripada kaedah PdP secara bersemuka di institusi kepada PdP secara atas talian (PdPT) sepenuhnya. Pada 16 Mei 2020, Mesyuarat Khas Menteri-menteri mengenai Pelaksanaan Perintah Kawalan Pergerakan (PKP) Majlis Keselamatan Negara (MKN) telah meluluskan cadangan Kementerian Pengajian Tinggi (KPT) berkenaan pengendalian aktiviti akademik di kampus Institusi Pengajian Tinggi (IPT) semasa dan pasca PKP. KPT menerusi kenyataan media bertarikh 27 Mei 2020 memaklumkan bahawa semua aktiviti PdP hendaklah di laksanakan secara atas talian sehingga 31 Disember 2020. Semua aktiviti PdP secara bersemuka adalah tidak dibenarkan kecuali untuk beberapa kategori pelajar yang berkeperluan untuk pulang ke kampus secara berperingkat bagi melaksanakan PdP dengan mematuhi sepenuhnya Prosedur Operasi Standard (SOP) yang ditetapkan dan mengutamakan langkah keselamatan serta penjarakkan sosial (Mohe, 2020). Justeru itu, semua pihak haruslah mempersiapkan diri bagi menghadapi norma baharu iaitu kaedah PdP secara atas talian secara menyeluruh (PdPT) semasa tempoh PKP ini demi kelangsungan proses PdP pelajar.

Oleh yang demikian, sistem pembelajaran kolaboratif berasaskan teknologi masa kini merupakan salah satu kaedah pendekatan pengajaran dan pembelajaran (PdP) yang amat sesuai di laksanakan secara agresif oleh para pendidik. Laal & Ghodsi (2012) menyatakan pembelajaran kolaboratif merupakan satu kaedah dalam pengajaran dan pembelajaran (PdP) yang melibatkan pembelajaran rakan sebaya, atau arahan rakan sebaya yang melibatkan pelajar yang bekerja secara berpasangan atau kumpulan kecil untuk membincangkan konsep atau mencari penyelesaian kepada masalah. Sama seperti idea bahawa dua atau tiga kepala adalah lebih baik daripada satu, penyelidik pendidikan telah mendapati bahawa melalui arahan rakan sebaya, pelajar mengajar satu sama lain dengan menangani salah faham dan menjelaskan salah tanggapan. Justeru, pembelajaran secara kolaboratif yang diserapkan dalam pembelajaran yang menggunakan teknologi seperti E-Portfolio dilihat dapat membantu meningkatkan pencapaian pelajar seperti yang dibuktikan melalui kajian-kajian yang telah dijalankan sebelum ini.

Subjek Pembelian Runcit adalah antara satu subjek wajib yang diambil oleh pelajar Diploma Pengurusan Peruncitan di politeknik yang menawarkan Diploma Pengurusan Peruncitan. Subjek ini telah ditawarkan kepada pelajar semester 4. Dengan melihat kepada keperluan penerapan kolaboratif dalam pengajaran dan pembelajaran, maka satu keperluan kajian yang berkaitan dengan pendidikan teknik dan vokasional bagi subjek Pembelian Runcit adalah wajar dijalankan bagi melihat kepada pelaksanaan pengajaran dan masalah yang dihadapi oleh warga Pengajar yang mengajar subjek Pembelian Runcit dalam mengendalikan sesi pengajaran dan pembelajaran dengan menggunakan E-Portfolio sebagai salah satu kaedah pendekatan pembelajaran kolaboratif.

E-Portfolio dari segi istilah akademik adalah koleksi digital yang dicipta oleh pengajar kepada pelajar berkaitan dengan kursus mereka, seperti esays, poster, gambar, video, dan karya seni. Melaui E-Portfolio ini, pengajar juga boleh menangkap aspek-aspek lain dalam kehidupan pelajar, seperti pengalaman sukarelawan, sejarah pekerjaan, aktiviti kokurikulum, dan banyak lagi. Dalam erti kata lain, dokumen E-Portfolios dan membuat pembelajaran pelajar kelihatan menarik dan mudah untuk dinilai dan diakses tahap pencapaian mereka sepanjang mereka berada di institusi pengajian.

Penggunaan E-Portfolio sesuai dijadikan sebagai tempat pengumpulan bahan bukti tugasan yang dilaksanakan oleh pelajar secara atas talian bagi tujuan audit. Ini kerana, E-Portfolio yang dibangunakan mungkin mengandungi semua atau beberapa perkara yang berikut seperti fail pelbagai format (teks, gambar, video, dll.), bukti yang berkaitan dengan kursus yang diambil, program pengajian, dll, penulisan yang mungkin termasuk beberapa draf untuk menunjukkan pembangunan dan penambahbaikan mahupun projek-projek yang disediakan untuk aktiviti kelas atau kokurikulum beserta dengan bukti kreativiti dan prestasi penilaian, analisis dan cadangan.

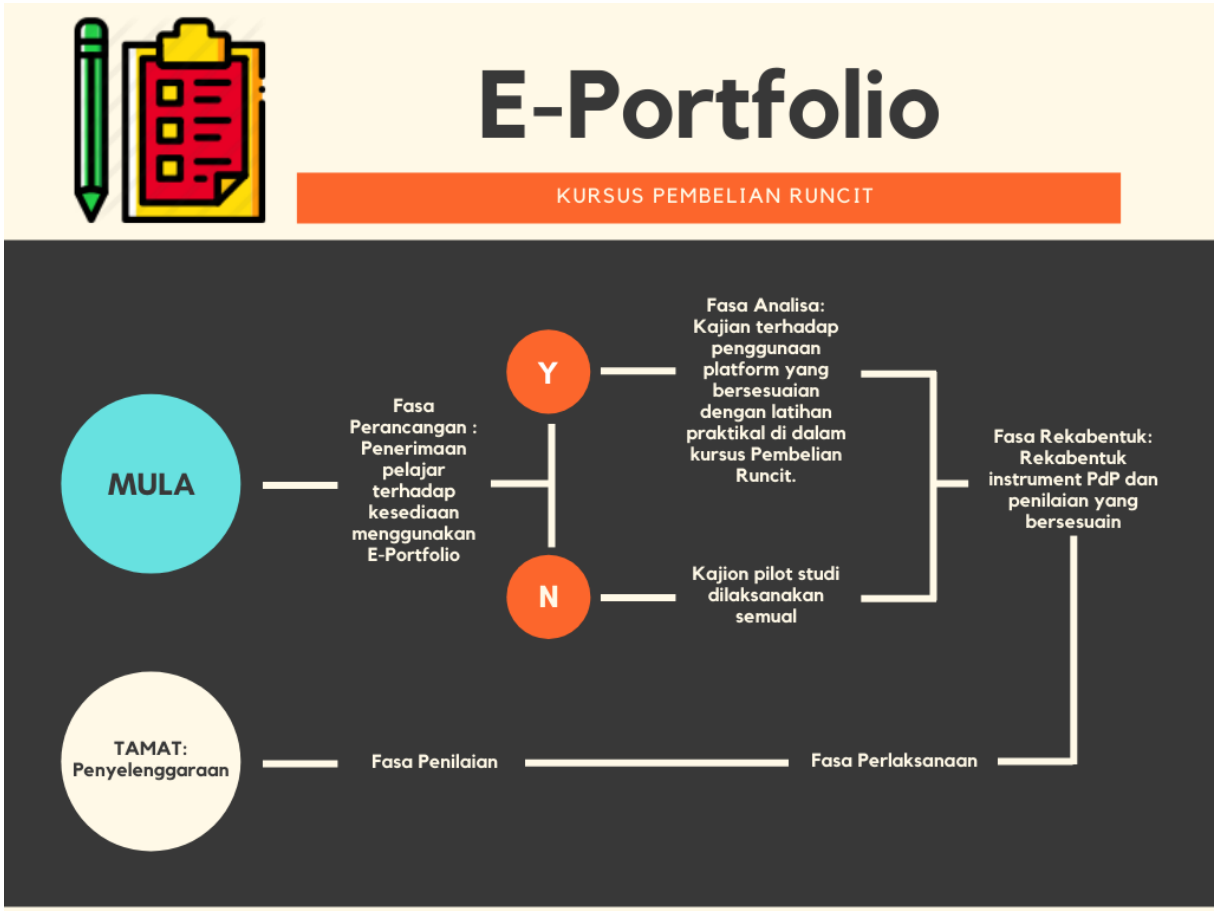
2. MASALAH KAJIAN

Pengurusan pelaksanaan penilaian praktikal pelajar bagi subjek Pembelian Runcit sebelum ini banyak melibatkan pengurusan secara manual yang mana laporan pelajar dinilai melalui fail portfolio praktikal pelajar yang dicetak. Pengajar yang mengajar subjek Pembelian Runcit perlu menyemak laporan pelajar secara manual dan menyimpan fail bahan bukti terhadap kerja - kerja praktikal pelajar bagi tujuan pengauditan. Kecelaruan dalam pengurusan pelaksanaan penilaian bahan pelajar bagi subjek Pembelian Runcit boleh berlaku akibat dari terlalu banyak pengurusan manual yang berasaskan kertas. Kesannya, penyelenggaraan terhadap bahan ini termasuk pengurusan fail bahan menjadi tidak teratur dan akan menyusahkan semua pihak termasuk pihak luar institusi seperti ibu bapa dan penilai dari jabatan untuk membuat semakan (Deborah, 2013) terutama sekali bila berlakunya keadaan yang tidak diduga seperti Pandemik COVID - 19 ini.

Selain daripada itu, pelaksanaan penilaian bahan pelajar bagi subjek Pembelian Runcit secara manual juga turut menyukarkan pengurusan penyimpanan bahan untuk dilaksanakan dengan cekap dan teratur. Setiap bahan pelajar perlulah di cetak dan difailkan untuk disimpan di dalam stor atau bilik khas yang disediakan (Shafinaz, 2010). Pengurusan penyimpanan bahan penilaian ini di dalam stor akan meningkatkan risiko kehilangan bahan bukti lebih-lebih lagi apabila semua bahan bukti bagi subjek yang lain turut di letakkan di dalam stor yang sama dan bercampur-campur dengan bahan-bahan dari tahun-tahun sebelumnya.

3. METODOLOGI KAJIAN

Seramai 24 orang pelajar Diploma Pengurusan Peruncitan Semester 5 dari Politeknik Sultan Azlan telah terlibat sebagai sampel dalam kajian ini. Pelajar semester 5 ini telah dipilih kerana mereka telah mengambil kursus Pembelian Runcit dan telah melaksanakan studi pilot sistem E-Portfolio ini semasa tempoh PKP yang lepas. Kajian ini menggunakan borang soal selidik Google Forms yang berbentuk skala Likert lima (5) mata (1 = Sangat tidak setuju; 5 = Sangat setuju) dan bagi tujuan pengumpulan data kajian pula, pengkaji telah mengedarkan borang soal selidik ini kepada pelajar secara atas talian selari dengan kemajuan era teknologi pada masa kini. Kandungan borang soal selidik yang digunakan ini telah diadpatasikan dari kajian lepas yang telah dilaksanakan di Pusat Latihan Pengajar dan Kemahiran Lanjutan (CIAST) dan Institut Latikan Perundustrian Kuala Lumpur (Rahim, Mohammad Yasin, Mohd Nordin, Nur Yunus, & Rahim, 2013)



Rajah : Metodologi Air Terjun (Sumber: Ian Sommerville, (2007))

Model Air Terjun E-Portfolio bagi kursus Pembelian Runcit telah digunapakai sebagai instrumen kajian. Metodologi ini dipilih kerana aktiviti yang dilakukan untuk membangunkan

projek ini adalah mengikut turutan. Metodologi ini terdiri daripada 5 fasa iaitu fasa perancangan, fasa analisis, fasa reka bentuk, fasa implementasi dan fasa pengujian. Pemilihan model ini dilakukan adalah kerana fasa-fasa adalah berjujukan dimana output fasa pertama mengalir ke fasa kedua dan seterusnya linear. Selain itu, model air terjun juga mudah dipantau kemajuannya.

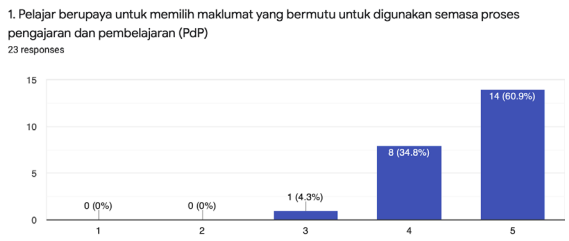
E-Porfolio bagi kursus Pembelian Runcit ini masih di dalam peringkat analisa keperluan yang mana pengkaji masih mengkaji platfrom yang bersesuaian untuk pembangunan sepenuhnya sistem E-Portfolio bagi kursus yang bersifat praktikal ini. Antara platform yang masih diujikaji adalah sistem CIDOS, penggunaan perisian Microsoft yang bersesuaian, Google Drive dan lain –lain aplikasi yang bersesuaian.

4. ANALISIS DAN KEPUTUSAN

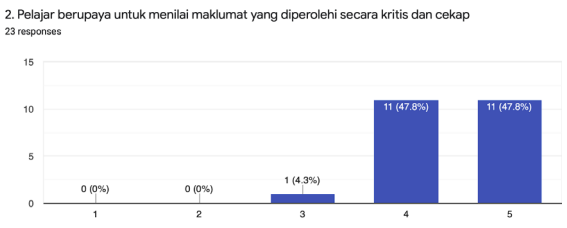
4.1 Tahap Pengetahuan dan Kemahiran Pelajar Semester 5 Diploma Pengurusan Peruncitan Terhadap Aplikasi Teknologi Maklumat dan Komunikasi

Secara keseluruhan analisis didapati tahap pengetahuan pelajar Semester 5 Diploma Pengurusan Peruncitan terhadap aplikasi teknologi maklumat dan komunikasi adalah tinggi. Ini dibuktikan dengan hasil analisis yang diperolehi dalam Jadual 1 hingga Jadual 8 seperti dibawah.

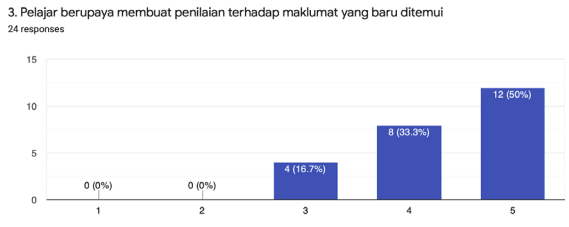
Jadual 1-8: Tahap Pengetahuan dan Kemahiran Pelajar Semester 5 Diploma Pengurusan Peruncitan Terhadap Aplikasi Teknologi Maklumat dan Komunikasi



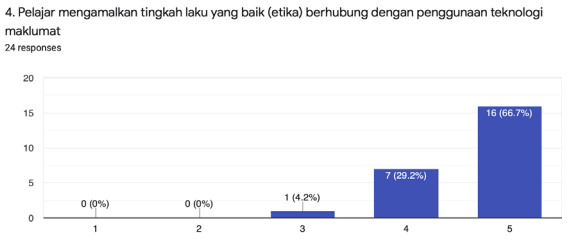
Jadual 1



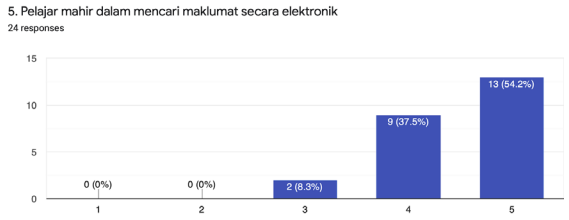
Jadual 2



Jadual 3



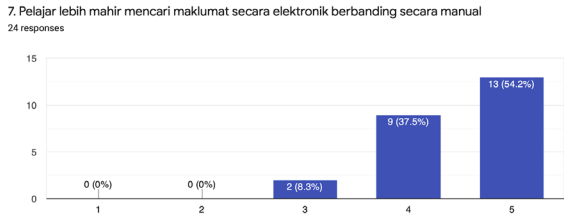
Jadual 4



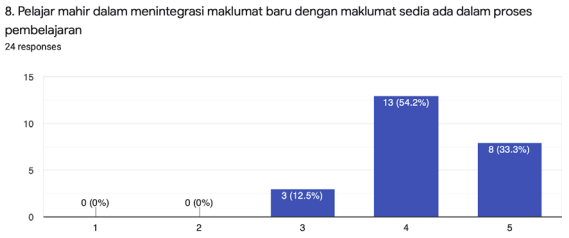
Jadual 5



Jadual 6



Jadual 7



Jadual 8

Dapatan hasil dari soal selidik yang dijalankan seperti di dalam Jadual 1 hingga Jadual 8 menunjukkan pelajar dilihat berupaya untuk memilih maklumat yang bermutu untuk digunakan semasa proses pengajaran dan pembelajaran, mereka juga berupaya untuk menilai maklumat yang diperolehi secara kritis dan cekap selain dari berupaya untuk membuat penilaian terhadap maklumat yang baru mereka ditemui secara di dalam proses pengajaran dan pembelajaran (PdP) secara elektronik melalui segmen E-Portfolio ini. Pelajar juga telah dilihat turut mengamalkan tingkah yang baik (etika) berhubung dengan penggunaan teknologi maklumat.

Selain dari tahap pengetahuan pelajar yang tinggi terhadap aplikasi berkaitan teknologi maklumat dan komunikasi yang tinggi, didapati juga pelajar Semester 5 Diploma Pengurusan Peruncitan yang telah mengambil subjek Pembelian Runcit dilihat turut juga mempunyai kemahiran yang tinggi di dalam penggunaan teknologi maklumat ini seperti yang boleh dilihat didalam Jadual 5 hingga Jadual 8. Jika dilihat didalam Jadual 5, didapati sebanyak 54.2% pelajar Semester 5 Diploma Pengurusan Peruncitan ini mahir didalam mencari maklumat berkaitan dengan subjek Pembelian Runcit secara elektronik seperti melakukan pencarian maklumat berkaitan dengan harga pembekal, mencari maklumat pembekal barangan bagi kedai simulasi didalam laman web yang berkaitan. Mereka juga dilihat cukup mahir untuk mengaplikasikan teknologi maklumat ini didalam sistem pembelajaran seharian mereka. Pelajar ini juga turut dilihat lebih mahir mencari maklumat secara elektronik berbanding secara manual iaitu sebanyak 54.2% sangat bersetuju. Ini adalah bersesuaian dengan mereka ini dari Generasi Z yang dikatakan amat rapat dan mahir didalam penggunaan teknologi (Jones, Vicki & Jo, Jun & Martin, Philippe. (2007). Namun begitu, mereka dilihat agak kurang sedikit mahir atau sederhana didalam mengintegrasikan maklumat baru dengan maklumat sedia ada didalam proses pembelajaran tetapi masalah ini mungkin dapat diatasi dengan sedikit bantuan dari para Pengajar.

4.2 Penawaran fasiliti bagi pelaksanaan E-porfolio

Jadual 9 menunjukkan hasil analisis peratusan fasiliti bagi perlaksaaan E-Portfolio dalam subjek Pembelian Runcit ( )dari sudut pandangan pelajar Semester 5 Diploma Pengurusan Peruncitan. Didapati hasil dari tinjauan, institusi telah menawarkan kemudahan internet kepada pelajar namun begitu kemudahan internet di dalam institusi pengajian adalah

berada di tahap tidak memuaskan iaitu hanya 45.8% menyatakan kemudahan capaian internet di institusi memuaskan dan selebihnya menyatakan tidak.

Oleh yang demikian, para pelajar telah memilih untuk lebih kerap mengakses internet di rumah berbanding di tempat pengajian kerana di rumah mereka juga turut dilengkapi kemudahan internet dan mereka juga turut memiliki komputer peribadi yang mempunyai rangkaian akses internet yang baik.

Jadual 9: Penawaran fasiliti bagi pelaksanaan E-porfolio

Bil	Item	Peratusan Kekerapan (%)	
		Ya	Tidak
1	Mempunyai kemudahan internet di institusi pengajian	100	0
2	Kemudahan capaian internet di institusi pengajian adalah memuaskan	45.8	54.2
3	Mempunyai kemudahan internet di rumah	87.5	12.5
4	Mengakses internet lebih kerap di rumah	83.3	16.7
5	Mengakses internet lebih kerap di tempat pengajian	58.3	41.7
6	Memiliki komputer peribadi	95.8	4.2
7	Komputer peribadi mempunyai rangkaian akses internet	70.8	29.2

5. KESIMPULAN

Secara keseluruhannya, dapat dirumuskan bahawa penggunaan E-Portfolio dalam subjek Pembelian Runcit boleh dilakukan dan diimprosasikan. Ini adalah kerana pelajar mempunyai asas pengetahuan dan kemahiran di dalam penggunaan komputer dan media elektronik dalam pencarian, pemilihan, penilaian dan mengintegrasi maklumat bagi penyediaan E-Portfolio . Pelajar juga mempunyai kemahiran asas penggunaan alat elektronik yang kukuh dan kuat didalam melaksanakan setiap aktiviti PdP yang dirancang. Selain itu, pihak institusi juga sentiasa memandang serius cadangan dan aduan daripada pelajar berkaitan capaian internet terutamanya dalam pelaksanaan PdP secara atas talian. Pelbagai kemudahan fasiliti ICT dirancang bagi memberi ruang kepada Pengajar dan pelajar untuk terus melaksanakan PdP secara atas talian seiring dengan era teknologi dan masalah pandemik yang melanda negara pada masa ini.

Antara cadangan yang perlu dilakukan bagi meningkatkan kemahiran dan pelajar bagi perlaksanaan penggunaan E-Portfolio adalah seperti:
i. Penyediaan soalan dan rubrik penilaian praktikal yang lebih formatif dan terarah yang bersesuaian dengan penilaian secara atas talian.
ii. Menyediakan pelantar yang sesuai bagi keperluan PdP secara atas talian.
iii. Kursus khas dalam meningkatkan kemahiran penggunaan pelbagai aplikasi bagi pelajar yang terlibat dengan PdP secara atas talian.

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MOTION SENSOR DETECTION APPLICATION (MoSAp) IN PSAS LIBRARY: BUILDING LIGHTING INSTALLATION FOR ENERGY SAVING

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Abstract. Green technology basically refers to systems that able to use natural resources or system that able to save energy consumption toward healthier atmosphere. MoSAp is a prototype that has been developed by integrating the green technology and automation system to the normal electrical installation in a building. Based on the data collected, few sections in PSAS's library has been identified as less occupied and lighting resources for whole library operating hours is irrelevant. With MoSAp, lights in particular sector will turn on for certain of time period only if present of object detected. Then after that, the lights will turn off. This is one of the efforts to lower energy demand on the consumer side by using the electricity efficiently, inherent to reduce electricity bill and future more to lower the financial implications. MoSAp project successfully contribute to 74% of energy saving from baseline and reduction of 13.758 tonne carbon emission. MoSAp prototype installed in PSAS library prove that efficient management in lighting system can contribute to the reduction of total monthly energy which can be translated into Greenhouse Gas emission reduction.

Keywords: Green Technology, Energy Saving, Greenhouse

1. INTRODUCTION

On February 2012, Ministry of Higher Education had introduced Energy Performance Contract (EPC) to polytechnics in Malaysia as one of the mechanisms for energy efficiency initiatives. Eight polytechnics was involved in this pioneer project include Politeknik Sultan Azlan Shah (PSAS). PSAS through Sustainable Energy Management (SEM) committee gradually take initiative organize awareness campaigns and monitor action plan for energy conservation, energy efficiency and green energy applications towards potentially contribute to more electricity saving.

By year 2017, PSAS had comprehensively implementing few successful projects and one of it was Motion Sensor Detection Application (MoSAp). MoSAp been installed in PSAS Library bookshelves areas and act as intelligent system which provides the flexible and efficient energy usage to control the lighting system in selected area.

Library in PSAS serves as an information resource centre for learning, teaching, and researching purposes for PSAS community particularly. This library has been operating since April 2003 and floor build-up area covered approximately 3774m^2 (PSAS, 2020). Strategically located in central of campus, hereby easily excess by lecturers and students from all over departments. In addition, PSAS library offers various facilities include technology enable collaborative classrooms, computer labs, discussion rooms, open carrels, and indoor games activity hall which make it conducive to accommodate by 1000 users at a time. These services and facilities can be occupied by user throughout the PSAS Library service hours (PSAS, 2020).

Based on the preliminary data collected, PSAS library had fully light up for average nine hours daily on working days. Some area occasionally occupied also been light up during these service hours daily because of the existing lighting wiring system, especially in bookshelves area. Electricity usage for pass few months also been analyzed and as result SEM had proposed for rewiring the lighting and installation of MoSAp for designated bookshelves area in ground floor and first floor. After approval from PSAS higher management team, this MoSAp project been implemented. The MoSAp works as intelligent lighting system towards smart campus initiative. The main idea of MoSAp is to save the energy consumption and reduce carbon emission.

2. LITERATURE REVIEW

2.1 Green Technology

Green technology refers to a type of technology that is considered environmentally friendly based on its production, process or clean energy production. Green technology is related to clean technology, which specifically refers to products or services that improve operational performance while also reducing costs, energy consumption, waste, or negative effects on the environment (Kenton, 2020).

2.2 Carbon Emission

The largest source of greenhouse gas emissions from human activities is from burning fossil fuels for electricity, heat, and transportation (US EPA, 2020). Human routine activities such as using electricity for lighting, heating and power equipment indirectly contribute to carbon emission (Earthhero, 2017). Other development activities also cut down large expanses of CO2-absorbing trees to make way for agriculture and new developments, or collect lumber to create new products. By removing forests, we also effectively remove the natural systems that absorb and store carbon (Earthhero, 2017).

Greenhouse gases (GHG) can be measured by recording emissions at source by estimating the amount emitted using activity data and applying relevant conversion factors. The emission factors allow organizations and individuals to calculate GHG emissions from a range of activities, including energy use (GreenTech, 2017).

2.3 Library Illumination

Basically, libraries form a space for self-study and group work through both concentration and relaxation. In addition, a proper lighting is emphasis as a welcoming atmosphere (Glamox, 2018). BS EN 12464 specifies lighting requirements for people in indoor workplaces, to meet the needs for visual comfort and performance of people having normal visual capacity. According to BS EN 12464-1 standard, to find the right shelf and the book, a vertical illuminance of 200 lux is required. The uniformity must be high so that the lowermost book is equally visible as the topmost. Different to reading areas, on the other hand needs a good working light. Referring to BS EN 12464-1 standard, the minimum average illuminance should be 500 lux with a high uniformity and low glare.

3. METHODOLOGY

3.1 Design Layout

MoSAp been developed purposely to manage the electricity utilization in infrequently occupied area. MoSAp classified as low-cost investment and constructed using passive infrared (PIR) sensor motion sensor detector HC-SR501 as input and PIC18F4520 microcontroller which been programmed using MPLAB IDE v8.63 software. The PIR sensor located on ceiling, centre between two bookshelf and functions to detect any movement of object that pass through the bookshelf. Figure 1 shows the MoSAp designed printed circuit board (PCB) which act as master controller. Meanwhile, Figure 2 and Figure 3 below shows the single line diagram of MoSAp installation in ground and first floor.

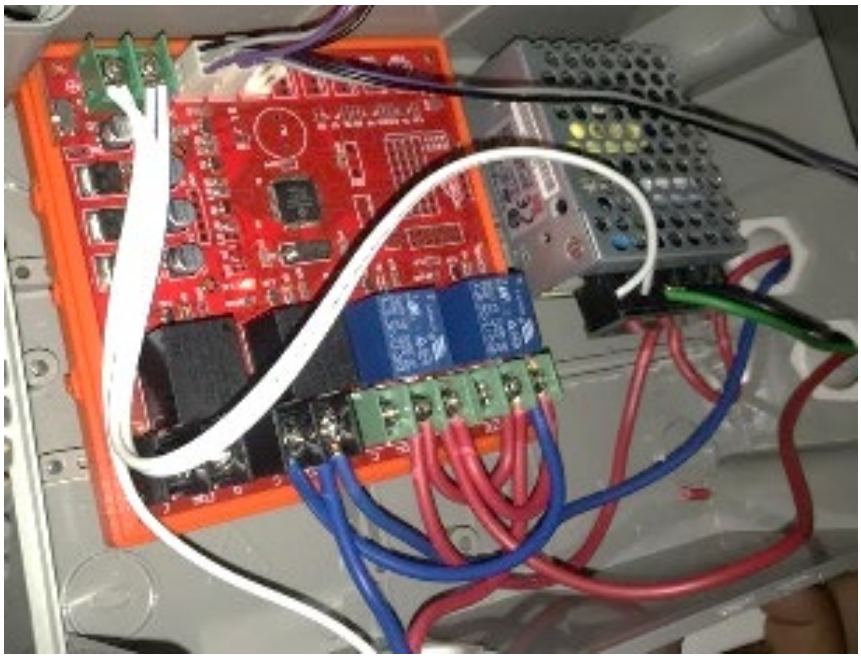


Figure 1: MoSAp PCB Design

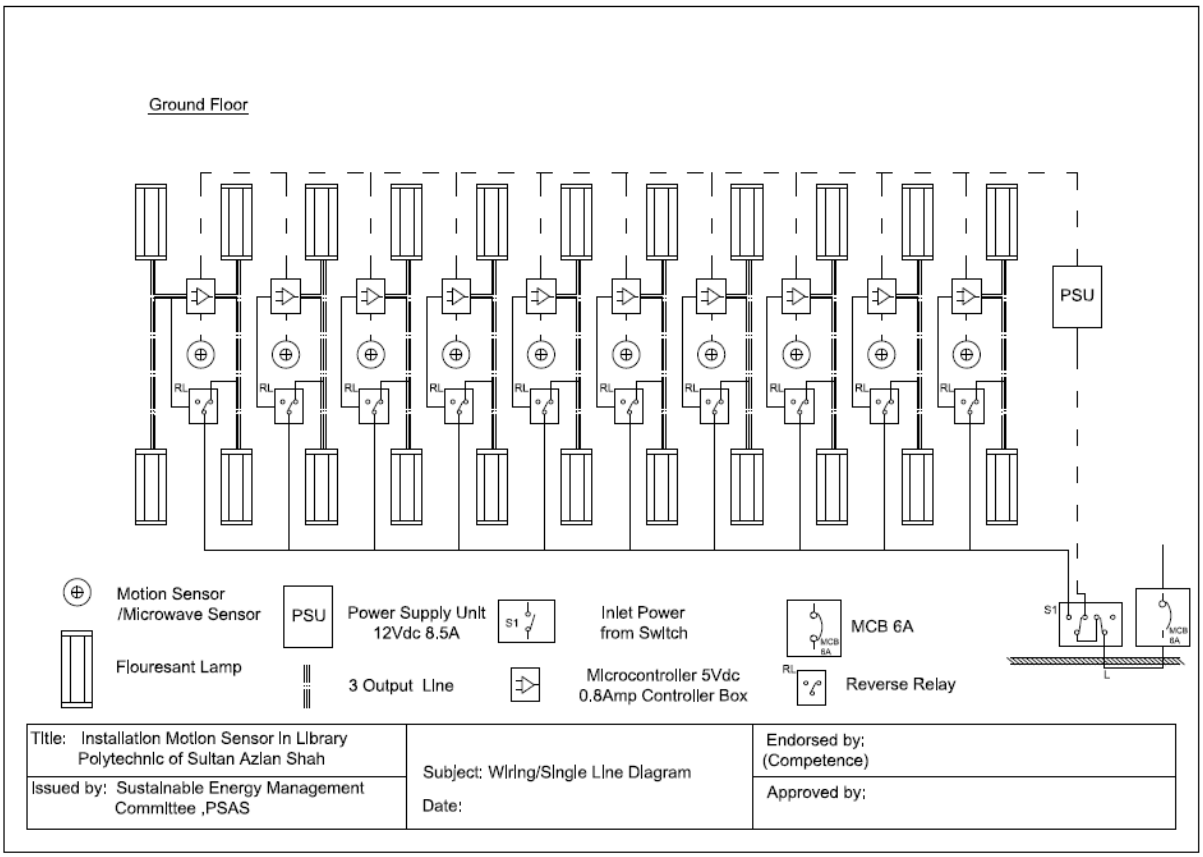


Figure 2: Single line Diagram for Ground Floor

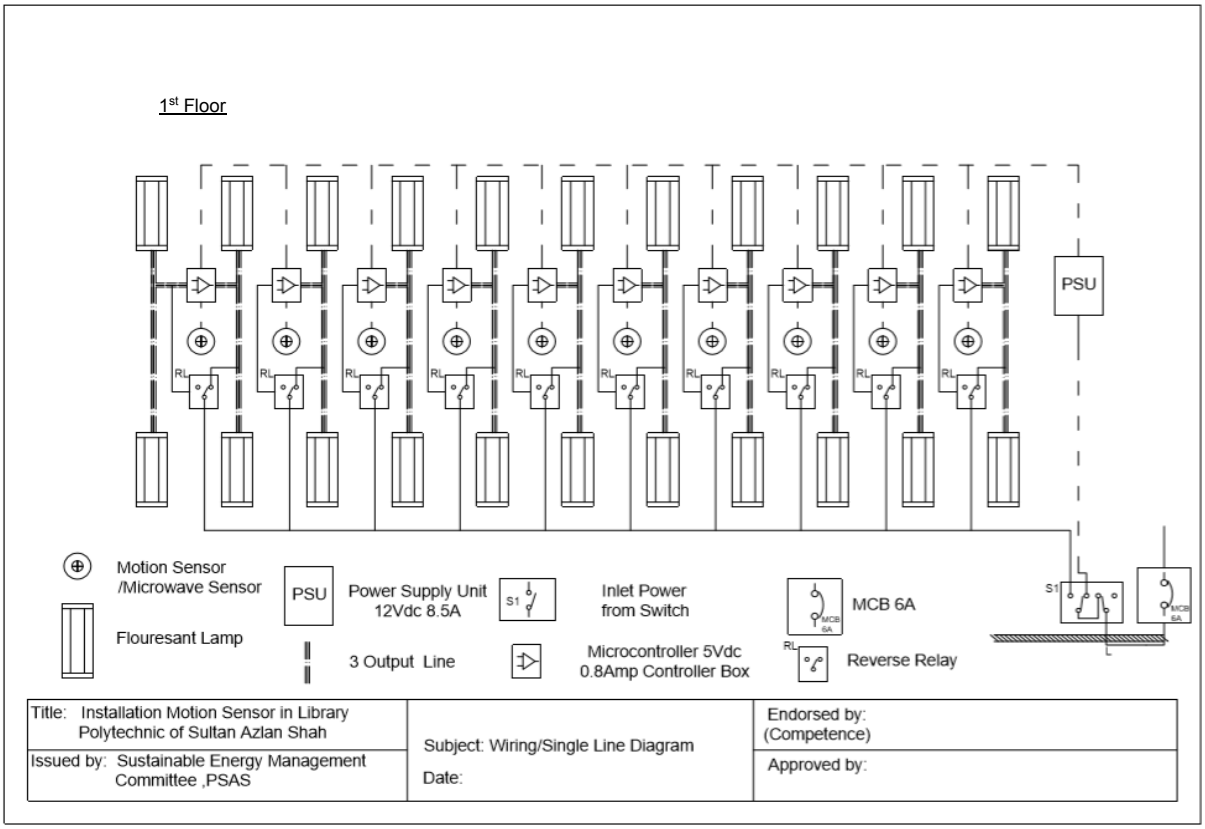


Figure 3: Single line Diagram for First Floor

3.2 Software Development

PIC18F4520 microcontroller been programmed to execute designed task for MoSAp. The flowchart in Figure 4, describe two mode operation of MoSAp either manual or intelligent. In automatic mode, an input will be any object movement that been detected by PIR motion sensor detector. This input will be transferred to the microcontroller, and lamps in respected sector will be switch on. The lights will remain on for duration of ten minutes. Otherwise, when the duration end and no longer motion been detected, the lamps in the sector will switch off automatically. Unlike manual mode, librarian need to switch on and switch off lights manually.

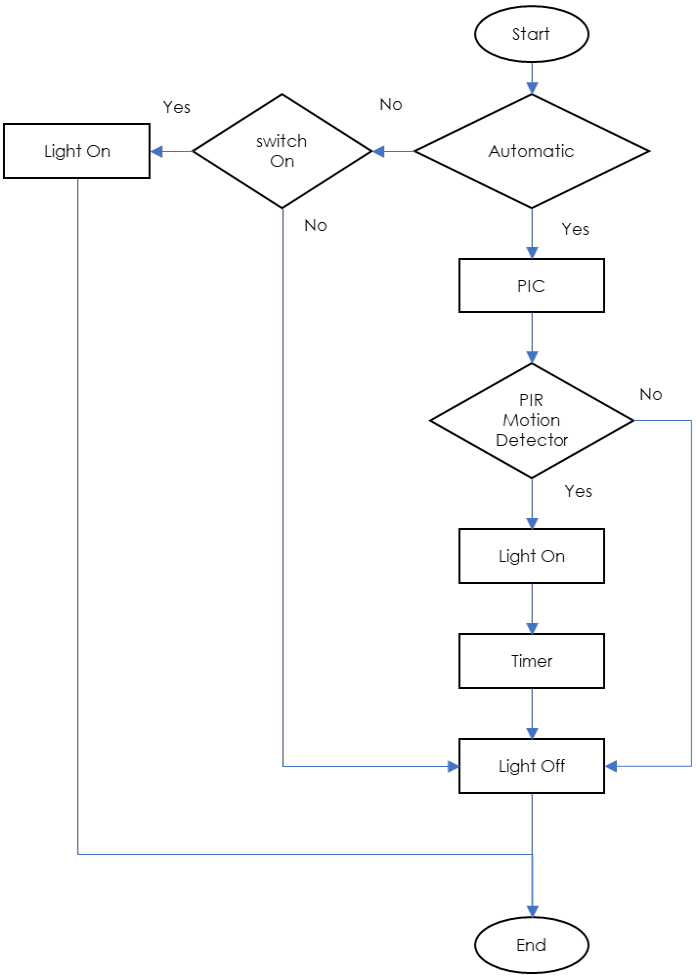


Figure 4: Flowchart of basic MoSAp Operating System

4. ANALYSIS DAN RESULTS

4.1 Energy Saving

PSAS have a few digital energy meters that been installed in main switchboard (MSB) and these meters been monitor by SEM committee member through online Energy Monitoring System (EMSv2). There are five MSB in PSAS and nine energy meters been installed in MSB-2. Table 1 below shows the total energy consumption (kWh) collected from August to September 2018 using energy meters in MSB-2. Based on data collected, library has the highest reading compare to other venue, which are 31,096kWh and 24,981kWh respectively. Hereby, library has been chosen and installation of MoSAp been executed in October 2018.

Table 1: Total Energy Consumption (kWh) for August and September 2018

Meter Name	August (kWh)	September (kWh)
PSAS 2-M1 (Mechanical Department)	18,960	19,509
PSAS 2-M2 (Library)	31,096	24,981
PSAS 2-M3 (Spare MCCB)	0	0
PSAS 2-M4 (To DB Substation 2)	84	85
PSAS 2-M5 (Mechanical Workshops)	2,831	3,119
PSAS 2-M6 (Civil Department)	13,999	12,101
PSAS 2-M7 (Hose Reel Pump)	0	0
PSAS 2-M8 (Student Affair Unit)	10,911	8,840

PSAS 2-M9 (To Cooling Tower No 1)	14,228	12,580

Table 2 below shows the total energy consumption (kWh) collected from energy meter in MSB-2 for month of November and December 2018. Tremendously after MoSAp project accomplish, library's total energy consumption shows a positive pattern of saving. Library's energy consumption for months of November and December lessen to 12,629kWh and 22,823kWh respectively.

Table 2: Total Energy Consumption (kWh) for November and December 2018

Meter Name	November (kWh)	December (kWh)
PSAS 2-M1 (Mechanical Department)	18,813	21,354
PSAS 2-M2 (Library)	12,629	22,823
PSAS 2-M3 (Spare MCCB)	0	0
PSAS 2-M4 (To DB Substation 2)	85	87
PSAS 2-M5 (Mechanical Workshops)	2,177	2,390
PSAS 2-M6 (Civil Department)	11,473	11,840
PSAS 2-M7 (Hose Reel Pump)	0	0
PSAS 2-M8 (Student Affair Unit)	8,041	7,878
PSAS 2-M9 (To Cooling Tower No 1)	13,391	14,861

Table 3 shows the baseline data that been calculated using previous two months reading from August to September 2018. Library's baseline been set as 28,039kWh. Table 3 also indicates percentage of total saving gain from benefit of MoSAp installation compare to other venue without any initiative. Referring to baseline, a total of 20,626 kWh energy usages had been reduce from MoSAp investment. It indicates 74% of saving and the lighting in bookshelves area been used more efficiently without eliminates illumination factor. Percentage of energy saving been calculated using Eq 1.

Table 3: Baseline and Total Saving of Energy Consumption (kWh)

Meter Name	Baseline (kWh)	November (%)	December (%)	Total Saving (%)
PSAS 2-M1 (Mechanical Department)	19,235	2	-11	-9
PSAS 2-M2 (Library)	28,039	55%	19	74
PSAS 2-M3 (Spare MCCB)	0	0	0	0
PSAS 2-M4 (TO DB Substation 2)	85	0	-2	-2
PSAS 2-M5 (Mechanical Workshops)	2,975	27	20	46
PSAS 2-M6 (civil Department)	13,050	12%	9	21
PSAS 2-M7 (Hose Reel Pump)	0	0	0	0
PSAS 2-M8 (Student Affair Unit)	9,876	19	20	39
PSAS 2-M9 (To Cooling Tower No 1)	13,404	0	-11	-11

$$\text{Eq 1: } Energy\ Saving = \frac{(Baseline\ kWh - monthly\ kWh)}{Baseline\ kWh} x\ 100\%$$

4.2 Carbon Emission Reduction

MoSAp practice in PSAS library had also shown potential of carbon emission reduction to atmosphere. Greenhouse Gases (GHG) calculated using Eq 2 and emission factor of 0.667 been used by referring to Clean Development Mechanism (CDM) Electricity Baseline for Malaysia (GreenTech, 2017)

Eq 2 : GHG= Energy saving x Emission Factor (EF)

Total saving of 20,626 kWh energy had contributed to iliminate13.758 tonne carbon emission and symbolically can be represent by 434 trees been saved. Calculation for GHG shown below.

$$\begin{aligned} GHG &= Energy\ Saving\ (kWh) x\ Emission\ Factor\ (EF) \\ &= 20626 kWh x\ 0.667 \\ &= 13758 kg\ CO_2 \\ &= 13.758 tonne\ CO_2 \end{aligned}$$

This proves that lamp electricity consumption effectively contributes to the total monthly energy usage that can be translated into Greenhouse Gas emission reduction. Also, can be represent with 344 trees been saved.

5. CONCLUSION

Based on data analysis, it can be concluded that MoSAp development and installation had meet its objective. MoSAp intelligent lighting system had eliminated unnecessary usage of power and significantly contribute to cost saving and electricity bill reduction. Therefore, carbon emission to atmosphere also been reduced. A total of 20,626 kWh energy been saved in two months after installation which, contribute to 74% of saving from baseline. MoSAp had also support the clean technology by reduction of 13.758 tonne carbon emission. As future planning, MoSAp installation will be expand to few other identified areas as infrequently used by PSAS community to gain more benefit from it.

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RHA PLASTIC COVER BLOCKS

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Abstract: Concrete cover blocks containing rice husk ash should be promoted as a new construction material to replace the existing concrete cover in market. The production of cement is expensive, requires high energy, diminishes natural resources and emits large amount of CO2. In this study, the main objectives are to produce the cover block from carbon RHA and plastic. It is also to determine the compressive strength and water absorption of the cover block. The uses of rice husk ash (RHA) for making concrete cover can reduce materials cost due to cement savings and environmental benefits. RHA Plastic cover blocks have its potential to replace conventional concrete cover block due to its plastic properties that will never crack when loads are put onto them. The results show that for 7 days, the compressive strength of RHA Plastic is higher than cement cover blocks which is the value of the strength is 4.3MPa. It shows that the RHA having a better compressive strength as normal material in production of RHA Plastic cover blocks compared to cement. The value of water absorption of RHA plastic cover block is lower than concrete cover. Therefore, the RHA Plastic cover blocks can be introduced as a new type of concrete cover without the use of cement in the construction industry.

Keywords: rice husk ash, concrete cover

1. INTRODUCTION

Concrete cover is used during reinforced concrete work because it is really important to embed the steel (reinforcement) in the concrete in order to avoid the rebar gets corrode or rusty and to add fire protection. Concrete cover has been used widely because it helps the structure to stand against premature failure of structure. Hence, using the concrete cover is very essential to the longevity of structure significantly without adding much cost. Refer to Table 1, 25mm thick concrete cover is most commonly used in the construction of beam for structures of standard size.

Table 1: Size and application of concrete cover

APPLICATION	SIZE (mm)
Roof Slab etc.	20mm
Beam, Lintel etc.	25mm
Column, Wall etc.	40mm
Foundation, Basement etc.	50mm

Neville (1997) described cement as a material with adhesive and cohesive properties that make it capable of bonding mineral fragments (stones, sand, bricks, building block, etc.) into a compact whole. Cement is the product of the silicate industry and is manufactured on the largest scale and used extensively in industrial buildings, building homes and other structures. It is time to look into the use of local inexpensive raw materials or industrial waste materials in replacing cement or build the construction. Cover blocks mixed with rice husk ash need to be widely marketed as a new building materials which to replace existing blocks in the industry. Rice husk ash is a by-product of the goods for rice milling. Rice is a primary source of food for billions of people especially in the Asian region. In rice milling operations

approximately 78% of the weight is recognized as rice and the approximately 22% are rice husks. In paddy milling process, approximately 78% by weight is received as rice and the rest, about 22% as husk. The un- burnt rice husk contained about 50% cellulose, 25-30% lignin and 15%-20% silica (Ismail et al., 1996). Having pozzolanic properties, not only give technical advantage to the resulting concrete but it also reduced cement consumption, thus the resulting benefits in terms of energy saving economy, environmental protection and conservation of resources will be substantial.

There is lack of research being done in Malaysia to develop the quality of concrete cover blocks available on the market. The agricultural residue that is under consideration in this study is the rice husk. The disposal of rice husks created environmental problem that leads to the idea of substituting rice husk ash (RHA) for silica in cement manufactured. As a result of the lack of emissions, the use of rice husk ash as a replacement for cement should cover the lack of cement as well as increase air quality. The manufacture of concrete cover blocks should comply with international requirements specifying the product's particular properties (Gunduzz, 2008). The use of rice husk in the manufacture of polymer composites therefore attracts a significant interest. From many rice producing countries in the world it is one of the most productive agricultural waste. Rice husk is a layer of rice grains that is difficult to cover and remove as a by-product during the milling process from rice seeds. As a waste product from the agricultural and forest waste industries, it is effectively free.

This study was conducted out to realize an environmentally friendly project, the use of rice husk ash has been studied and applied as an additive to replace cement in mortar mixture. Therefore, this study used the resulting cover blocks is made of plastic and rice husk ash. Plastic is a substance composed of large organic molecules (carbon-containing) which can be formed into different products. Long carbon chains that give plastics many useful properties are the molecules which make up plastic. A substance composed of long-chain molecules is commonly called a polymer. Plastic is a synthetic, synthetic (chemical) material that is mostly derived from fossil fuels, such as oil, coal, or natural gas. Plastic is used in almost every manufacturing industry such as construction and others.

2. MATERIALS

Rice husk ash is a highly reactive pozzolanic additive in cement and concrete and can be used for the purpose of strength acceleration in concrete mixtures containing less reactive pozzolans such as fly ash (Mehta,1989). The main raw material that are used in this study is carbon rice husk ash which has been grinded into fine particles. It is found that rice husk ash is an ideal for use as a cement substitute because it contains a high silica content and can minimise the waste dumping issue (Rosli, 2017). The use of rice husk ash as partial Portland cement replacement has given impetus to research and development of methods for producing energy and other useful industrial by-products (Kartini, 2010).

Rice husk ash is a general term use to describe the type of ash produced from burning rice husk. Rice husks are the shells produced during the de-husking operation of paddy rice. The average composition of well-burnt RHA is 90% amourphous silica, 5% carbon, and 2% K_2O. 80-85% of silica can be found in the RHA (Siddique, 2008). The silica can be found in three forms, one of them is amorphous silica. Amorphous silica is reactive as pozzolans and can be replaced some of the Portland cement. Amorphous silica was founded in RHA that is burned in specific temperature and duration (Chindaprasirt et al., 2007).

Plastic are synthetic materials made from polymers which are long molecules built around chains of carbon atoms, that is hydrogen, oxygen, sulphur, and others (Woodford, 2019). Plastic can be moulded and shaped by heat and pressure. A good plastic product takes the advantage of plasticity, such as low density, low electrical conductivity, transparency, and toughness (Rodriguez, 2006).

3. METHODOLOGY

The samples for each RHA plastic cover block and cement concrete cover was made before conducting the test. The materials used in order to produce RHA plastic cover blocks are 305mm x 305mm HDPE plastic bag, cooking oil and carbon rice husk ash (RHA). The apparatus required are cooking pot, spatula and PVC pipe that is cut into required height and tray.

To produce one sample of RHA plastic cover block, prepare 12 sheets of 305mm x 305mm HDPE plastic bag and 20 grams of carbon RHA, a cooking pot and stove, spatula and cooking oil. Turn on the stove and put some oil in the cooking pot, take 12 sheets of HDPE plastic and put it into the cooking pot and stir until its shape became small and rounded. Put 20 grams of carbon RHA and keep stirring until the plastic RHA becomes half-way melting. The process takes only 3-5 minutes on low heat temperature of the stove. Turn of the heat and put the plastic RHA into PVC moulds and let it rest and shaped into round shape. It will harden after 5 minutes of rest.

All tests are performed on RHA plastic cover blocks of similar dimension, 55mm of width, 20mm of thickness, 54mm of length ± and 35 grams of weight ±. To produce accurate dimension and weight is almost impossible due to its plastic properties hence ± is used. The total number of RHA plastic cover block sample produced for compressive strength test and water absorption test are 6 sample per test and 3 sample are used per week. The total days of testing are 14 days or 2 weeks. The test methods are carried out but due to the lack of standard for the concrete cover, the minimum size of the concrete cover that is 50mm.



Figure 1: Apparatus use for compressive strength test

The sample are tested to identify their properties in compressive test strength after 7 and 14 days of curing period. The compressive strength test was determined by using computerized Universal Testing Machine strength test machine. The average value of compressive strength for each type of plastic RHA cover block and cement cover block as control was calculated after the result.



Figure 2: Water absorption test

The test for determining water absorption is done by submerging the RHA plastic cover block into water and put into cold temperature of 20°C for 7 and 14 days. The initial weight and final weight of the plastic RHA cover block was recorded. The differences are then converted into percentage.

4. RESULTS AND DISCUSSION

The analysis of the data was based on the testing that was conducted. The test that was carried out are compression strength and water absorption. The result of the testing is evaluated and discuss as shown in Table 1.

Table 2: The various results for testing of the sample

Test	Days	Cement	RHA Plastic
Compression Strength (MPa)	7	4.00	4.38
	14	9.10	5.98
Water Absorption (%)	7	6.7	6.3
	14	9.0	4.6

From this figure it is found that cement at 14 days is the highest compressive strength with 9.1 MPa and the lowest value of compressive strength is cement at 7 days with 4.00 MPa. It is also found that the result for 7 days shown the compressive strength of RHA plastic is higher than cement with that RHA Plastic value 4.3 MPa. A study conducted by Kartini (2004-2009) revealed that the compressive strength of cement and RHA concretes increase with age. However, the RHA concrete attained lower values of compressive strength than the cement concrete at early ages of 7 days. From the result obtained, it is showed that early 7 days, RHA plastic cover block is having a better compressive strength as normal material in production of RHA plastic compared to cement.

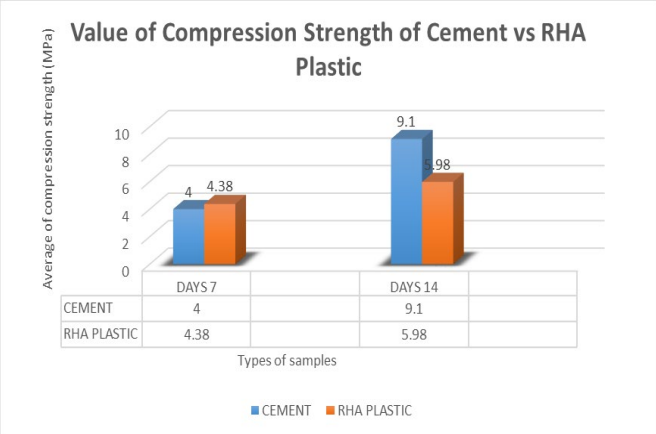


Figure 3: Comparing the average of compression strength of Cement and RHA Plastic with days

At the result for 14 days showed the compressive strength of RHA Plastic is lower than cement with that value is 5.98 MPa. From this result showed cement having a better compressive

strength when cured. Ikpong (1993) reported that on various grades of concrete and with varying levels of cement substitution by volume, reveals that the compressive strength increase with age but decreased with RHA content.

As shown in Table 2, it is clearly seen that the RHA plastic cover block cured in water gave lower permeability compared to cement. It shows that pore distribution of cover block is modified with the presence of RHA and the permeability is lowered if curing is sufficient. This result confirmed the importance of curing where it resulted in less permeable cover blocks.

5. CONCLUSION

This study was carried out to evaluate the significance of utilizing agriculture and waste materials such as rice husk ash (RHA) and wasted plastic bags and converting them into construction material that is RHA plastic cover blocks, something useful for the construction industry. From the result obtained from this research we can conclude that:

i. The result of this research shows that RHA plastic cover block needs more improvements to be added to be used in the construction industry as a construction material. Based on the British Standard for concrete cover, concrete cover should have etc.
ii. The RHA plastic cover block is significantly lightweight when being compared to the standard concrete cover. The cost for the RHA plastic cover block is much lower because it does not use cement and cement is more expensive.
iii. RHA plastic cover block have lower rate of water absorption when compared to standard concrete cover.
iv. RHA plastic cover block can be introduced as a new type of concrete cover in the construction industry as it reduced the application of sand and cement to save cost while saving the earth by reusing the old and used plastic and utilizing the carbon RHA.

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POTENSI SISTEM PENUAIAN AIR HUJAN UNTUK BANGUNAN AKADEMIK MENGGUNAKAN MODEL SIMULASI KESEIMBANGAN AIR HARIAN

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Abstrak. Pada masa kini, terdapat peningkatan terhadap pemasangan Sistem Penuaian Air Hujan (SPAH) di Malaysia disebabkan oleh penguatkuasaan pihak berkuasa tempatan dan juga potensi besar SPAH berdasarkan jumlah curahan hujan yang terdapat di negara ini . Dalam persekitaran kampus, SPAH boleh dijadikan sebagai salah satu daripada inisiatif kampus hijau terutamanya untuk kegunaan air yang tidak boleh diminum seperti untuk simbahan tandas. Tujuan utama kajian ini dijalankan adalah untuk menganalisis potensi SPAH bagi mengantikan penggunaan air bersih untuk tujuan pembilasan tandas di empat buah bangunan akademik di Politeknik Sultan Azlan Shah (PSAS) iaitu Jabatan Kejuruteraan Awam (JKA), Jabatan Kejuruteraan Elektrik (JKE), Jabatan Kejuruteraan Mekanikal (JKM) dan Jabatan Perdagangan (JP). Di samping itu, kajian ini juga dijalankan untuk menentukan saiz tangki optimum yang diperlukan bagi setiap bangunan akademik tersebut. Data purata curahan air hujan selama 10 tahun dari stesen Felda Gedangsa, keluasan bumbung dan permintaan air untuk simbahan tandas setiap bangunan diperolehi dan dianalisis menggunakan model simulasi keseimbangan air harian bagi menentukan potensi SPAH untuk menggantikan penggunaan air bersih dalam kegunaan simbahan tandas. Hasil kajian mendapati bahawa untuk menggantikan sepenuhnya penggunaan air bersih untuk kegunaan simbahan tandas dengan SPAH, ukuran tangki yang diperlukan untuk JKE adalah 120 m^3, JKA 150 m^3 , JKM 210m^3 dan ukuran tangki yang lebih besar diperlukan untuk bangunan JP iaitu 330m^3. Penemuan ini menunjukkan bahawa SPAH berpotensi menggantikan penggunaan air bersih untuk tujuan simbahan tandas di bangunan akademik. Hasil kajian ini juga dapat di gunakan sebagai panduan di dalam merekabentuk pemasangan SPAH untuk kegunaan intitusi pendidikan ke arah merealisasikan agenda kampus hijau.

Kata Kunci: Sistem Penuaian Air Hujan, Potensi

1. PENGENALAN

Malaysia merupakan satu negara tropika yang kaya dengan sumber air dan menerima jumlah hujan yang agak tinggi iaitu sekitar 2400 mm atau 324 bilion m^3 setahun (Che-Ani et al., 2009). Sebelum itu, Salmah dan Rafidah (1999) menyatakan bahawa hujan yang diterima di Malaysia adalah sekitar 3000 mm setahun iaitu 2420 mm di Semenanjung Malaysia, 2360 mm di Sabah dan 3830 mm di Sarawak. Data semasa yang dikeluarkan oleh Bank Dunia (2018) menunjukkan bahawa data purata hujan dari tahun 1991 hingga 2015 adalah sekitar 3098.4 mm setiap tahun. Namun, Malaysia masih mengalami masalah bekalan air bersih yang mana masih terdapat beberapa negeri di negara ini yang sering terputus bekalan air bersih seperti di negeri Selangor.

Sistem Penuaian Air Hujan (SPAH) merupakan salah satu initiatif yang diambil oleh kerajaan dalam usaha untuk mengatasi kekurangan sumber air yang dihadapi. Di Malaysia, SPAH telah dilaksanakan sejak tahun 1984 di kawasan luar bandar iaitu di Sandakan, Sabah berikutan masalah bekalan air terawat yang terhad (Majlis Perbandaran Sandakan, 2008). Perlaksanaan SPAH juga dapat menyumbang ke arah pembangunan teknologi hijau dan kelestarian alam sekitar melalui penjimatan air yang diperolehi dari sistem ini. Dengan adanya sistem SPAH ini juga, ianya dapat dijadikan alternatif dalam penjimatan air di bangunan (Özdemir et al., 2011; Domènech et al., 2013).

Menurut Che-Ani et al. (2009), SPAH adalah sistem yang menggunakan teknik saintifik untuk menyimpan air hujan yang jatuh di permukaan bumbung ke dalam tangki simpanan dan digunakan untuk kegunaan harian seperti mandi, mencuci pakaian, tandas dan penyiraman tanaman. Menurut *Standard Specifications for Building Works* (2014), air hujan yang dikumpul di Malaysia hanya dapat digunakan untuk air yang tidak boleh diminum seperti untuk pembilasan tandas, pembersihan umum dan pengairan landskap. Di antara semua kegunaan tersebut, pembilasan tandas menggunakan jumlah air yang tertinggi iaitu sekitar 63% daripada penggunaan air domestik (Hamid dan Nordin, 2011).

Maka, objektif utama kajian ini adalah untuk menganalisis potensi SPAH bagi mengantikan penggunaan air bersih untuk tujuan pembilasan tandas. Kajian ini dilakukan di bangunan akademik memandangkan kategori bangunan ini mempunyai jumlah penghuni yang ramai yang mana penggunaan airnya juga adalah tinggi. Kajian dijalankan di empat buah bangunan akademik di Politeknik Sultan Azlan Shah (PSAS) iaitu Jabatan Kejuruteraan Awam (JKA), Jabatan Kejuruteraan Elektrik (JKE), Jabatan kejuruteraan Mekanikal (JKM) dan Jabatan Perdagangan (JP). Di samping itu, kajian ini juga dijalankan untuk menentukan saiz tangki optimum yang diperlukan bagi setiap bangunan akademik tersebut. Hasil kajian ini boleh dijadikan sebagai panduan di dalam merekabentuk SPAH untuk institusi pendidikan, yamg mana ianya dapat membantu menjimatkan penggunaan air bersih, mengurangkan bil air dan juga dapat membantu dalam usaha untuk mencapai matlamat perlaksanaan kampus hijau.

2. SOROTAN KAJIAN

2.1 Pengenalan Sistem Penuaian Air Hujan (SPAH)

2.1.1 Definisi SPAH

Secara umumnya, SPAH merujuk kepada pengumpulan air hujan yang jatuh ke bumbung dan disimpan untuk kegunaan harian. Manakala kajian semasa mendefinisikan SPAH dengan cara yang berbeza seperti yang dinyatakan oleh Lani et al. (2018), "SPAH dapat didefinisikan sebagai pengumpulan dan penyimpanan air hujan untuk digunakan daripada ianya dibazirkan sebagai air larian". Walau apapun maksud yang ditafsirkan, secara keseluruhannya sistem ini adalah merupakan kaedah dalam mencari sumber air alternatif.

2.1.2 Tujuan SPAH

Terdapat pelbagai tujuan yang boleh digunakan di dalam perlaksanaan SPAH. Kajian yang dilaksanakan oleh Morales-Pinzón et al. (2015) telah mengenal pasti bahawa dengan adanya perlaksanaan SPAH, ianya dapat memberikan manfaat kepada ekonomi, alam sekitar dan juga sosial di samping dapat membantu memenuhi permintaan air yang tinggi. Kajian terbaru oleh Jones et al. (2010) juga berpendapat bahawa SPAH adalah satu sistem yang digunakan untuk menjimatkan penggunaan air bersih dan sekaligus menyelesaikan masalah kekurangan air.

2.1.3 Kebaikan SPAH

Tedapat beberapa kebaikan dengan pemasangan SPAH iaitu ia dapat menjimatkan penggunaan air bersih, mengurangkan kejadian banjir kilat bagi kawasan bandar khususnya, mengurangkan beban kerajaan untuk menggantikan saluran paip yang lama dan juga menyediakan sumber air alternatif. De Gois et al. (2015) mendakwa bahawa SPAH

juga berpotensi dalam mengatasi masalah kekurangan air dan mengurangkan kebergantungan pada bekalan air terawat.

2.2 Pemasangan dan Rekabentuk SPAH

2.2.1 Elemen SPAH

Jadual 1 menunjukkan beberapa garis panduan di Malaysia yang telah mengariskan pelbagai elemen yang diperlukan untuk pemasangan dan rekabentuk SPAH. Manual Saliran Mesra Alam Malaysia (MSMA) yang diterbitkan oleh Jabatan Pengairan dan Saliran (2012) mengariskan terdapat lima elemen SPAH yang diperlukan untuk pemasangan SPAH iaitu kawasan tadahan, *conveyance*, penapis, tangki simpanan dan paip agihan. Manakala Garis Panduan Sistem Pengumpulan dan Penggunaan Air Hujan yang diterbitkan oleh Jabatan Perancangan Bandar dan Desa, Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan menyatakan terdapat empat elemen SPAH iaitu kawasan tadahan, *conveyance*, tangki simpanan dan paip agihan. Elemen yang sama juga telah dinyatakan di dalam NAHRIM *Technical Guide No. 2* yang diterbitkan oleh Jabatan Pengairan dan Saliran (JPS) pada tahun 2014.

Jadual 1: Garis Panduan di Malaysia

	Kawasan Tadahan	***Conveyance***	**Penapis**	**Tangki Simpanan**	**Paip Agihan**
MSMA 2nd Edition	√	√	√	√	√
Garis Panduan Sistem Pengumpulan dan Penggunaan Air Hujan	√	√		√	√
NAHRIM *Technical Guide No.2.*	√	√		√	√

2.2.2 Kawasan Tadahan Air Hujan

Kawasan tadahan dalam konteks SPAH merujuk pada kawasan bumbung bangunan yang merupakan titik kontak pertama air hujan (Texas A&M AgriLife Extension). Menurut NAHRIM Technical Guide No. 2 (2014) pula, kawasan tadahan didefinisikan sebagai kawasan pengumpulan di mana air hujan yang jatuh dikumpul. Manakala MSMA (2012) pula mendefinisikan sebagai kawasan tadahan air hujan yang turun iaitu bumbung, jalan atau kawasan lanskap.

2.2.3 Conveyance

Conveyance di dalam SPAH terdiri daripada *gutter dan* paip saluran air hujan yang merupakan rangkaian paip yang membawa air hujan dari permukaan bumbung ke tangki penyimpanan (Texas A&M AgriLife Extension). Di dalam MSMA (2012) menyatakan bahawa *Conveyance* adalah saluran atau paip yang menyalurkan air hujan dari kawasan tadahan ke tangki penyimpanan. Manakala menurut NAHRIM *Technical Guide No. 2 (2014*), *Conveyance* didefinisikan sebagai saluran sempit yang mengumpulkan air hujan dari bumbung bangunan dan mengalirkan air ke tangki simpanan air hujan dan melalui penapis.

2.2.4 Penapis

Villarreal dan Dixon (2005) dan MSMA (2012) menyatakan bahawa pemasangan alat penapis di dalam SPAH dapat meningkatkan kualiti air hujan yang dikumpul. Penapis didefinisikan sebagai alat yang biasanya dipasang di dalam SPAH (NAHRIM *Technical Guide No. 2 (2014*). Namun, menurut Gikas dan Tsihrintzis (2012) sistem penapis dapat meningkatkan kualiti air hujan yang dikumpul tetapi tidak dapat mengelakkan pencemaran mikroba yang terkandung di dalam air hujan yang tersimpan.

2.2.5 Tangki Simpanan

Tangki simpanan merupakan salah satu komponen SPAH yang paling penting di mana ia digunakan untuk menyimpan air hujan yang dikumpul yang akan digunakan. Tujuan utama

tangki simpanan adalah untuk memastikan air yang disimpan selamat digunakan dan selamat dari sebarang akses haiwan (Texas A&M AgriLife Extension). Manakala menurut MSMA (2012), tangki simpanan adalah satu komponen yang mengumpul dan menyimpan air hujan. Nahrim (2014) menyatakan bahawa tangki simpanan air hujan adalah tempat yang digunakan untuk mengumpul dan menyimpan air hujan bagi mengurangkan penggunaan air bersih yang dapat memberikan manfaat jangka panjang dari segi ekonomi dan juga persekitaran.

2.2.6 Paip Pengagihan
Pap pengagihan dalam SPAH secara umumnya ditafsirkan sebagai satu komponen pengagihan yang menyalurkan air dari tempat penyimpanan ke tempat penggunaan menerusi paip, pam dan aksesori lain seperti injap (Texas A&M AgriLife Extension). Menurut MSMA (2012), paip pengagihan didefinisikan sebagai sistem yang menyalurkan air hujan ke tempat penggunaan sama ada secara graviti atau dengan penggunaan pam. Nahrim (2014) menyatakan bahawa paip pengagihan terdiri daripada alat seperti hos, paip servis dan injap yang digunakan untuk mengawal aliran dan arah aliran air hujan.

3. METODOLOGI KAJIAN

3.1 Potensi Air Hujan
Potensi Air Hujan yang dikumpul (PAH) dikira dengan mempertimbangkan purata jumlah hujan, luas bumbung dan pekali air larian (Silva et al., 2015). Menurut Rahman (2017), SPAH harus direkabentuk dengan mengambil kira keadaan jumlah hujan setempat. Oleh itu, data hujan dari Stesen Felda Gedangsa dipilih untuk kajian ini kerana ia berhampiran dengan kawasan kajian iaitu dengan jarak 13.8km. Dalam kajian ini juga, purata jumlah hujan harian selama 10 tahun iaitu dari bulan Januari 2008 hingga Disember 2018 telah digunakan.

Bagi menganggarkan pengiraan PAH, Persamaan 1 yang diadaptasi dari Lani et.al. (2018a) diguna pakai seperti yang di nyatakan bawah:

$$\textit{Persamaan 1: } PAH = KB \; x \; PAR \; x \; DR$$

dimana *PAH* ialah Potensi Air Hujan (m^3), *KB* ialah Kawasan Bumbung, *PAR* ialah Pekali Air Larian (-) dan *PAHH* ialah Purata Air Hujan Harian (m). Untuk mengira kawasan bumbung tadahan iaitu KB, Persamaan 2 dibawah telah digunakan.

$$\textit{Persamaan 2: } KB = (PKB \; x \; LKB) \; x \; CB$$

dimana *KB* ialah Kawasan Bumbung, *PKB* ialah panjang kawasan bumbung (m^2) , *LKB* ialah Lebar Bumbung (m) dan CB ialah Curam Bumbung (°).
3.2 Permintaan Air

Permintaan Air (PA) adalah penggunaan air oleh penghuni bangunan iaitu untuk kegunaan membersih, mencuci, minum dan lain-lain. Kajian ini hanya memfokuskan kepada permintaan air bagi penggunaan simbahan tandas sahaja. Berdasarkan Vickers (2001) dan Nahrim (2014), purata penggunaan simbahan tandas yang digunakan setiap hari bagi keperluan dosmetik adalah 5 kali sehari. Walau bagaimanapun, purata penggunaan air yang digunakan dalam kajian ini diperolehi dari hasil tinjauan soal selidik yang dilaksanakan sebelum ini iaitu dengan mengambil kira kekerapan penggunaan tandas dan tempoh masa pengunaan bangunan tersebut. Soal selidik ini telah diedarkan kepada pelajar dan pensyarah di PSAS secara di atas talian dengan menggunakan *Google Form*. Data ini telah di analisis dengan mengunakkan perisian SPSS.

Permintaan air dalam kajian ini dikiran dengan menggunakan Persamaan 3 dibawah:

$$\textit{Persamaan 3: } PA = B \; x \; FT \; x \; FW$$

dimana *PA* ialah permintaan harian untuk simbahan tandas , *B* ialah jumlah keseluruhan penghuni bangunan, *FT* ialah purata bilangan kekerapan simbahan tandas setiap hari dan *FW* ialah jumlah air yang diperlukan untuk sekali simbahan tandas.

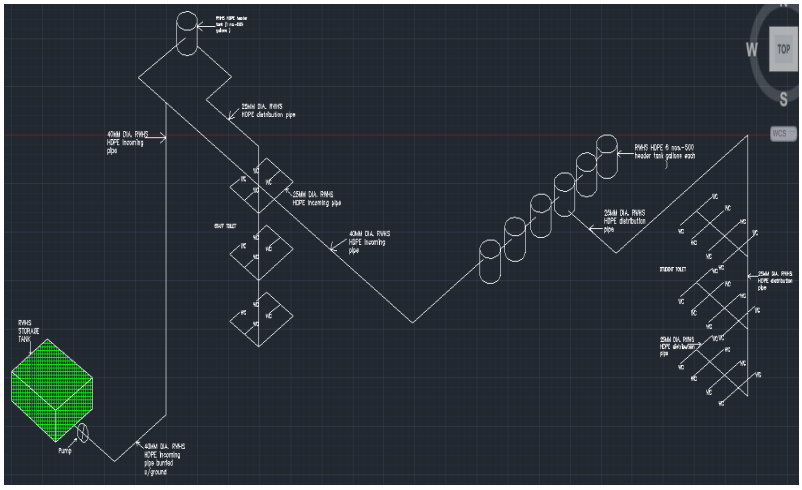
3.3 Model Simulasi Keseimbangan Air Harian
Kajian ini menggunakan Model Simulasi Keseimbangan Air Harian untuk mengira potensi SPAH untuk menggantikan penggunaan air bersih dalam kegunaan simbahan tandas. Model ini juga banyak digunakan oleh kajian terdahulu seperti Su et al. (2009), Rahman et al. (2012), Lani et al. (2018a) dan Lani et al. (2018c)

Rumus Model Simulasi Keseimbangan Jisim Air Harian yang digunakan dalam kajian ini adalah seperti Persamaan 4 berikut:

Persamaan 4: $$R_t = \begin{cases} D_t & \text{if } WI_t + WS_{t-1} \geq D_t \\ WI_t + WS_{t-1} & \text{if } WI_t + WS_{t-1} < D_t \end{cases}$$

Di mana *Rt* adalah air harian yang dibekalkan (m³), *Dt* adalah permintaan air harian (m³), WI adalah aliran masuk (jumlah hujan yang dikumpul dari bumbung) (m³), WS_{t-1} adalah jumlah air dalam tangki simpanan di akhir hari sebelumnya (m³) dan *t* adalah masa (hari).

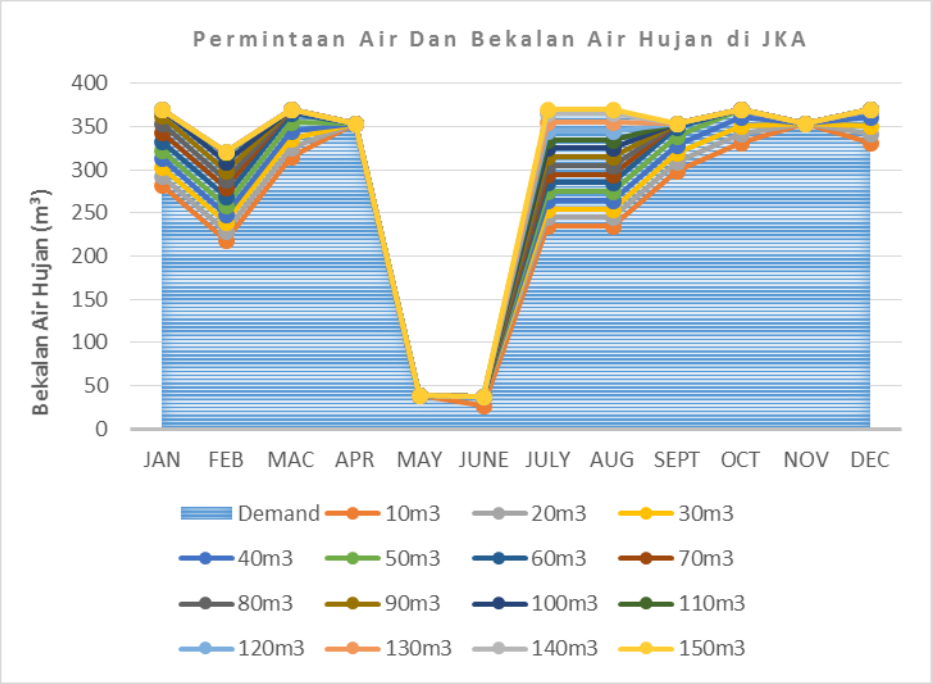
Model Simulasi Keseimbangan Jisim Air Harian dibina dengan menggunakan perisian Microsoft Excel. Simulasi ini juga turut mengambilkira saiz tangki simpanan yang berbeza-beza dan ditingkatkan dalam gandaan 10m³ sehingga potensi air hujan yang dibekalkan mampu menggantikan permintaan air bersih untuk simbahan tandas sepenuhnya (100%).



Rajah 1: Contoh cadangan SPAH untuk Bangunan JKA

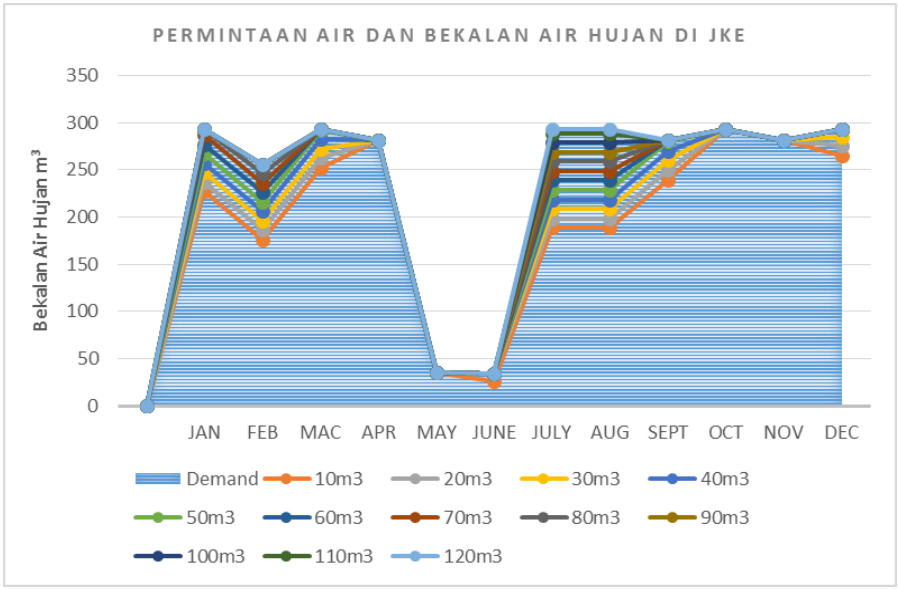
4. ANALISA DAN KEPUTUSAN

4.1 Bekalan Air Hujan dan Permintaan Air di PSAS
Melalui model simulasi, keseimbangan antara permintaan air untuk kegunaan simbahan tandas dan bekalan air hujan yang dapat dibekalkan untuk setiap bangunan telah diperolehi dan hasilnya ditunjukkan di dalam rajah-rajah berikut.



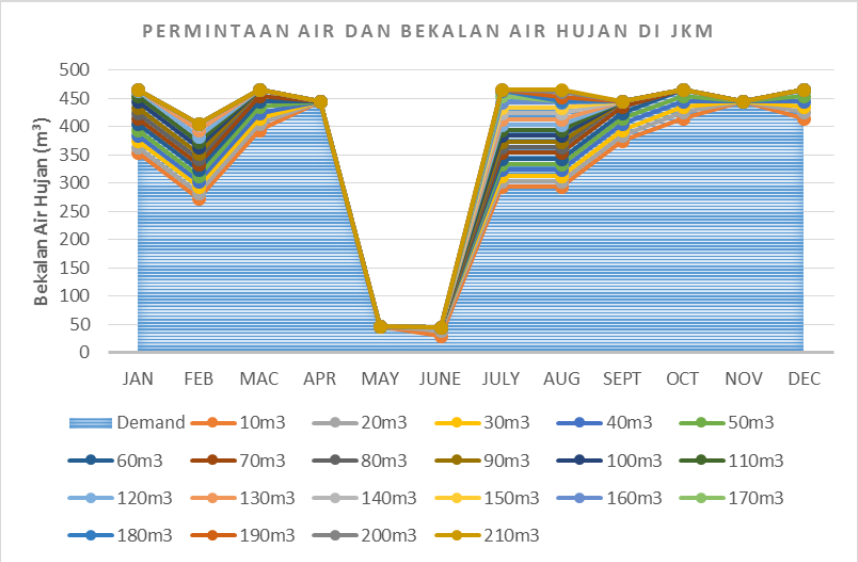
Rajah 2: Permintaan Air dan Bekalan Air Hujan untuk Bangunan JKA

Rajah 2 menunjukkan permintaan air untuk simbahan tandas dan bekalan air hujan yang dibekalkan mengikut saiz tangki simpanan iaitu dari 10m³ hingga 150m³ dari bulan Januari hingga Disember bagi bangunan JKA. Seperti yang di tunjukkan oleh graf di atas, pada bulan Januari, Februari, Julai dan Ogos, jumlah air hujan yang dikumpul adalah sedikit dan sukar untuk memenuhi permintaan air untuk simbahan tandas. Manakala pada bulan Mei dan Jun pula, permintaan air untuk simbahan air mudah dipenuhi, ini adalah kerana pada bulan ini kurangnya permintaan air disebabkan ketiadaan pelajar berikutan cuti semester. Berbeza dengan permintaan air pada bulan April, Oktober, November dan Disember, permintaan air mudah dipenuhi disebabkan oleh jumlah air hujan yang di kumpul adalah tinggi pada bulan-bulan tersebut. Untuk bangunan ini, saiz tangki yang diperlukan untuk memenuhi permintaan air untuk kegunaan simbahan tandas adalah 150 m3.



Rajah 3: Permintaan Air dan Bekalan Air Hujan untuk Bangunan JKE

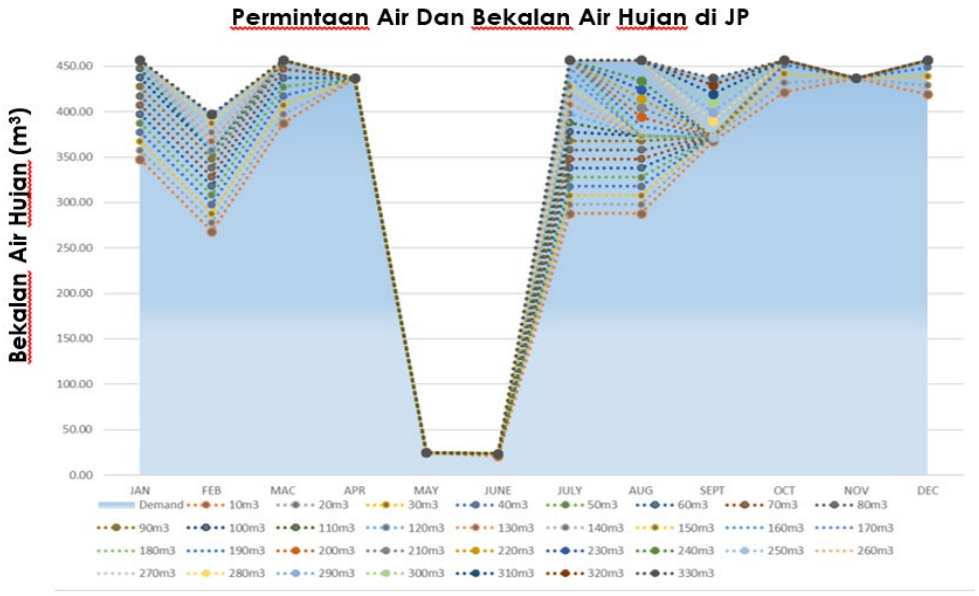
Rajah 3 menunjukkan permintaan air untuk simbahan tandas dan bekalan air hujan mengikut saiz tangki simpanan iaitu dari 10m³ hingga 120m³ dari bulan Januari hingga Disember bagi bangunan JKE. Seperti yang di tunjukkan oleh graf di atas, pada bulan Januari, Februari, Julai dan Ogos, jumlah air hujan yang dikumpul adalah sedikit dan sukar untuk memenuhi permintaan air untuk simbahan tandas. Manakala pada bulan Mei dan Jun pula, permintaan air untuk simbahan air mudah dipenuhi, ini adalah kerana pada bulan ini kurangnya permintaan air disebabkan ketiadaan pelajar berikutan cuti semester. Berbeza dengan permintaan air pada bulan April, Oktober, November dan Disember, permintaan air mudah dipenuhi disebabkan oleh jumlah air hujan yang di kumpul adalah tinggi pada bulan-bulan tersebut. Untuk bangunan ini, saiz tangki yang diperlukan untuk memenuhi permintaan air untuk kegunaan simbahan tandas adalah 120 m3.



Rajah 4: Permintaan Air dan Bekalan Air Hujan untuk Bangunan JKM

Rajah 4 menunjukkan permintaan air untuk simbahan tandas dan bekalan air hujan mengikut saiz tangki simpanan iaitu dari 10m³ hingga 150m³ dari bulan Januari hingga Disember bagi bangunan JKM. Seperti yang di tunjukkan oleh graf di atas, pada bulan Januari, Februari, Julai dan Ogos, jumlah air hujan yang dikumpul adalah sedikit dan sukar untuk memenuhi permintaan air untuk simbahan tandas. Manakala pada bulan Mei dan Jun pula, permintaan air untuk simbahan air mudah dipenuhi, ini adalah kerana pada bulan ini kurangnya permintaan air disebabkan ketiadaan pelajar berikutan cuti semester. Berbeza dengan permintaan air pada bulan April, Oktober, November dan Disember, permintaan air mudah dipenuhi disebabkan oleh jumlah air hujan yang di kumpul adalah tinggi pada bulan-bulan tersebut. Untuk bangunan ini, saiz tangki yang diperlukan untuk memenuhi permintaan air untuk kegunaan simbahan tandas adalah 210 m3.

Rajah 5 menunjukkan permintaan air untuk simbahan tandas dan bekalan air hujan mengikut saiz tangki simpanan iaitu dari 10m³ hingga 150m³ dari bulan Januari hingga Disember bagi JP. Seperti yang di tunjukkan oleh graf di atas, pada bulan Januari, Februari, Julai dan Ogos, jumlah air hujan yang dikumpul adalah sedikit dan sukar untuk memenuhi permintaan air untuk simbahan tandas. Manakala pada bulan Mei dan Jun pula, permintaan air untuk simbahan air mudah dipenuhi, ini adalah kerana pada bulan ini kurangnya permintaan air disebabkan ketiadaan pelajar berikutan cuti semester. Untuk bangunan ini, saiz tangki yang diperlukan untuk memenuhi permintaan air untuk kegunaan simbahan tandas adalah 330 m3.



Rajah 5: Permintaan Air dan Bekalan Air Hujan untuk Bangunan JP

Sistem Penuaian Air Hujan (SPAH) adalah sistem yang dapat memberikan sumber air alternatif yang boleh digunapakai dalam usaha penjimatan bekalan air bersih. Hasil kajian ini mendapati bahawa untuk menggantikan sepenuhnya penggunaan air bersih untuk kegunaan simbahan tandas dengan SPAH, ukuran tangki yang diperlukan untuk keempat-empat bangunan akademik tersebut adalah berbeza bergantung kepada keluasan bumbung bangunan tersebut yang mempengaruhi jumlah air hujan yang dikumpul dan juga jumlah permintaan air yang telah dipengaruhi oleh jumlah bilangan pelajar di bangunan tersebut. Untuk menggantikan sepenuhnya pemintaan air untuk simbahan tandas menggunakan SPAH, bangunan JKE perlu menggunakan saiz tangki 120 m^3 iaitu yang terkecil berbanding bangunan akademik yang lain disebabkan oleh keseimbangan di antara jumah air hujan yang dikumpul dan permintaan air untuk kegunaan simbahan tandas diikuti dengan bangunan JKA iaitu 150 m^3. Untuk bangunan JKM, saiz tangki yang agak besar diperlukan iaitu 210m^3 berikutan bangunan ini mempunyai lebih ramai pelajar berbanding JKE dan JKA yang menyebabkan jumlah permintaan air adalah tinggi walaupun keluasan bumbung untuk tadahan air bagi ketiga-tiga bangunan ini adalah hampir sama. Berbeza dengan bangunan JP, saiz tangki yang paling besar diperlukan iaitu 330m^3 berikutan ketidakseimbangan di antara antara jumah air hujan yang dikumpul dan permintaan air untuk kegunaan simbahan tandas pada bangunan tersebut. Hal ini kerana JP mempunyai kawasan bumbung yang kecil berbanding bangunan akademik yang lain dan jumlah pelajar di bangunan tersebut adalah paling ramai berbanding JKE, JKA dan JKM. Hasil kajian ini adalah selari dengan hasil kajian yang telah dilaksanakan oleh Guo dan Baezt (2007), Kim dan Yoo (2009), Imteaz et al (2011), Mun dan Han (2012), Campisano et al. (2013), Morales-Pinzon et al (2015) dan Temesgen et al (2015) dimana mereka mendakwa bahawa potensi SPAH bergantung kepada corak hujan, keluasan bumbung, permintaan air dan pengunaan tangka simpanan.

5. KESIMPULAN

Kajian ini dijalankan untuk Secara keseluruhannya, hasil kajian ini telah membuktikan bahawa SPAH adalah berpotensi untuk menggantikan penggunaan air bersih untuk kegunaan simbahan tandas di bangunan akademik dan seterusnya dapat menjimatkan penggunaan bekalan air terawat. Selain itu, hasil kajian ini juga dapat digunakan sebagai panduan di dalam merekabentuk pemasangan SPAH di intitusi pendidikan ke arah merealisasikan agenda kampus hijau.

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A STUDY ON MECHANICAL PROPERTIES OF RAPID PROTOTYPING PRODUCT

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Abstract. The article proposes of the Single Socket Base Using Rapid Prototyping (RP) machine with snap fit concept. The use of screws on the socket causes difficulties in repairing the interior compare using the snap fit concept. Rapid prototyping process integrates with several CAD software to design the single socket shape and convert to STL files before manufactures using 3D Rapid Prototype Machine. The material use for single socket is ABS plastic P400. In this project, the mechanical properties of socket produced by the RP were discussed. The result shows with the implementation of the RP process give better surface roughness, tensile strength, hardness, and impact properties.

Keywords: Rapid Prototypes, Additive Manufacturing, ABS

1. INTRODUCTION

Traditionally, manufacturing engineers have created three dimensional models and prototypes by using conventional or traditional methods of fabrication, such as machining which involves longer lead times thus resulted in delays of getting the products to the market. Rapid prototyping (RP) was developed to automate new product development and to shorten the building cycle effectively.

Rapid prototyping (RP) has helped scores of manufacturing companies in shortening product development time, discovering design flaws, and improving product quality. Rapid prototyping has managed to streamline the production of engine parts, cellular phones, jewelry, toys, hip joints architectural models, skeletal replicas and even art and mathematical models. With rapid layer building approach, today RP machines can produce virtually any shape. Moreover, the production of complex parts is being simplified through the advancement of RP techniques.

Currently RP is a new technology and technique which building up a prototype rapidly and effectively. New design created in CAD software can be download to the RP machine to build the prototype, instantly without using any tooling or die. However, to build prototype within the acceptable tolerance requires optimization of the machine setup parameters and this usually quite tedious and requires "trial and error", method.

Usually each machine provides the default setting for the parameters which are sometimes not the optimum parameters. When this happen, the built part will have the limitation in terms of accuracy and surface roughness. Therefore, it is essential that the parameter setting of the RP machine should be optimized to produce a part which satisfying all the manufacturing requirements such as lower built time, accurate and good finishing. The objective of the project is to introduce the snap fit concept into the single socket base and develop as a product through rapid prototype process. Rapid Prototype (RP) as described in this text refers to the fabrication of a physical, three-dimensional part of arbitrary shape directly from a numerical description (typically a CAD model) by quickly, totally automated

and highly flexible process. RP is defined as a special class of machine technology that quickly produces models and prototype parts from 3-D data using an additive approach to from the physical models. These two definitions are the "classic" definitions that describe the systems and technologies that created the rapid prototyping industries in the late 1980s.

Research regarding RP process were conducted by many researchers. Facing the problem in selecting the suitable process parameters especially in fabricate the component is the common issue in RP process. Factors should be kept in researcher's mind when selecting the RP process parameter are fabrication cost, time, accuracy of the quality and part strength of the generated model product. Some study and investigation on RP were conducted and reported by Karapatis et al. (1998), Cheah et al. (2005) and Huang et al. (2013) on the impact of rapid manufacturing technology. According to Medellin-Castillo and Torres (2009), the mechanical performance depends on the rapid prototyping method and prototypes are weaker and more fragile compared to those made conventionally from metals and engineering plastics.

Raut, et al. (2014) have investigated the effect of built orientation on the mechanical properties and total cost of the ABS parts generated through FDM. They found that at 0° built up orientation has maximum tensile strength and minimum cost. In this study, they concluded that built orientation has affect the tensile strength significantly. The experiment by Durgun and Ertan (2014) showed the orientation of 0° was the optimum condition in improving the mechanical properties.

Maurya et al. (2020) highlighted that medical model generated through rapid prototyping has better dimensional accuracy compared to other manufacturing methods, and rapid tooling has shortened the lead time of the product development cycle. Unlike traditional manufacturing processes, rapid prototyping can generate complex parts at no extra cost Hague et al. (2003) and Atzeni et al. (2010).

Besides the mechanical properties, surface roughness also plays important role in rapid prototyping product. The surface finish is critical as it affected the accuracy, processing costs and parts' function. According to the experimental investigation done by Udroiu and Mihail (2009) on surface roughness of matte and glossy rapid prototyping products, they found the roughness value for matte surface finish is higher than the glossy surface finish. Adelnia et al. (2006), reported that the roughness has influenced the aerodynamic data of the models tested in the wind tunnel. Medellin-Castillo and Torres (2009) summarized that the rapid prototyping product has less dimensional accuracy and surface quality compared to CNC machining and injection molding product. Kumar and Gurunathan (2013) conclude in their research as the surface roughness increase with increase in build direction till 90° but then decreases till 180° for builds with support structure.

2. MATERIALS AND RESEARCH METHODOLOGY

2.1 Material Properties

The material used to produce this socket was ABS. Table 1 show the mechanical properties of the ABS.

Table 1: Properties of ABS material

Density g/cm	1.05-1.07
Tensile strength MPa	50
Impact strength J/m^2	200 - 215
Hardness Vickers	5.6 – 15.3
Dielectric strength V/mil	385
Max use temp °C	71-93

2.2 Method

Figure 1 showed the detail methodology of this project. In general, the rapid prototype process includes the creation and slicing of a virtual computer model followed by the layer-by-layer fabrication process. RP involves five steps: 1) CAD model creation, 2) CAD model converter format, 3) Sliced STL file into cross-sectional layers digitally 4) Prototype build the layer and 5) Clean and finish.

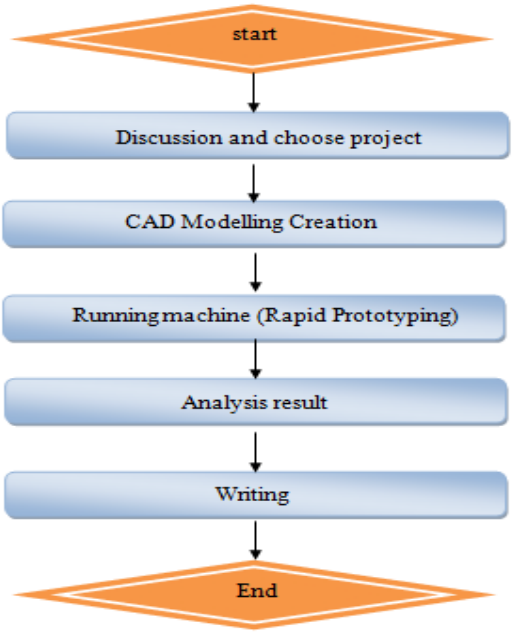


Figure 1 : Project Sequence

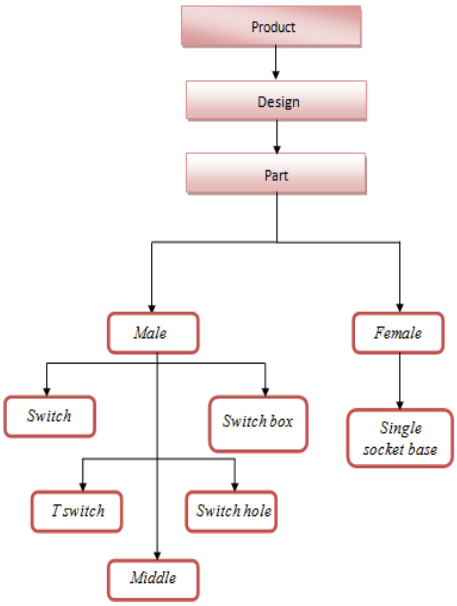
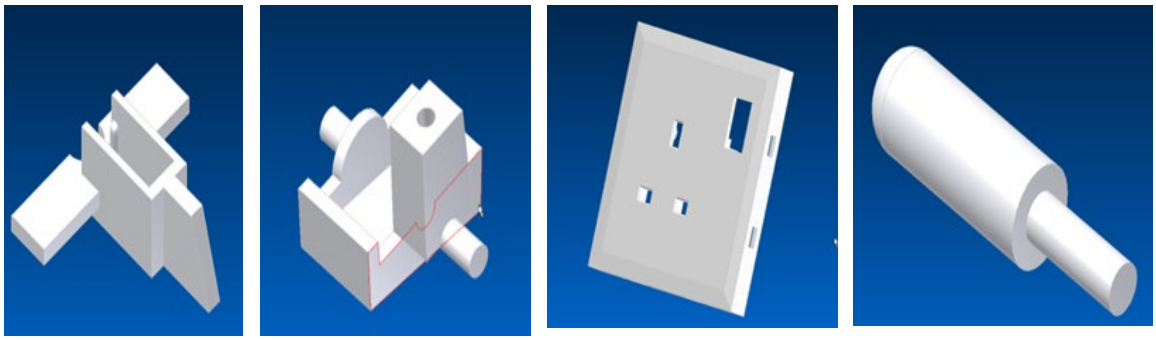


Figure 2 : Product Component

2.2.1 CAD Modeling Creation

Figure 2 and Figure 3 show the CAD modeling of the product. It is generated by inventor and AutoCAD software. The inside component name T-switch, switch, switch box, switch hole and middle part. The complete assembly of the product are show in Figure 3g.



a) T-Switch b) Switch c) Switch Box d) Switch Hole



e) Middle Part f) Socket Base g) Assembly Product

Figure 3 : The single socket component

2.2.2 Rapid Prototyping Procedure

In the RP process, the drawing from the CAD package used in different algorithms to represent solid objects. To establish consistency, the CAD file must be converted into the STL file. Figure 4 shows the completed process for RP and Figure 5 shows the conversion process of the CAD file to STL file using CatalystEX software.

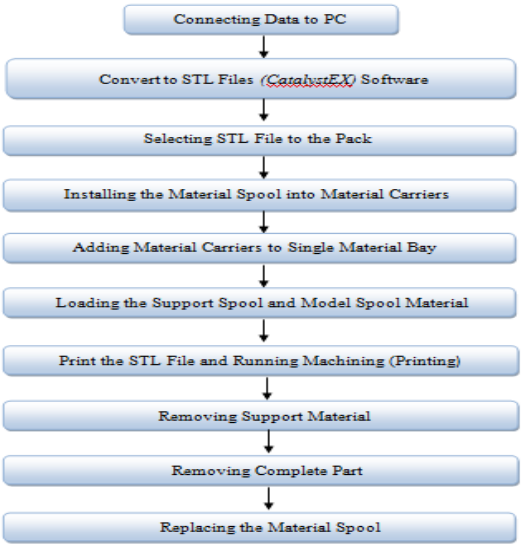


Figure 4: Overall Rapid Prototyping Process

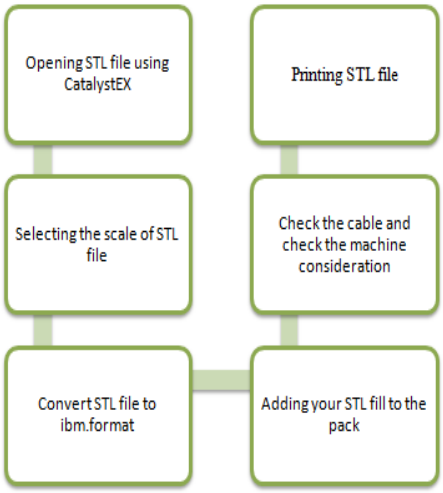


Figure 5: CatalystEX Converter

The STL format is usually used in many RP machine and this process is identical for all of the RP build techniques. The STL model (Figure 6) is then brought into the slicing program in RP machine. The size, location, and orientation of the model generated from the slicing software.

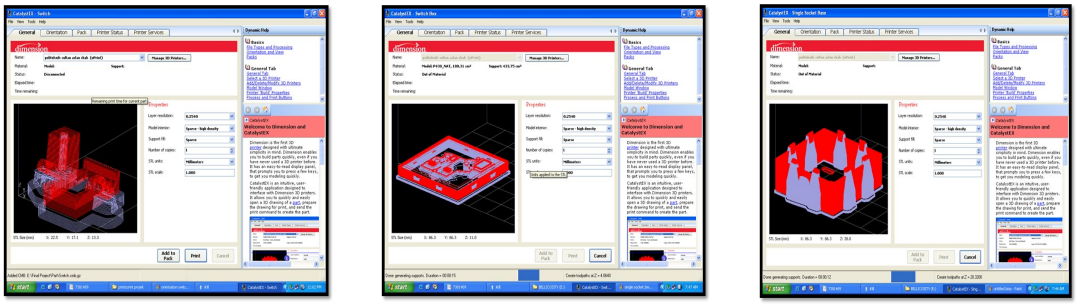


Figure 6: The STL format into the slicing program

After the STL model completely sliced into the layers, the tool patterns are generated for both build and support areas for each layer, the physical model will then be fabricated using the ABS material. Figure 7 shows the physical model completed from the RP machine.

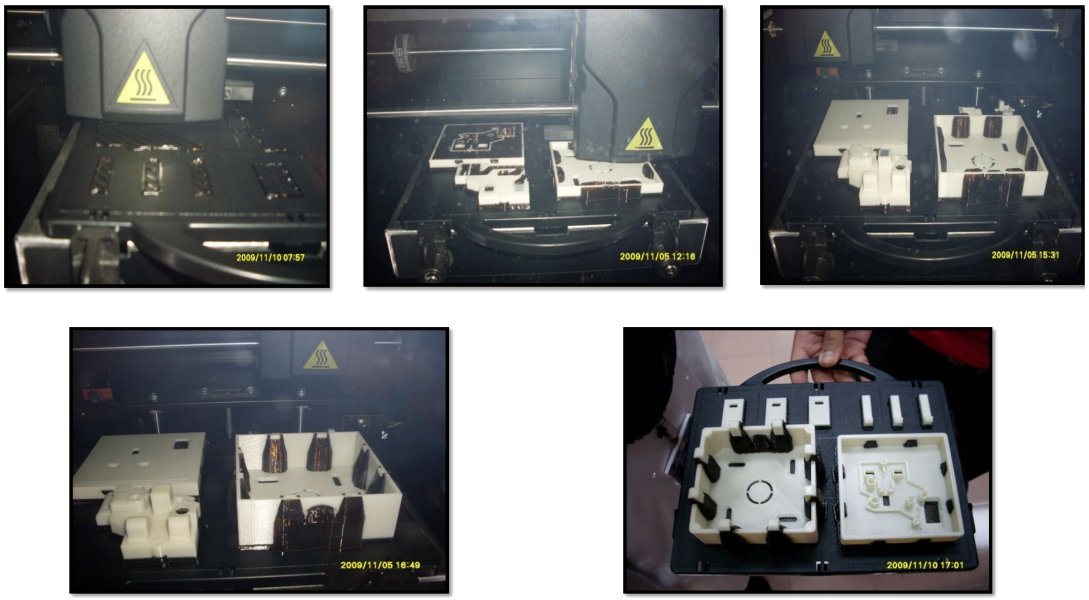


Figure 7: The completed physical model of product

2.2.3 Testing equipment

a) Hardness Vickers

Mittotoyo AVK-C1/C2 hardness Vickers machine is used to measure the hardness at the surface of socket housing. The surface is indented by diamond indenter with 136° angle and 2 kg load for 10 seconds.

b) Tensile strength

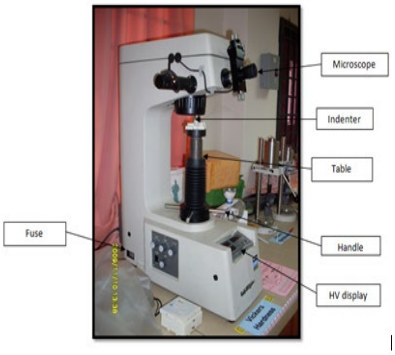
The strength of the snap fits part is measure by Ultimate Testing Machine. Three samples were undergoing a tensile test to obtain the average value of maximum force the samples could bear before failed. Besides, the force of yield strength also obtains through this testing.

c) Impact Test

The impact test is conducted to measure the energy absorbed by the sample when the sudden load applied. Charpy-Izod Impact Testing Machine EUROTECH (ET 2206-50J) is used for this purpose. The hammer weight used is 4.4 kg or 29 J and drop angle is 120°.

d) Surface Roughness

Surface roughness tester Helio LIO-UMG 50 is used to determine the surface quality of the socket. The roughness of the top surfaces and side surfaces is measured and compared.



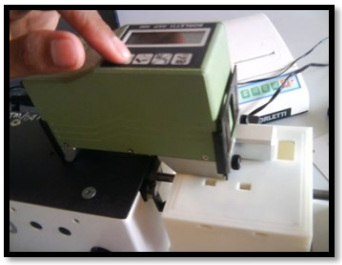
a) Hardness Machine



b) TensileTest Machine



C) Impact Test Machine



d) Surface Roughness Machine

Figure 8 (a-d) : Testing equipment

3. RESULTS AND ANALYSIS

3.1 Hardness Test

The hardness result in Figure 9 shows the highest value is 47.9 HV at surface 3, while the lowest is at surface 1 with the value 41 HV. This maybe because of the different thickness and shape of the surface. Although the hardness value varies, it still higher compared to the hardness value of ABS which is between 5.6 to 15.3 HV. Thus, this process does not reduce the hardness of ABS.

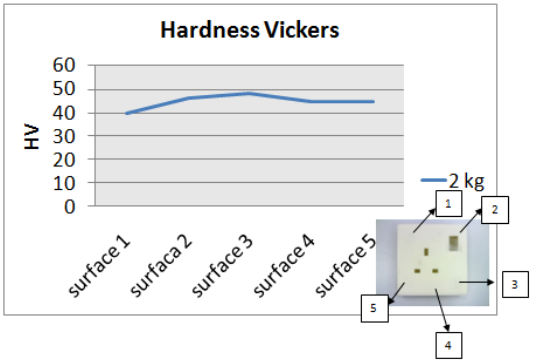


Figure 9 : The Hardness of the product surface

3.2 Surface roughness

The bar chart (Figure 10) shows the surface roughness of the product. The highest result is at top 2 surface with value 23 µm and the lowest value is 17 µm at side 4. The lower the value of

surface roughness, the better the surface quality of the product. According to the result, we can also conclude that side surfaces has better surface quality than the top surfaces. This affected by the texture orientation where the side surfaces have 0° orientation, while the top surfaces have 45° orientation. This result supported by Kumar (2016) where they stated that the surface roughness increases with increase in build orientation (θ) with respect to the build direction till 90°.

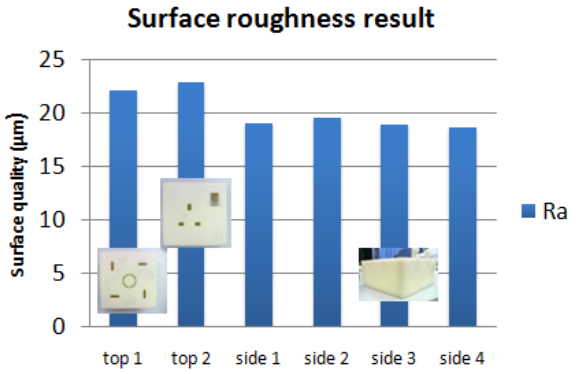


Figure 10: Surface quality of the product

3.3 Tensile strength

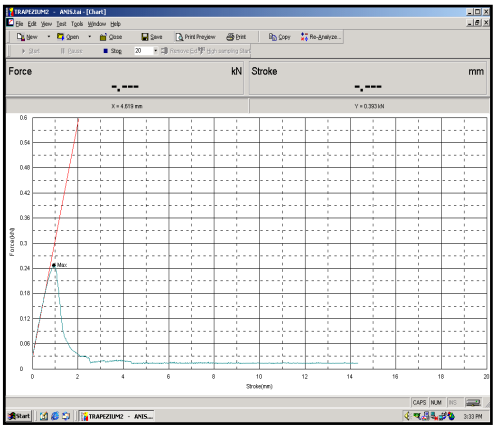
Figure 11 (b-d) shows the tensile strength result for the snap fits. The average maximum force that the snap fits can bear before failed is 0.2539 kN. The average yield strength for this snap fit design is at force 0.203 kN. These force values are not the optimum value because the orientation for this snap fit is 45°. These values can be improved by changing the built up orientation to 0° because it has maximum tensile strength (Raut, et al., 2014) and it is the optimum condition in improving the mechanical properties (Durgun and Ertan, 2014).

Table 2: The result of the tensile test

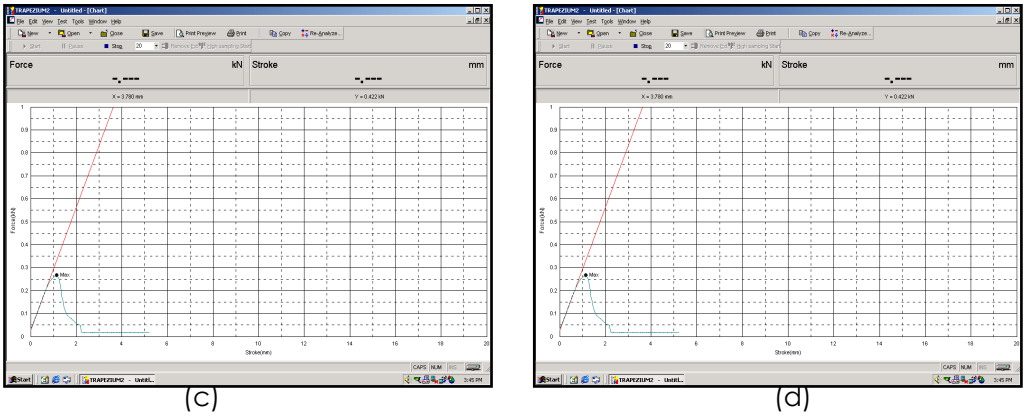
Force	Sample			Average
	1	2	3	
Max. force (kN)	0.24656	0.26719	0.24781	0.25385
Yield force (kN)	0.21	0.20	0.20	0.203



(a)



(b)



(c) (d)

Figure 11(a-d): The result of the tensile strength

3.4 Impact Test

The impact test result for the snap fit components are shown in Table 2. In this paper, the impact values are reported in terms of energy absorbed by the snap fit component to fracture. The energy absorbed to fracture the female and male samples is 4.0 J and 5.5 J, respectively.

Table 3: The result of the impact test

Sample	Female	Male
Angle before testing	120°	120°
Angle after testing	108°	103°
Energy absorbed	4J	5.5J
Impact strength (kJ/m²)	80	153

4. CONCLUSION

According to the product features using rapid prototyping, quality, cost and time to market are important factors for a manufacturer to remain competitive. Rapid prototyping systems offer the opportunities to make products faster and usually at lower costs than using conventional methods. In this project, the socket takes 9 hours and 27 minutes to produce and consumed total support material and model material is 34.32 cm^3 and 104.62 cm^3 respectively. From the project's objective we can conclude that all the parameters such as time machining, surface finish, tensile test, impact test and hardness test given significant result on the rapid prototype process. The testing result showed the best surface quality is on side 4 with surface roughness value of 17 μm. The hardness of this product is 47.9 HV. The average maximum force and the average force for yield point are 0.2539 kN and 0.203 kN respectively. Lastly, the result of impact test is 4.0 J for female sample and 5.5 J for male sample.

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EKSPERIMENTASI DAUN JATI KE ATAS TEKNIK ECO PRINT DENGAN PENGUNAAN PERWARNAAN ALAM SEMULAJADI TERHADAP KAIN SUTERA SATIN

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Abstrak. Kajian ini merupakan proses kepada pembuatan sampel rekacorak, jalinan, dan warna terhadap pengunaan warna alam semulajadi ke atas daun jati yang juga dikenali sebagai Tectona grandis. Sampel-sampel yang terhasil menunjukkan rekaaan yang berbeza diantara satu sama lain dengan gabungan teknik eco print terhadap 10 perwarnaan semulajadi seperti Kayu kuning, Pinang, Kayu Bakau Batu, Akar Sintuk, Akar Mengkudu, Terminalia Chebula, Terminalia Belliricaa, Hibiscus Acetosell, Kunyit Kasturi, dan Daun Inai. Indiana Flint merupakan pelopor pertama bagi teknik eco print dengan menyatakan eco print adalah proses memindahkan warna dan bentuk ke kain secara langsung. Objektif kajian ini adalah untuk dapatkan hasil tindakbalas warna alam semulajadi terhadap daun Jati dan pemati warna tawas dalam teknik eco print di atas kain sutera satin. Kajian dijalankan dengan kaedah *Practice Based Research*, pengumpulan data, kajian literatur dan ujikaji. Ujikaji terhadap daun jati ini menunjukkan tahap optimum teknik eco print terhadap kain sutera satin yang menghasilkan cetakan *silhouette* dan berwarna. Hasil kajian dijadikan sampel-sampel yang boleh dijadikan sampel / bahan rujukan bagi keperluan kursus Diploma Rekabentuk Fesyen & Pakaian, Jabatan Rekabentuk & Komunikasi Visual, Politeknik Ibrahim Sultan, Johor dan juga menjadi sumber panduan serta formula bagi penggiat tekstil tempatan.

Kata Kunci: Eco print, daun jati,

1. PENGENALAN

Malaysia adalah salah sebuah negara yang berkoordinat di bawah garisan khatulistiwa dan juga mempunyai hutan hujan tropika yang memiliki kekayaan hasil bumi yang banyak disamping kekayaan hasil hidupan flora dan fauna. Kekayaan hasil bumi dan hutan telah dimanfaatkan dengan pelbagai cara seperti pembinaan, makanan, dan pembuatan. Hasil pembuatan daripada sumber hutan yang telah dimanfaatkan seperti pembuatan perabot, penghasilan tekstil antara penyumbang kepada pembangunan ekonomi negara. Sehubungan itu, penghasilan warna-warna yang berteraskan bahan alam semulajadi juga tidak terkecuali dalam mengambil tempat seiring dengan pembangunan tekstil. Warna alam semulajadi ini, di ekstrak daripada hasil hutan dan memiliki nilai-nilai tertentu dalam penghasilan warna ke atas fabrik.

Penggunaan warna alam semulajadi telahpun digunapakai ribuan tahun yang lalu dimana sejarah membuktikan penemuaan lukisan-lukisan dinding yang dihasilkan oleh manusia zaman prasejarah yang berasaskan bahan alam semulajadi (Goodall, David, Kershaw, & Fredericks, 2009). Dalam era revolusi perindustrian pula penggunaan warna alam semulajadi giat digunakan dalam penghasilan makananan dan minuman (Ajizah, 2009). Di timur tengah penggunaan zafron digunakan sebagai pewarna makanan harian mereka dan di barat pula penggunaan warna alam semulajadi digunakan dalam penghasilan makanan dan minuman ringan. Penggunaan warna alam semulajadi tidaklah asing akan pengtakrifan penggunaannya dalam sektor perindustrian kerana warna alam ini mempunyai khasiat-khasiat tersendiri dan digunakan untuk tujuan yang tertentu.

Pewarnaan sintetik dalam penghasilan tekstil telah mendominasi penggunaan warna alam semulajadi sekian lama kerana kesetabilan kandungan dan penggunaan warna alam banyak mempengaruhi hasil pengeluaran yang tidak menentu(Ainur Rosyida, 2014). Hasil daripada itu telah menjadikan pewarnaan alam ini sesuatu yang mempunyai nilai tersendiri dalam pasaran tekstil. Di negara-negara Asia Tenggara, pasaran tekstil adalah merupakan antara industri yang menyumbang kepada ekonomi negara dan memberi peluang pekerjaan kepada pelbagai peringkat masyarakat (Saptutyningsih & Wardani, 2019). Di Malaysia, industri-industri seperti ini telah dipelopori oleh sebilangan masyarakat desa dalam penghasilan tenun, kain batik, dan pembuatan kraf.

Penggunaan pewarnaan alam semulajadi telah menjadi suatu inisiatif ke arah melestarikan teknologi hijau (eco green) yang mana daripada teknologi alam semulajadi ini telah terhasilnya satu teknik eco percetakkan *(eco-print)* yang mula meraih perhatian penggemar tekstil tempatan. *Eco-print* merupakan salah satu teknik yang menggunakan bahan pewarna alam dengan cara memindahkan warna dan bentuk pada media kain secara langsung (Ristiani, 2019). Menurut Irianingsih (2018), eco print adalah salah satu cara mengolah kain dengan menggunakan pelbagai tumbuh-tumbuhan yang boleh mengeluarkan warna-warna serta zat dan teknik ini juga merupakan teknik seni cetak. Pemindahan warna daripada tumbuhan kepada kain yang tercetak hasil daripada proses pengukusan menimbulkan corak dan rupa bentuk daun (silhouette) ini menyamai teknik cop batik yang popular digunakan dalam industri tekstil.

Penemuan teknik eco print yang pertama adalah dihasilkan oleh Indiana Flint, beliau merupakan pengkarya seni tekstil yang berasal dari negara Austratlia Selatan dan telah menghasilkan pelbagai corak yang menarik dan telah menjadi sumber rujukan pengkaji tekstil serta penggemarnya. Menurut Flint (2011) juga pengaplikasian teknik ini dengan cara menempelkan daun-daun dapat mengeluarkan zat-zat mahupun pigmen warna pada kain berserat alam semulajadi serta menghasilkan corak yang tidak terduga. Pemilihan bahan alam semulajadi merupakan suatu yang sangat penting dalam melakukan teknik eco print ini kerana tidak semua bahan alam semulajadi mampu mengeluarkan warna yang boleh digunakan bagi proses pemindahan warna ke kain. Bahan alam semulajadi ini juga mampu diolah dengan campuran bahan-bahan berunsur asid dan alkali. Secara logiknya, tindakbalas kimia daripada bahan berunsur asid dan alkali mampu merubah tekstur serta warna diatas permukaan kain malah memberi kesan kepada daun-daun yang digunakan.

Pemilihan daun-daun dan bunga-bunga adalah sebagai ejen utama pembalikan warna, bentuk daun ke atas fabrik yang dipilih. Pemilihan fabrik sutera satin dalam melaksanakan kajian ini kerana sifat dan permukaan fabrik tersebut adalah juga diantara bahan alam semulajadi dan boleh menyerap pewarnaan alam semulajadi terus ke atas fabrik itu. Terdapat banyak jenis daun yang mampu mengeluarkan warna dan zat dalam kadar yang banyak dan sederhana antaranya adalah daun jati. Daun jati adalah berasal daripada tanaman pokok jati yang hidup di hutan hujan tropika. Pokok jati yang terkenal digunakan dalam industri pembuatan dan kraf mempunyai banyak manfaat malah daunnya juga boleh digunakan sebagai pewarna dalam makanan dan juga fabric. Daun jati yang mempunyai zat berwarna merah kaya dengan pigmen antosianin menghasilkan warna yang berupa dan bervariasi (Ainur Rosyida, 2014).

Teknik *eco print* ini biasa digunakan pada bahan yang berserat alam seperti kain kanvas, kain kapas, kain sutera dan kain linen. Menurut Salsabila & Ramadhan (2018), tidak semua kain yang beserat alam semulajadi dapat menghasilkan hasil yang sama, diantara satu sama lain dan berbeza dalam menghasilkan warna dan cetakan yang tercetak di atas fabrik.

Terdapat beberapa kajian dan pemerhatian tentang teknik ini dengan menggunakan pelbagai jenis fabrik seperti kain kapas, linen, kanvas, dan sutera. Pemerhatian dan penilitian yang dijalankan terhadap kajian ini berakhir dengan memilih material fabrik jenis sutera kerana hasil kajian yang diperoleh juga, material fabrik jenis kain kapas, linen, dan kanvas

tidak boleh mengeluarkan zat-zat, warna dan bentuk dedaunan dan bunga-bungaan secara optimum. Kombinasi penggunaan kain sutera satin dan daun jati telah banyak digunakan oleh pengkarya seni tekstil terutama dalam teknik *eco print* tetapi terdapat banyak lagi cara yang belum diketahui dalam mengadaptasi daun jati ini. Justeru kajian ini adalah mengkaji penggunaan warna alam semulajadi serta tindakbalasnya terhadap jaun jati dan pemati warna yang tertentu.

Daun jati (Tectona grandis) memilik kandungan antioksidan sebagai tumbuhan boleh menghasilkan pewarnaan alam semulajadi iaitu merah, ungu dan biru. Menurut Kembaren et al., (2014), tanaman jati juga adalah tanaman jenis tropika dengan penanaman yang meluas di Asia Tenggara seperti Thailand, Laos, Burma dan Indonesia. Potensi kepada tamanan ini sangat besar manfaatnya terutamanya perindustrian pembuatan perabot terutamanya di bahagian kayu dalam bentuk log. Bahagian pokok jati seperti bunga dan daunnya kurang dimanfaatkan secara efektif.

Daun jati muda dikatakan memiliki kandungan beberapa campuran pigmen terutama antosianin. Campuran antosianin ini memberi tindakbalas warna dengan terhasilnya merah, ungu sehinggalah merah gelap. Menurut Ariviani (2010), antosianin merupakan gabungan atau campuran flavonoid yang memiliki kemampuan sebagai antioksidan. Daun jati sangat bermanfaat kerana tumbuhan alam ini dapat menghasilkan pigmen sumber alam semulajadi secara sihat tanpa sebarang kesan sampingan yang tidak baik. Penggunaan pucuk daun jati muda dikatakan lebih merah warnanya jika dibezakan dengan daun jati tua kerana kandungan antosianin lebih tinggi (Kembaren, 2014).

Menurut Saraswati (2018), kajian yang dijalankan oleh beliau, pada peringkat pertama dapat menghasilkan cetakan eco print yang bebeza bersesuaian dengan kandungan antosianin yang tinggi pada pucuk daun jati tersebut sehingga pada daun jati yang terdekat dengan batang pokok ini. Pucuk pokok jati mempunyai kandungan yang paling tinggi hingga ke peringkat 3 dengan terhasilnya warna ungu dan membentuk urat utama - ibu tulang (costa), dan cabang-cabang urat – tulang cabang (*nervus lateralis*) dan urat-urat daun (vena) tercetak pada kain dengan begitu baik. Teknik eco print ini dapat diulang cetak sehingga ke peringkat kedua dan ketiga dengan kandungan antosianin yang tinggi, serta urat utama – ibu tulang (costa), cabang-cabang urat – tulang cabang (*nervus lateralis*) dan urat-urat daun(vena) yang menonjol dengan kuat jika dibandingkan di bahagian peringkat 1 ataupun pucuk.

Justeru, kajian ini dijalankan untuk mendapatkan hasil tindakbalas 10 warna khusus kepada daun jati. Dalam menghasilkan kajian ini beberapa objektif dikenalpasti; pertama melakukan ujikaji nilai ph 10 bahan pewarnaan semulajadi. Kedua mengkaji tindakbalas warna terhadap bahan pemati warna iaitu tawas (aluminium sulfat) Ketiga; melihat hasil tindakbalas 10 pewarnaaan alam semulajadi dan bahan pemati warna; tawas terhadap daun jati.

2. SOROTAN KAJIAN

2.1 Eco print

Eco print adalah suatu teknik yang dihasilkan berdasarkan kajian dan penelitian penggiat seni tekstil yang di ilhamkan daripada teknik cetakkan cop. Perbezaan cetakkan cop dengan teknik *eco print* ini adalah teknik ini menggunakan bahan alam semulajadi kerana warna serta bentuk yang terhasil adalah daripada zat bahan alam itu sendiri (Salsabila & Ramadhan 2018). Zat bahan alam semulajadi seperti daun dan bunga mempunyai warna-warna yang tersendiri dan mempunyai kandungan zat yang berbeza setiap satunya. Hasil daripada proses mordan dan pengukusan, zat warna dapat dipindahkan daripada bahan alam semulajadi kepada kain.

2.2 Pewarna alam semulajadi

Seperti yang diketahui, bahan alam semulajadi seperti hasil hutan boleh dimanfaatkan untuk dijadikan pelbagai benda yang mampu membantu kelangsungan hidup manusia. Bahan

alam semualajadi seperti hasil hutan juga boleh dijadikan pewarna untuk kegunaan manusia. Pewarnaan alam ini juga boleh dijadikan bahan pewarna fabrik dalam industri tekstil dan mempunyai nilai yang tersendiri kepada penggemarnya. Bahan pewarnaan alam semulajadi ini dihasilkan daripada kayu, daun, akar dan bunga malah setiap bahagian pokok dapat menghasilkan warna yang berbeza bergantung kepada kondisi pokok tersebut (Alamsyah, 2018). Bahan alam ini dapat diekstrak dengan cara merebus bahagian-bahagian pokok sehingga zat pada bahan alam itu keluar dan menghasilkan warna. Warna yang terhasil itu digunakan dengan cara merendam kain dalam tempoh beberapa lama dan warna tersebut meresap ke dalam kain.

2.3 Daun Jati

Pokok jati adalah pokok hutan hujan tropika yang tumbuh kuat dan kukuh yang tumbuh subur di Malaysia. Pokok jati sering dijadikan bahan pembuatan seperti perabut tetapi daunnya sering tidak digunakan dan dibiarkan. Hasil kajian dan penelitian menunjukkan bahawa daun jati mempunyai antosianin dan merupakan bahan antioksida yan baik. Antosianin daun jati menghasilkan warna merah, ungu dan biru bergantung kepada kondisi daun tersebut (Kembaren et al., 2014). Pucuk daun jati menghasilkan warna yang lebih pekat dan lebih terang berbanding daun jati tua tetapi daun jati tua pula dapat menghasilkan jalinan dan corak yang menarik (Saraswati & Sulandjari, 2018). Daun jati kini mempunyai banyak manfaat dan boleh di adaptasi oleh manusia dalam pelbagai cara sekiranya dipelajari dengan betul.

3. METODOLOGI KAJIAN

3.1 Pendekatan dan jenis kajian

Dalam kajian yang dijalankan ini, penggunaan Practice Based Research digunakan sebagai metodologi kajian. Kajian dilakukan dengan kaedah pemerhatian dan eksperimentasi dengan merekod setiap data yang diperolehi. Penyelidikan berasaskan praktik adalah penyelidikan yang baharu bagi memperoleh data dengan melakukan eksperimen dan hasil eksperimen telah direkodkan disampaikan dengan bentuk penjadualan

3.2 Tempat dan waktu Penelitian

Kajian ini dilaksanakan di bengkel perusahaaan Ezryhelmy Enterprise, seorang usahawan muda eco-print yang beralamat, No. 183, Jalan Cendana 3, Felda Inas, 81700 Kulai Johor yang telah dilaksanakan sekitar disember 2019.

3.3 Sampel Kajian

Terdapat 10 sampel bahan pewarnaan alam semulajadi yang digunakan dalam kajian ini manakala 1 sampel daun jati yang diambil di daerah Pontian, Johor dan satu jenis bahan pemati warna iaitu tawas.

3.4 Prosedur Penyelidikan

Teknik eco-printing dalam kajian ini dihasilkan melalui beberapa proses dan memakan masa yang tertentu untuk mendapatkan hasil yang optimum. Antara proses-proses yang dilalui adalah proses mordant, penghasilan warna bahan alam semulajadi, penghasilan larutan pewati warna, pemindahan warna, pemati warna, dan proses ketahanan warna.

3.4.1 Proses mordant (perawatan)

Proses perawatan dan pembersihan dilakukan terhadap 20 helai kain sutera satin berukuran 21 cm X 30 cm dan 10 helai tersebut diambil dan direndam ke dalam larutan cuka dan tawas dengan nisbah larutan 1: 3-liter air tawas. Proses perawatan kain ini adalah bertujuan memberi impak yang optimum dalam proses pembalikan warna.

3.4.2 Proses penghasilan warna alam semulajadi

Pewarnaan yang digunakan adalah diambil daripada 10 jenis sumber alam yang terdiri daripada kayu bakau batu, akar Mengkudu, akar Sintok, pokok kayu kuning, Kunyit kasturi, Hibiscus acetosella, daun Inai, Terminalia chebula, Terminalia bellirica dan buah Pinang. Bahan bahan tersebut dicincang dan di rebus menggunakan 10 cawan air dan dibiarkan sehingga

kering sebanyak 5 cawan. Rebusan yang terhasil mengeluarkan warna yang pekat dan boleh digunakan keatas kain.

3.4.3 Penghasilan larutan pemati warna
Dalam kajian ini larutan pemati warna yang digunakan dalam teknik eco print adalah larutan tawas ($KAI(SO_4)_2$. Larutan pemati warna digunakan untuk mengunci warna setelah proses pewarnaan dan eco-print selesai. Larutan pemati warna tawas disediakan menggunakan 1-liter air hujan yang di panaskan dan 50 gram tawas. Bahan tawas ini perlu di didihkan bagi mempercepat proses melarut. Setelah bahan larut, bahan tersebut dibiarkan sejuk dalam suhu bilik sebelum digunakan.

3.4.4 Proses memindah warna
Teknik ec-print dalam kajian ini menggunakan proses pemindahan warna daripada 10 helai kain yang decelup menggunakan warna yang terhasil daripada 10 bahan alam semulajadi. 10 helai kain yang telah dirawat diambil dan dicelupkan didalam warna seterusnya dikeringkan dibawah panas matahari. Sementar itu 10 kain yang tidak diwarnai dibentang diatas lantai dan daun jati yang dipilih disusun di atas permukaan kain. Susun atur daun jati dilakukan secara rawak sahaja seterusnya kain yang telah diwarnakan yang telah kering diambil dan ditindankan di atas kain putih yang telah disusun daunya. Setelah ditindan rapi, *plastic wrap* digunakan dan di hamparkan di atas permukaan kain-kain yang telah disusun seterusnya dipotong mengikut saiz yang sesuai.

Kesemua kain-kain yang telah disusun dengan daun dan ditindih dengan kain berwarna serta di hamparkan plastik di gulung rapat dan di bungkus rapi. Kain-kain yang telah dibungkus pula dikukus selama dua jam. Setelah siap dikukus, bungkusan-bungkusan kain itu dibiarkan sejuk dan dibuka. Sisa-sisa daun dikeluarkan dan kain dibersihkan seterusnya kain dijemur sesehingga kering. Daripada proses ini, corak-corak terhasil dapat dilihat dengan jelas dan kesemua warna dapat dipindahkan kepada kain dengan baik.

3.4.5 Proses pemati warna
Proses pemati warna bertujuan mengikat zat warna pada kain supaya tidak luntur. Proses ini dilakukan dengan mencelupkan sampel-sampel kain ke dalam larutan tawas selama lima (5) minit. Setelah kain dicelup, diperah dan di keringkan dibawah panas matahari.

3.4.6 Ketahanan warna
Keupaayaan ketahanan warna pada kajian dilaksanakan untuk mengetahui keawetan warna pada daun jati pada kain sutera satin. Ujikaji ketahanan warna pada sampel kain dilakukan dengan cara fabrik dibersihkan dengan menggunakan cecair pencuci pakaian. Kain-kain dibersihkan, dibilas dan dikeringkan. Setelah kering, barulah hasil eco-print ini dapat dinilai hasilnya.

4. ANALISIS DAN KEPUTUSAN

4.1 Hasil kajian
Pewarnaan alam semulajadi dengan menggunakan daun jati sebagai medium utama dapat menghasilkan warna merah dan seakan-akan warna ungu serta warna kekuningan yang bercampur dengan warna coklat (Ainur Rosyida, 2014). Pewarnaan alam semulajadi keatas kain sutera satin dengan mengaplikasikan teknik *eco print* dapat menghasilkan pelbagai jenis warna dan rupa hasil daripada tindakbalas kimia daripada bahan-bahan alam serta bentuk daun dan bunga yang digunakan (Salsabila & Ramadhan, 2018). Setiap pewarnaan alam semulajadi yang dihasilkan mempunyai kadar nilai potensi hidrogen (pH) yang tersendiri daripada sifat alkali, natural dan asid. Sifat-sifat pada zat bahan alam ini mampu berinteraksi kepada bahan-bahan pemati warna dan bahan mordant.

Jadual 1: Jadual bahan-bahan pewarna alam semulajadi

PENANDA	NAMA BAHAN PEWARNA	Nilai pH
A	Kayu Bakau Batu	6.49
B	Akar Mengkudu	5.10
C	Akar Sintok	5.60
D	Pokok Kayu Kuning	5.90
E	Kunyit Kasturi	5.75
F	Hibiscus acetosella	2.17
G	Daun Inai	4.46
H	Terminalia Chebula	2.50
I	Terminalia Belliricaa	3.49
J	Buah Pinang	4.96

Jadual 1 menunjukkan jenis-jenis bahan pewarnaan alam semulajadi yang dilabel beserta nilai bacaan potensi hidrogen (pH). Nilai pH diukur bermula daripada 1 yang menunjukkan bacaan kepada asid dan sehingga 14 yang menunjukkan bacaan alkali. Dalam kajian ini, kesemua bahan pewarnaan alam semulajadi ini menunjukkan kea rah sifat-sifat yang berasid seperti bahan pewarna *Hibiscus acetosella* menunjukkan bacaan pH 2.17 manakala bahan pewarna yang lebih bersifat natural adalah kayu bakau batu dengan bacaan pH 6.49. Akar mengkudu menunjukkan bacaan pH 5.10 dan akar sintok pula menunjukkan bacaan pH 5.60 di atas paras asid. Pokok kayu kuning dan kunyit kasturi yang menghasilkan warna kuning juga menunjukkan bacaan pH 5.90 dan 5.75.

Bahan pewarnaan daripada daun inai dan buah pinang menghasilkan warna yang berasid dengan nilai bacaan pH 4.46 dan 4.96 manakala bahan rempah seperti *Terminalia chebula* dan *Terminalia bellirica* menghasilkan bahan pewarnaan yang berasid dengan bacaan pH 2.50 dan 3.49. Hasil daripada kajian dan penelitian terhadap 10 bahan pewarnaan alam semulajadi ini menunjukkan kesemua bahan adalah bersifat asid dan aktif bertindakbalas dengan bahan yang bersifat natural dan alkali.

Jadual 2 menunjukkan hasil tindak balas bahan pemati warna tawas terhadap 10 bahan pewarnaan alam semulajadi. Setiap warna alam semulajdi ini mengandungi asid manakala tawas juga bersifat asid dengan bacaan pH 2.65. Walaubagaimanapun sifat asid bahan pewarna, masing-masing mempunyai zat yang berbeza yang dapat bertindakbalas dengan sifat zat bahan pemati warna seperti tawas.

Jadual 2: Hasil tindakbalas tawas terhadap 10 bahan pewarnaan alam semulajadi

BAHAN PEMATI WARNA	BAHAN PEWARNA ALAM SEMULAJADI									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
										
TAWAS										

Jadual 3: Hasil Eco Print daun jati di atas kain sutera menggunakan bahan pewarnaan alam semulajadi dengan tawas.

BAHAN PEWARNA	**BAHAN PEMATI WARNA**	**BAHAN ECO PRINT**	**FABRIK**	**HASIL**
A: pH 6.49 	Tawas pH2.65	Daun Jati	Sutera Satin	
B: pH 5.10 	Tawas pH2.65	Daun Jati	Sutera Satin	

C: pH 5.60	Tawas pH2.65	Daun Jati	Sutera Satin	
D: pH 5.90	Tawas pH2.65	Daun Jati	Sutera Satin	
E: pH 5.75	Tawas pH2.65	Daun Jati	Sutera Satin	
F: pH 2.17	Tawas pH2.65	Daun Jati	Sutera Satin	
G: pH 4.46	Tawas pH2.65	Daun Jati	Sutera Satin	
H: pH 2.50	Tawas pH2.65	Daun Jati	Sutera Satin	
I: pH 3.49	Tawas pH2.65	Daun Jati	Sutera Satin	

J: pH 4.96 	Tawas pH2.65	Daun Jati	Sutera Satin	

Berdasarkan hasil kajian yang dijalankan mengikut jadual 3, hasil eco print pada kesemua warna alam semulajadi pada setiap sampel seperti kayu bakau batu, Akar Mengkudu, Akar Sintok, Pokok Kayu Kuning, Kunyit Kasturi, *Hibiscus acetosella*, Daun Inai, *Terminalia Chebula*, *Terminalia Belliricaa*, Buah Pinang dengan menggunakan tawas sebagai agen pemati warna. Hasil sampel-sampel yang terhasil di jemur sehingga kering bagi tujuan merekod, menganalisis serta membezakan setiap hasil eco print. Setiap bahan pewarnaan menghasilkan warna yang berbeza dan memberi kesan yang berbeza terhadap daun jati. Daun jati yang menghasilkan warna kemerahan dan ungu dapat dilihat dengan jelas di dalam kajian ini. Hasil yang diperolehi juga dapat merumuskan bahawa agen pemati warna juga mempengaruhi hasil warna alam semulajadi dan zat-zat yang ada pada daun jati.

Perbezaan warna yang ketara dan berbeza seperti warna akar kayu sintuk terhadap daun inai, warna *Terminalia Chebula*, *Terminalia Belliricaa*, yang mempunyai warna coklat yang seakan sama. Warna alam semulajadi dari akar mengkudu dan warna Kunyit Kasturi menghasilkan warna kekuningan yang berbeza diantara satu sama lain. Kunyit Kasturi menghasilkan warna kuning terang berbandingan warna akar mengkudu yang sedikit gelap dan kedua-dua warna tersebut menghasilkan *silhouette*, dan warna serta urat-urat daun jati yang lebih jelas. Kain yang di celup bahan A, C, J menunjukkan hasil *eco print* daun jati yang berwarna ungu kemerahan dan tindakbalasnya terhadap bahan tawas menghasilkan warna yang kekuningan. Bahan B, D dan E pula mempengaruhi warna daun jati dengan variasi warna kuning dan menjadikan daun jati berwarna merah cerah dan dapat dilihat dengan jelas manakala tinbdakbalasnya terhadap bahan tawas menjadikan tekstur daun jati lebih gelap.

Hasil teknik eco print bahan F menghasilkan jalinan daun jati yang lembut dan tindakbalas terhadap bahan tawas menjadikan sekitar daun jati menjadi kekuningan. Bahan G menghasilkan warna perang dan tindakbalas terhadap daun jati menghasilkan warna ungu gelap dan merah terang manakala celupan bahan tawas menghasilkan kesan kekuningan pada fabrik. Yang terakhir adalah bahan H dan I yang menghasilkan warna yang serupa dan tindakbalas daun jati juga sama iaitu penghasilan jalinan barwarna merah. Tindakbalas bahan tawas menghasilkan warna kekuningan pada sekitar daun jati.

5. KESIMPULAN

Setiap pewarnaan alam semulajadi telah memberi pelbagai warna yang mempunyai daya tarikan tersendiri memberi tindakbalas yang berbeza terhadap bahan pemati warna yang digunakan oleh pengkaji. Sepuluh pewarnaan alam semulajadi memberi tindakbalas dan hasil yang berbeza antara satu sama lain mengikut material / bahan yang dipilih bagi proses *eco print*. Daripada kaedah pemgumpulan data yang dilaksanakan terdapat beberapa zat tumbuhan yang terhasil dalam proses teknik *eco print* ke atas perwarnaan alam semulajadi. Kesimpulan kepada proses penghasilan teknik *eco print* ini, penggunaan daun jati ini adalah bahan utama untuk mengeluarkan pigmen-pigmen / zat-zat terus ke atas kain sutera satin. Pada tahap ini, pengkaji dapat melihat penghasilan *eco print* ke atas fabrik utama, menghasilkan pelbagai bentuk, warna, corak serta jalinan yang indah pada setiap sampel kain. Proses *mordant* (perawatan) pada setiap bahan-bahan iaitu dedaun dan bunga-bunga yang dipilih adalah salah satu faktor penyumbang kepada warna, corak serta jalinan *(texture)* yang terhasil pada setiap jenis pewarnaan semulajadi ke atas sampel fabrik.

Proses eksperimentasi *eco print* ini adalah salah satu kaedah penghasilan rekabentuk corak, warna, jalinan *(texture)* yang indah dan eksklusif kepada pereka-pereka tekstil. Beberapa eksperimentasi telah dilaksanakan untuk melihat secara terperinci akan teknik *eco print* dengan menggunakan kaedah *Practice Based Research*. Daripada beberapa proses tersebut, yang utama adalah eksperimentasi bagi mendapatkan jenis daun dan jenis bunga yang boleh tercetak sama ada sifat, bentuk, rupa ke atas fabrik yang dipilih. Dari hasil keseluruhan eksperimentasi ini. Dari keseluruhan sampel yang diperolehi, daun jati menghasilkan warna, jalinan *(texture)* dan rupa yang sangat jelas. Bahan-bahan yang digunakan untuk penghasilan pewarnaan alam semula jadi sehingga kepada penghasilan teknik *eco print* ke atas fabrik tidak memerlukan kos yang tinggi kerana boleh diperoleh di kawasan sekitar. Kajian ini akan menjadi satu fenomena baharu yang berevolusi dalam dunia tekstil disamping menghargai dan mengimplimentasikan sumber alam semulajadi berkonsepkan kehijauan dalam kelestarian kehidupan. Cadangan pengkaji untuk kajian akan datang ialah dengan mengkaji lebih mendalam bahan-bahan alam semulajadi yang lain yang dapat memberi manfaat kepada manusia dan alam.

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THE POTENTIAL OF CHICKEN FAT AS BIODIESEL

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Abstract. Biodiesel is a non-petroleum-based alternative diesel fuel that consists of alkyl esters derived from renewable feedstock which is animal fats that can help reduce greenhouse gas emissions and minimize the "carbon footprint" of agriculture. Biodiesel is also a diesel fuel substitute that can be made from a variety of oils, fats, and greases, also interest to farmers for a number of reasons. Therefore, for this study, chicken fat has been used to produce biodiesel. The main objective of this research is to analyze the properties of biodiesel from chicken fats in terms of density, flammability, solubility, kinematic viscosity and pH. There are two main methods for the production of biodiesel which are micro emulsions and transesterification. However, the most commonly used is transesterification reaction method. Besides, chemical process has been used to convert animal fats to biodiesel usually involves a reversible reaction. Based on finding, biodiesel from chicken fat has equal ability as ordinary diesel which follow the European Standard specification, EN14214. The value of kinematic viscosity is 4.55 mm2/s which is in the range of 4.35 mm2/s to 4.65 mm2/s. While for flammability, biodiesel produce less soot compare to diesel. As a conclusion, the use of chicken fat into biodiesel production is suitable. This project uses waste materials from animals which can be used to the maximum in order to increase the production of biodiesel from a variety of sources.

Keyword: Biodiesel, chicken fat

1. INTRODUCTION

Increased urbanization and increase in population led to an increased demand for fuels. The result's the costs of fuels are reaching new heights a day. The diesel engines led to emission of hazardous gases like sulphur dioxide, nitrogen dioxide and carbon monoxide which can further have led to problems like acid rains. These things can also affect human health and increase global warming. Today with the advances in the knowledge and developing technologies there is a way to control pollution where the use of biofuel can be an alternative to current fuels (Naresh & Prabhakar, 2018). Problems faced by the world is the lack of fuel for the fire source. To deal with these problems arise power source biotechnology as an alternative energy fuel that can replace the fire than it is. The technology is environmentally friendly because it is a renewable resource after undergoing the process (Zahan & Kano, 2018).

Biodiesel is a non-petroleum based alternative diesel fuel that consists of alkyl esters derived from renewable feedstock such as plant oils or animal fats. The fuel is made by converting the oils and fats into what are known as fatty acid alkyl esters. The conventional processes require the oils or fats be heated and mixed with methanol, ethanol, propanol, butane, amyl alcohol and potassium hydroxide. The conversion process is called transesterification (Zahan & Kano, 2018). The blending of Biodiesel in diesel fuel became mandatory when the Biofuels Act of 2006 which also known as Republic Act 9367, was signed into law by President Gloria Macapagal-Arroyo on January 2007. They said act was initiated by Senator Mirriam Defensor-Santiago, who also authored and sponsored the Biofuels Law. Law requires bioethanol

content of all gasoline sold in the country to be increased to at least ten percent (10%) by the fourth year of the law's effectively. On the other hand, diesel fuels sold in the country will be required to have at least one percent (1%) blend of biofuel upon the effectively of the law, which will be later increased up to two percent (2%) after second year (Alvarez, 2008).

In addition, chicken fats are the byproducts of poultry cuts until presently has not been utilized ideally. The utilization of it is still cannot be utilized as an arrangement to create ideal utilize of squander chicken fats are exceptionally abundant (Jayathilakan et al., 2012). Therefore, the idea of making biodiesel with raw flour chicken fats is a very promising idea which can produce an alternative energy source so that it can be applied either to use equipment that uses diesel oil as fuel or vehicles.

2. LITERATURE REVIEW

The development of alternative fuels to the market gradually produced from petroleum is necessary from an economic and an ecological point of view. Petroleum conventionally considered as the main source of energy. However, it was on the verge of extinction, leading to higher energy prices. In addition, in line with rising CO2 production, is also intensifying climate change. As a result, there is increasing interest in developing alternative energy sources such as wind power, solar energy and hydrogen cells. However, this technology is still under development and the cost of using them is high. Biodiesel (fatty acid methyl ester or FAME) has been identified as a potential alternative fuel and reliable.

2.1 Biodiesel

Biodiesel is a non-petroleum-based alternative diesel fuel that consists of alkyl esters derived from renewable feedstock such as animal fats and plant oils that can help reduce greenhouse gas emissions and minimize the "carbon footprint" of agriculture (Das et al., 2013). It contributes less to heating because the carbon within the fuel was faraway from the air by the plant feedstock. Biodiesel is also a diesel fuel substitute that can be made from a variety of oils, fats, and greases, is of interest to farmers for a number of reasons. It can allow farmers to grow the fuel they need for farm machinery, it can provide an additional market for vegetable oils and animal fats, and it can decrease U.S. dependence on imported oil since fuel feed stocks can be grown domestically (Shereena & Thangaraj, 2009). Biodiesel is defined by ASTM as a fuel composed of mono alkyl esters of long-chain fatty acids derived from renewable animal fats or vegetable oils (Amber et al., 2014).

One of the foremost advantages of using biodiesel is which will be utilized in existing diesel engines with little or no modifications in the least and may replace fossil fuels to become the foremost preferred primary transport energy source. Biodiesel are often utilized in 100% (B100) or in blends with petroleum diesel. B20 is named as 20% blend of biodiesel with 80% diesel oil. It improves engine lubrication and increases engine life since it's virtually sulphur free (Zahan & Kano, 2018). Meanwhile, less carbon output and few pollutants are produced when biofuels are burnt. Biodiesel produces less soot (particulate matter), carbon monoxide gas, unburned hydrocarbons and sulphur dioxide compared to petroleum diesel. Flashpoint for biodiesel is above 150°C whereas an equivalent is about 52°C for petroleum diesel, which makes it less combustible. Therefore, it is safe to handle, store and transport (Ruano et al., 2016).

2.2 Chicken Fats

Chicken fats shown in figure are the byproducts of poultry cuts until now has not been used optimally. Most of chicken fats thrown around the abattoir and as a result cause environmental noise (pollution or emission). Especially in rural areas, waste wool chicken cuts result in both small and large scale burned up can cause air pollution caused by smoke and odor, other than that some have thrown into the water can flow obstructing the water flow like rivers or gullies. The waste of the chicken fat is sometimes fed to birds and lizards (Tesfaye et al., 2017).



Figure 1: Chicken fat

The main goal of using chicken fat in this project is because chicken fat has a good potential to be used as biodiesel. Apart from the high income statistics in the manufacture of wet, in the meantime, there is no specific and the best management can do to chicken fat other than discarded or fed to other animals (Mohiddin et al., 2018). The utilization of it is still cannot be used as a solution to make optimum use of waste chicken fats (Ramos et al., 2019).

3. RESEARCH METHODOLOGY

Chicken fat is used as main material to produce biodiesel. There are 5 tests that has been done to determine the effectiveness chicken fat as biodiesel which are kinematic viscosity, flammability, density, solubility and pH. Biodiesel is made through a process of transesterification with alcohol used methanol and potassium hydroxide as a catalyst and formation of glycerine will be produced. The two products can be separated by gravity and pipette is used to separate the two materials. After that, the washing oil process by using activated carbon from coal to attracts organic chemicals from vapour and liquid streams cleaning them of unwanted chemicals. The methodology flow chart is shown as follows.

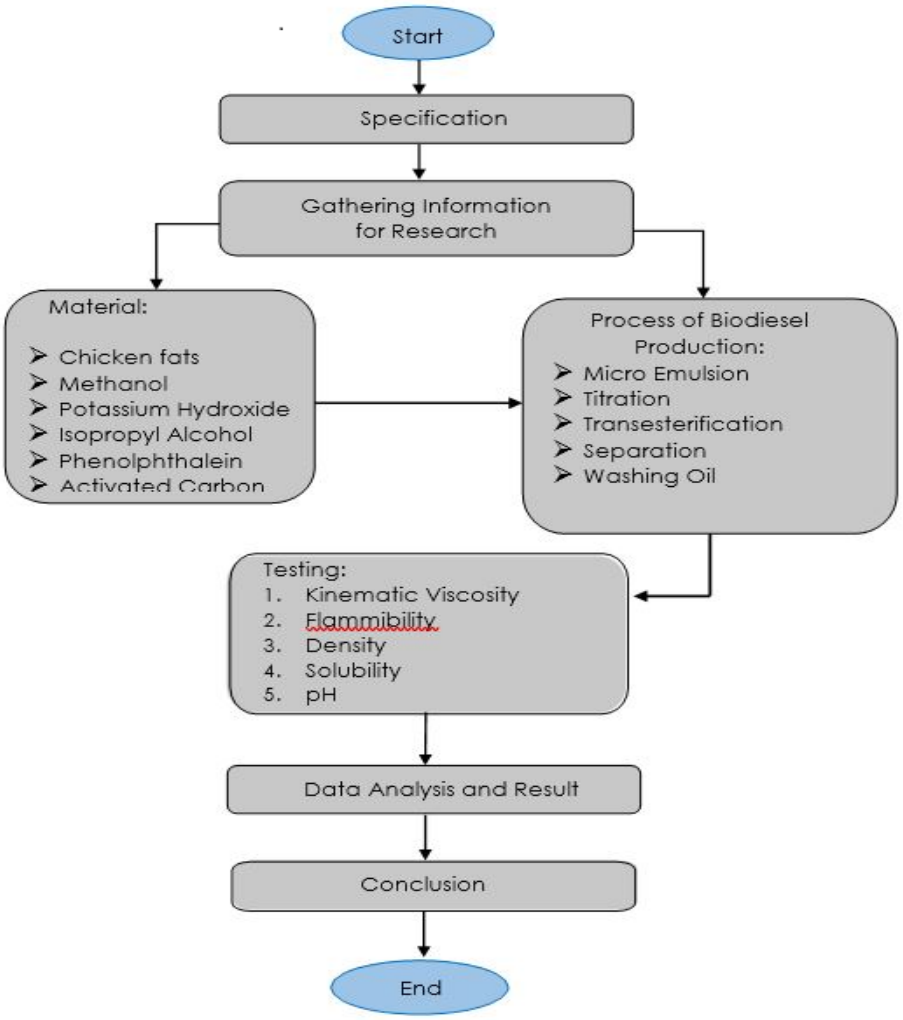


Figure 2: Methodology Flow Chart

4. ANALYSIS AND RESULTS

There are five types of testing that must be done to determine the effectiveness of biodiesel which are kinematic viscosity, flammability, density, solubility and pH.

4.1 Kinematic Viscosity for Biodiesel Sample
The result of kinematic viscosity is shown as follows.

Table 1: Result of Kinematic Viscosity

test parameters	units	results	method references
kinematic viscosity @40 °C	mm^2/s	4.55	ASTM D7042

The table shows the result of kinematic viscosity for biodiesel sample. The value of kinematic viscosity ranged between 4.35 mm^2/s to 4.65 mm^2/s, which is our result is acceptable because the result is 4.55 mm^2/s. The testing is important to determine viscosity because high viscosity leads to negative impacts on fuel injector performance and increased exhaust smoke. Viscosity in our result is good ranged, if the viscosity increases with the higher degree of saturation and the presence of free fatty acids (FFA) traces in the sample.

4.2 Flammability Test



Figure 3 : Flammability Test Diesel Sample (Left) and Biodiesel Sample (Right)

From this flammability experiments, this study was conducted using a flame lamp. A comparison of the two different types were done between biodiesel and diesel in the market. However, a mixture of methanol into biodiesel fuel can light up similar to diesel. It was found that the flame biodiesel is better without producing any soot or black smoke.

4.3 Density Test



Figure 4 : Density Test by Using Electronic Balance for Biodiesel Sample (Left) and Diesel Sample (Right)

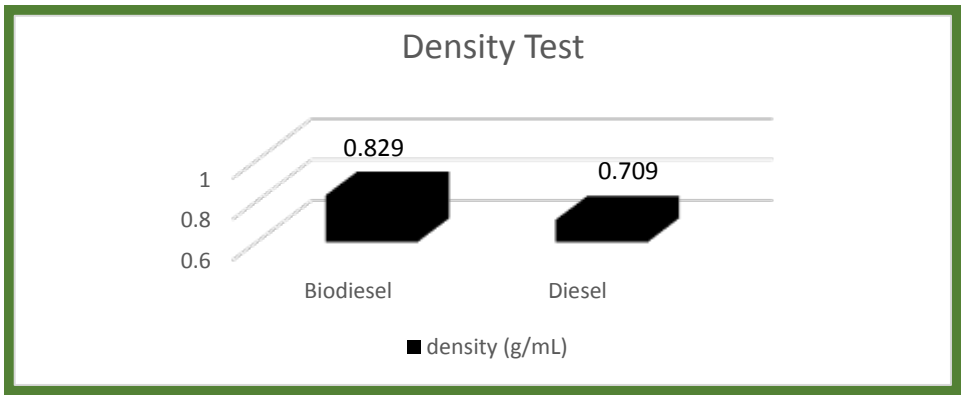


Figure 5 : Graph Of Density Test

The graph shows the reading of density for biodiesel and diesel. Instead of counting is done according to the density of the formula in the table the result of density test, the density ratio of the two types of oil can be obtained when one quantity measure of either the mass or weight. To get the best reading, data is read three times and an average is calculated. To facilitate the calculations are made, the volume of the oil will be kept constant using 20 mL. From the data, the density of biodiesel is higher than diesel which is 0.829 g/mL and 0.709 g/mL.

4.4 Solubility Test



Figure 6 : Comparison of Diesel Solubility Ratio (Left) and Biodiesel (Right) In Distilled Water by Using the Measuring Cylinder

This experiment was conducted to test biodiesel solubility in water as generally oil will not dissolve in water. The experiment was conducted using 40 mL of distilled water for both types of biodiesel produced oil and diesel also purchased (market). After that, the measuring cylinder filled with biodiesel until reaching 10 mL. From this experiment also found that biodiesel does not mix with the water same like diesel.

4.5 pH test



Figure 7 : Result of pH Test by Using pH Indicator Strip Biodiesel Sample (Left) and Diesel Sample (Right)

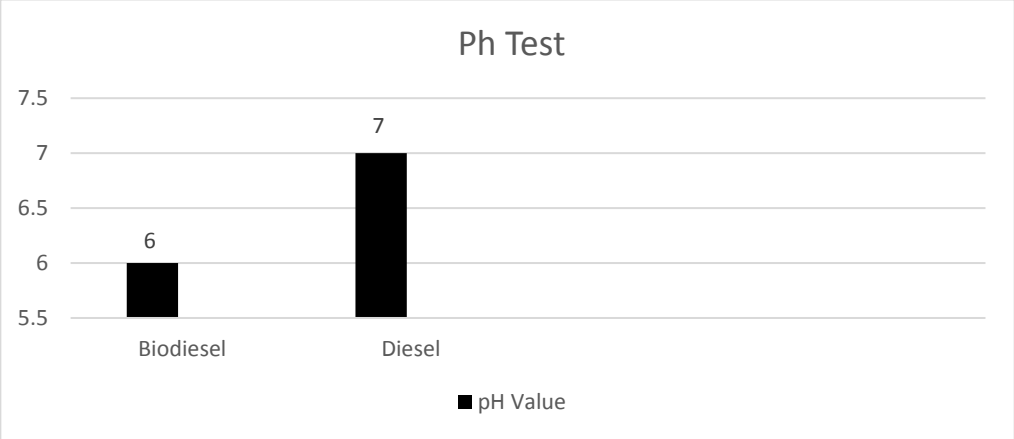


Figure 8 : Graph of pH Test

From figure, graph compares the pH biodiesel obtained in which the pH reading closest to the pH value of diesel. This experiment was conducted at Environmental Laboratory Polytechnic Sultan Idris Shah by Using pH Indicator Strip. The result for biodiesel pH value is 6, while for diesel pH value is 7.

5. CONCLUSION

The experiments of pH test is to ensure that the production of biodiesel is at neutral to prevent erosion in the engine. Flammability test is made to ensure that biodiesel can light a fire with the production of soot cleaner than diesel in the market. Solubility test is to test the level of biodiesel into the water solubility. Relative density test is to calculate the density of biodiesel by oil standard of less than 1 mg/L. Kinematic viscosity is the latest experiments, the experiment is designed to ensure that we produce biodiesel within the prescribed standard kinematic viscosity. The results of this test should be in the range specified for biodiesel is suitable for use in motor vehicles. If reading is the maximum level, this will cause pump channel will be blocked.

As a conclusion, the production of chicken fat into biodiesel is suitable to be used. Based on the data of each tests, all the result is fulfilling the requirement of the Europe standard. The biodiesel from chicken fat is very environmentally friendly and appropriate to replace the energy in the market to reduce pollution from existing energy sources.

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ENERGY EFFICIENCY IN THE TECHNICAL EDUCATIONAL BUILDING SECTOR THROUGH ELECTRICAL ENERGY SAVING MEASURE RETROFIT

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Abstract. Rising demand for electricity energy occurred due to emerging market economies reflected by the growth of educational, economic, industrialization and population scale in Malaysia. Hence, energy conservation through sustainable technology and practices on electricity energy use is needed to reduce energy consumption and energy cost while maintaining the level of environmental sustainability. Implementation of Sustainable Energy Management at Politeknik Sultan Azlan Shah (PSAS) is to determine how and where electrical energy is consumed and also to identify suitable application of energy saving measures. Remedial action has been taken to improve energy consumption for lighting loads, server room, air conditioners, distribution substation supply and their power consumption pattern was determined. This paper presents the energy consumption saving achieved by PSAS based on the energy conservation and saving measures technique implemented from 2016 to 2019 by referring to the baseline in 2013. It is proven that 2,818,881kWh electricity energy consumption with a total cost of RM1, 384,523 has been saved by PSAS from 2016 to 2019 which indirectly contribute to the Greenhouse Gas (GHG) emission reduction.

Keywords: Sustainable Energy Management, Energy Saving.

1. INTRODUCTION

The world's CO_2 emissions are projected to increase around 50 percent, absent any global agreement to limit emissions from 2004 to 2030 (Hong, W., 2007). In line with the Malaysia government's intention to achieve a reduction in carbon emissions, various implementation strategies have been introduced to achieve that vision. The commitment expressed by Malaysia at the 15th Conference of the Parties (COP15) in Copenhagen to reduce the intensity of gross domestic product (GDP) emissions to 40% by 2020 based on the 2005 level needs to be implemented through effective strategies (Anonymous, The Academy of Sciences Malaysia, 2013). The energy retrofit method in charge by Sustainable Energy Management Committee in government buildings is one of the strategies measures that have been introduced while ensuring that the government to lead by example towards that achievement.

Retrofit of existing PSAS buildings represent an opportunity to improve the energy performance of building assets in the future ahead. Retrofit involves modifications to existing buildings such as lighting loads, server room, air conditioners, distribution substation supply that may improve energy efficiency or decrease energy demand. Energy efficiency retrofits are projected to reduce operating costs while increasing the level of energy sustainability on campus.
The aim of this research is to study the performance of energy efficient for Politeknik Sultan Azlan Shah complex. Its measurable objectives are to identify energy consumption in a Politeknik Sultan Azlan Shah complex, study energy saving opportunities in the selected buildings and analyze achievement of energy cost and energy consumption saving.

2. LITERATURE REVIEW

Energy is a key driver for agriculture, industries, and service sectors that influence economic development, but today's rising concern over its sustainability has put the world in a critical position. The burning of fossil fuels causes multiple environmental problems such as air pollution and global climate change (Zidansek, 2009). Forest, land and ocean availability and its allocation including regulations will give influenced to the energy production which it is the factors affecting standards of living and life quality. European Commission – Environment has stated the impact to the environment are minimized by efficiently used of resources and sustainable exploitation of the limited asset (European Commission-Environment., 2018). Portion of energy consumption and greenhouse gas emission are mostly contributed by various types of residential building. 27% of energy consumption and emitting 17% of the GHG emissions worldwide were contributed by the residential sector (Nejat, P. et al., 2015). GHG is carbon dioxide CO_2 which enters the atmosphere through burning fossil fuels during electricity generation processes using coal, natural gas and oil. The GHG affected the stable heating of atmosphere and surface which contribute to the global warming (Darkwah., et al. 2018). Global change threatens the very existence of life. Transforming the present coal dominated energy mix to renewable and sustainable energy dominated energy use is one of the herculean tasks facing India (Institute for Energy Research, 2014). Nowadays, attention has been paid to ensure energy efficiency (EE) in buildings even though it has tremendous impact on costs and environment. The innovation in new and advanced energy technologies has enabled India to resolve the barriers of commercial production of sustainable energy. Therefore, sustainable energy and low carbon technologies could provide ways for development opportunities that result in a world that is healthy, viable and has a secure energy source (Steven & Majumdar, 2012).

3. RESEARCH METHODOLOGY

Energy saving result after implementation had measured and verified against the baseline energy consumption of the organization or machine/ equipment. Energy Saving Measure (ESM) in Table 1 was implemented in PSAS to improve the electricity consumption level. Measurement and Verification by Malaysian Green Technology Corporation successfully finalized on September 2015 (Anonymous, International Performance Measurement & Verification Protocol, 2002).

Table 1: Energy Saving Measures at PSAS

Energy Saving Measures (ESM)	Description
1	Installation of Voltage Optimization (VOU) Unit
2	Installation of Water Cool Package Unit (WCPU)Smart Controller System
3	T8 Fluorescent Light Bulb Replacement to T5 Tube
4	Installation of High Efficiency Split Unit Air Conditioner for Server Rooms
5	Installation of 1.5 HP Air Conditioner for Laboratories

A comparison of the measured energy used before and after the implementation of energy saving measures determines the rate of savings achievement (Anonymous, International Performance Measurement & Verification Protocol, 2002). In general:

Energy Savings = Base year Energy Use – Post-Retrofit Energy Use ± Adjustments

Figure 1 and Table 2 show the baseline data on energy use at Politeknik Sultan Azlan Shah in 2013 which the average value of electricity consumption and maximum demand are 416,470 kwH and 1780 kW which contributes to the average energy cost of RM205, 936. While the

actual value of electricity consumption and maximum demand in 2013 was 4,997,645 kwH and 21,356kW which contributed to the energy cost of RM2, 471,227.

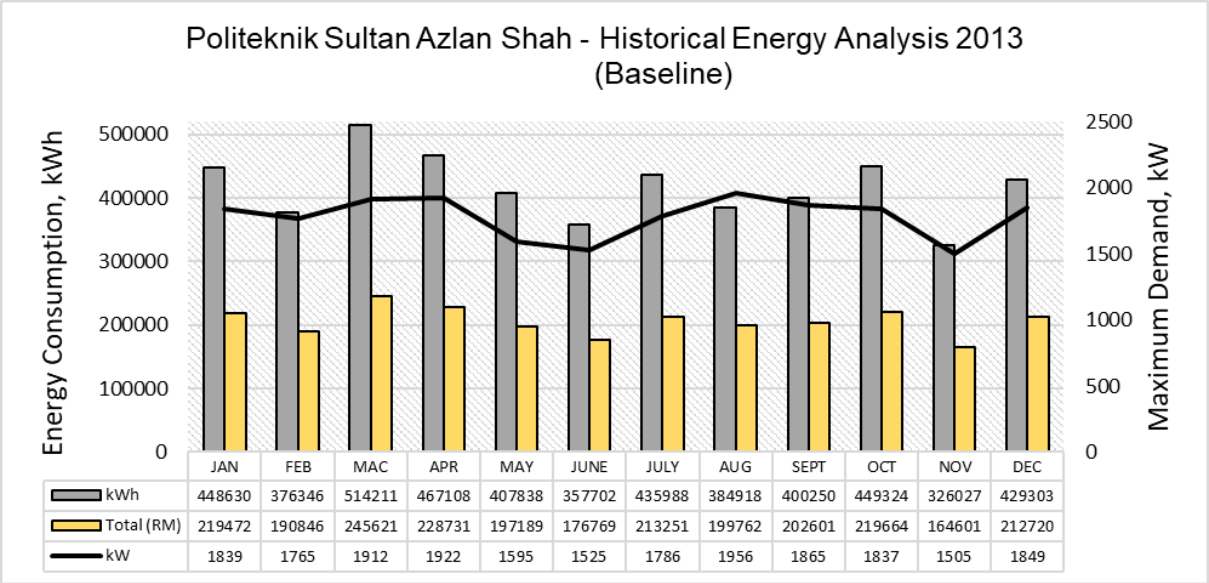


Figure 1- Politeknik Sultan Azlan Shah Historical Energy Analysis Graph 2013 (Baseline)

Table 2: Politeknik Sultan Azlan Shah Historical Energy Analysis 2013 (Baseline)

MONTH	Baseline 2013				
	kWh	RM(kWh)	kW	RM(kW)	RM(Total)
JAN	448630	163750	1839	55722	219472
FEB	376346	137366	1765	53480	190846
MAC	514211	187687	1912	57934	245621
APR	467108	170494	1922	58237	228731
MAY	407838	148861	1595	48329	197189
JUNE	357702	130561	1525	46208	176769
JULY	435988	159136	1786	54116	213251
AUG	384918	140495	1956	59267	199762
SEPT	400250	146091	1865	56510	202601
OCT	449324	164003	1837	55661	219664
NOV	326027	119000	1505	45602	164601
DEC	429303	156695.6	1849	56025	212720
TOTAL(1-12)	4997645	1667445	21356	591062	2471227
AVERAGE (1-12)	416470	152012	1780	53924	205936

3.1 Voltage Optimization Unit (VOU) installation

Complex of Politeknik Sultan Azlan Shah receives 11kV supply from the National Grid and reduced to 400V via five consumer distribution substation. Figure 2 show the Voltage Optimization Unit (VOU) were installed series to load bus bar at each substation's Main Switchboard (MSB) which composed with voltage regulation system, servo motor and automatic control circuit.

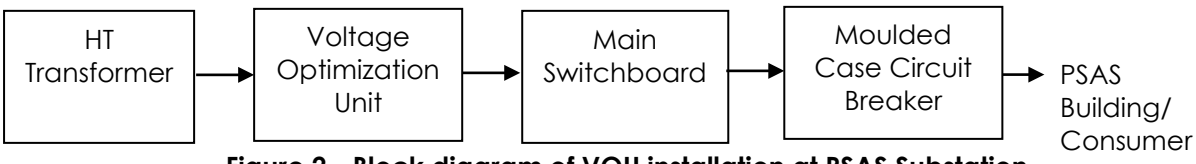


Figure 2 - Block diagram of VOU installation at PSAS Substation

When grid voltage is unstable or when the load change, the automatic control circuit will send signal to control the servo motor to adjust the position of carbon brush on the VOU. The output voltage then regulated to the rated value.

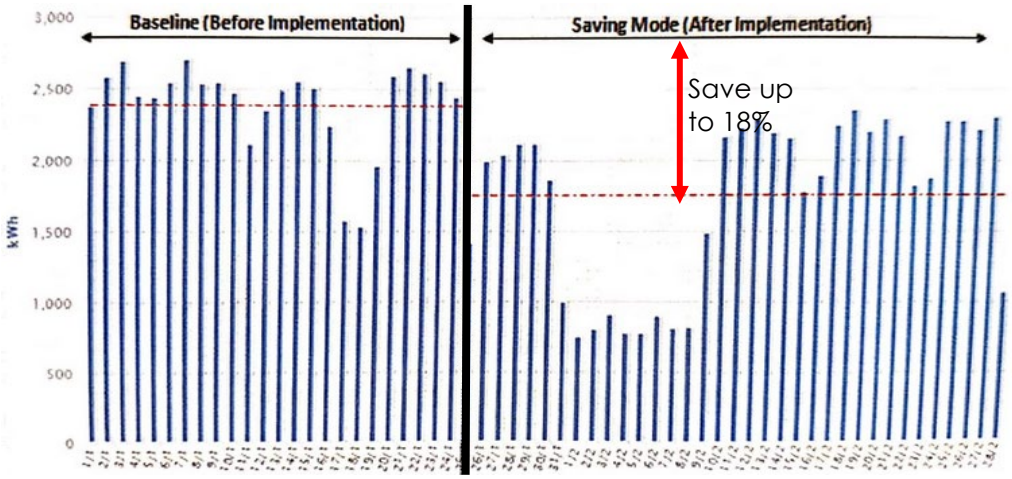


Figure 3- Energy Consumption kWh PSAS Substation 3

Figure 3 shows the result after commissioning VOU at MSB Substation 3 where 18% energy consumption reduction achieved. Comparison between period of Baseline before and after installation of the VOU.

Table 3: Average energy saving at PSAS MSB.

Substation No	Tx Rating (kVA)	ACB Rating (A)	VOU Size (kVA)	Connected Load	Average Energy Saving
1	1800	2500	800	Admin, JSKK, Street Lighting, Main Lecture hall	8.96%
2	2300	3200	1000	Mechanical Dept, Library, Cooling Tower, Civil Dept, HEP	13.81%
3	1250	2000	500	Cafetaria, UPS, Islamic Center, Hostel	18.44%
5	1800	2500	800	Electrical Workshop, Commerce Dept, ULPL, Muallim Hall	9.02%
	1800	2500	800	Electrical Eng Dept & Cooling Tower	
	Average				12.56%

Table 3 shows the result of average energy saving contributed from each VOU unit at Consumer Substation Main Switchboard after commissioning where it is shown that 12.56% average energy saving achieved.

3.2 Water Cooled Package Unit (WCPU) Smart Controller System

Compressor control is a primary approach to save energy, match supply to demand and protect the compressor from overheating, over-pressure situations, and excessive amperage draw (Efficient Plant, 2018). In connection with that, 44 units of WCPU were retrofitted where smart controller system were installed. This system capable to control the WCPU compressor

speed during operation by using temperature parameter. Compressor will operate proportional with temperature value in which one of two compressor unit will be ON and OFF according to the value of temperature setting.

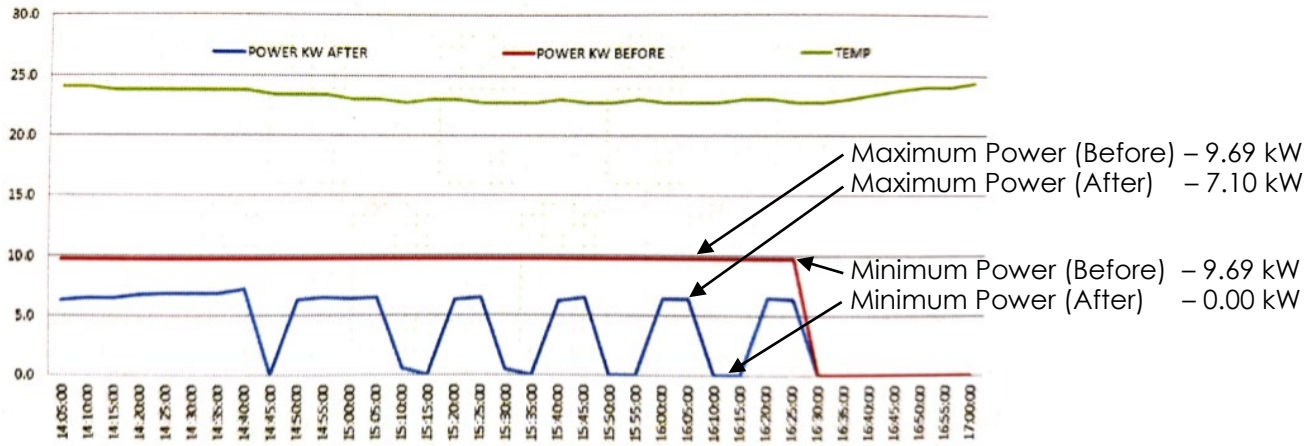


Figure 4- Load Profile – WCPU-1F-JKE after WCPU installation

Figure 4 shows the result of comparison between period of Baseline before and after commissioning WCPU at JKE where it shown that up to 50% average energy saving achieved.

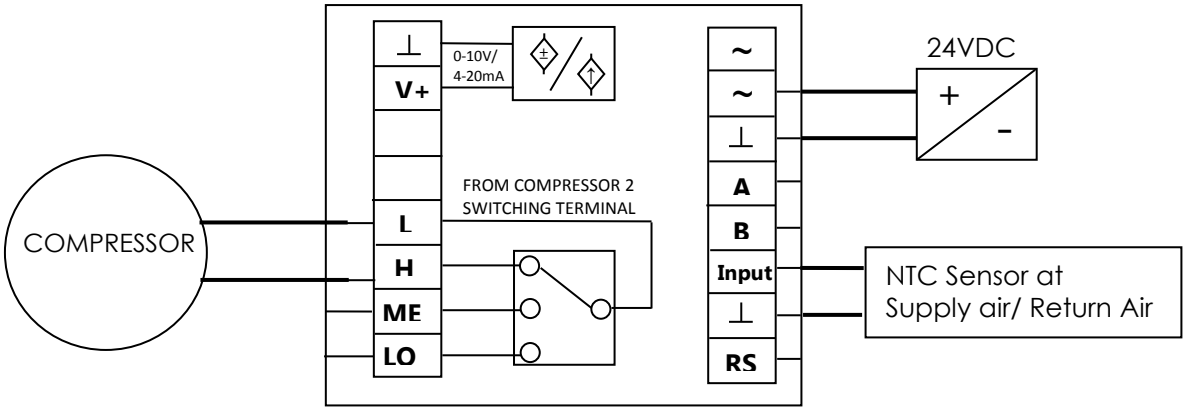


Figure 5- Smart Controller Schematic Diagram

Figure 5 shows the Smart Controller Schematic Diagram installed in the Air Handling Unit room at the WCPU package. Negative Thermocouple (NTC) sensor was assembled at the Supply Air and Return Air area to sense the temperature level. The feedback signal sent back to controller to control the ON and OFF operation of compressor which indirectly reduce the consumption of electricity energy.

3.3 T5 Lighting System

The most efficient lamp was the tubular fluorescent T5, followed by tubular fluorescent T8, compact fluorescent, sodium vapor (Priscilla A. et al., 2016). Referring to this findings, Energy Saving Measure using T5 light bulb have been used to replace the existing T8 light bulb which the energy consumption was significantly improve up to 50%. This is done by electronically converting the luminaires to high frequency operation using electronic ballast. The T5 tube contain with self-ballast which no wiring involved in the installation process of 8300 unit of T5 18 Watt and 700 units of 20 Watt light bulb.



Figure 6- Pin base type of T5 lamps Pin Based Type is different from T8

Figure 6 shows the comparison between pin base type of T5 lamps and pin based type of T8 lamps. T5 lamps have a miniature bi-pin base while T8 lamps used a medium bi-pin base. The T8 fluorescent bulb generates light through electromagnetic induction ballast while T5 illuminate light through advanced electronic circuits. The T8 Fluorescent light bulb replacement to T5 light bulb contributed to 50% energy saving based on data as shown in Table 4. Sampling data at 7 point of T5 lamp average lux reading at ICT room was 311 lux which is within recommended by MS1525:2014 at 300 – 400 lux.

Table 4: Average energy saving using T5 Lighting System

Description	Before Retrofit (kWh/year)	After Retrofit (kWh/year)	Saving (kWh/year)
Conversion T8 36 Watt Light Bulb - 8300 units (T5 18W) - 700 Units (T5 20W)	610,560	305,280	305,280

3.4 High Efficiency Split Unit Air Conditioner

Server Room which locate computer and information technology equipment's generates heat and also have an effect to heat and humidity. The information technology sector contributed to a larger increment in power density and heat dissipation within the footprint of computer and telecommunications hardware (Schmidt et al., 2003). Air conditioners is an equipment that have been used in maintaining a stable temperature and humidity within tight tolerances to information technology system reliability. 2 unit of High Efficiency Split Unit Air Conditioner were retrofitted at PSAS main server room in maintaining a stable temperature and humidity for equipment's in the server room while considering the energy consumption. Table 5 show the Energy saving using High Efficiency Split Unit Air Conditioner at Server Room which contributed to 77% energy saving compared to the condition before.

Table 5: Energy saving using High Efficiency Split Unit Air Conditioner at Server Room

Description	Before Retrofit (kW)	After Retrofit (kW)	Saving (kW)	Energy Saving
High Efficiency Split Unit Air Conditioner	Unit 1 Voltage: 221V Current: 8.4A Power Factor: 0.28 Power: 0.524kW Unit 2 Voltage: 220V Current: 12A Power Factor: 0.94 Power: 2.5kW	Unit 1 Voltage: 224V Current: 1.8A Power Factor: 0.92 Power: 0.386kW Unit 2 Voltage: 225V Current: 1.7A Power Factor: 0.75 Power: 0.292kW	Power = 3.024kW - 0.678kW = 2.346kW	77%

3.5 1.5 HP Air Conditioner for Laboratories

18 laboratories were equipped with WCPU which covered for the laboratories and lecturer room simultaneously. Opportunities for energy saving can be achieved by installing 1.5 HP Air Conditioner for lecturer room to eliminate energy use of WCPU when there are no students in the laboratories. This method will give lecturer having their individual air conditioner only when WCPU turn OFF, otherwise when WCPU is turned ON, cooling system will be operating in normal condition. Figure 7 show the Schematic Diagram installed to control operation between the lecturer room 1.5 HP Air Conditioner and laboratories WCPU.

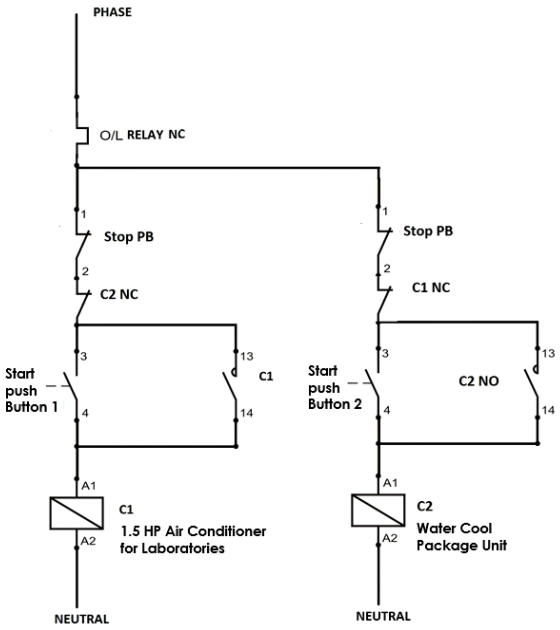


Figure 7- Schematic Diagram for Control Circuit 1.5 HP Air Conditioner and Water Cooled Package Unit (WCPU) for Laboratories

4. ANALYSIS AND RESULTS

4.1 Energy Analysis: Energy Saving and Energy Cost Saving

Based on Figure 8 and Table 6 related to Politeknik Sultan Azlan Shah analysis of energy saving and energy cost data in 2016 to 2019, it is shown that the achievement of savings rate is around 13% to 15% compared to 2013. Average value of electricity consumption and the maximum demand of 2019 is 352,617 kwH and 1503kW which contributes to the average energy cost of RM174,253.92 compared to the average value of electricity consumption and the maximum demand of 2013 is 416,470 kwH and 1780 kW which contributes to the average energy cost of RM205,935.60. While the actual value of electricity consumption and maximum demand of 2019 is 4,231,412 kwH and 18,039 kW which contributes to the energy cost of RM2,091,047.08 compared to the value of total electricity consumption and maximum demand in 2013 is 4,997,645 kwH and 21,356kW which contributes to energy costs of RM2,471,227.23.

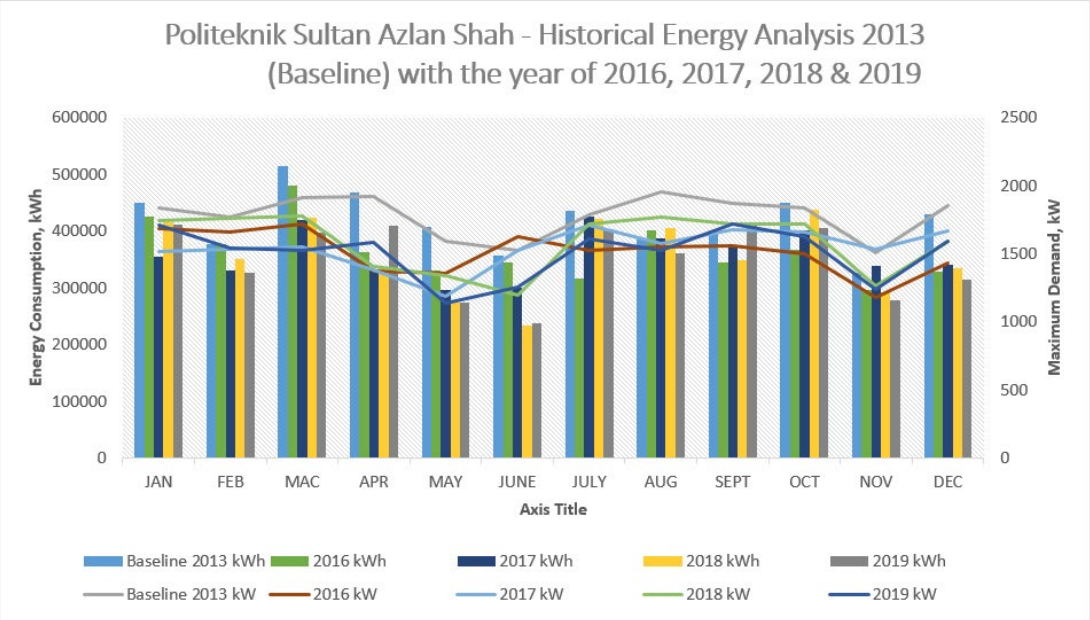


Figure 8: Politeknik Sultan Azlan Shah Historical Energy Analysis Graph 2013 (Baseline)

Table 6: Historical Energy Analysis Energy Cost and Energy Saving – Comparison Between 2019, 2018, 2017, 2016 and Baseline 2013

MONTH	Baseline 2013					2016					2017					2018					2019				
	kWh	RM(kWh)	kW	RM(kW)	RM(Total)	kWh	RM(kWh)	kW	RM(kW)	RM(Total)	kWh	RM(kWh)	kW	RM(kW)	RM(Total)	kWh	RM(kWh)	kW	RM(kW)	RM(Total)	kWh	RM(kWh)	kW	RM(kW)	RM(Total)
JAN	448630	163750	1839	55722	219472	425420	155278	1682	50965	206243	354637	129443	1519	46026	175468	416075	151867	1739	52691.7	204559	412109	150419.8	1710	51813	202233
FEB	376346	137366	1765	53480	190846	376300	137350	1661	50328	187678	330167	120511	1529	46329	166840	349936	127727	1757	53237.1	180964	327293	119461.9	1537	46571	166033
MAC	514211	187687	1912	57934	245621	479303	174946	1715	51965	226910	419218	153015	1549	46935	199949	423761	154673	1773	53721.9	208395	396652	144778	1523	46147	190925
APR	467108	170494	1922	58237	228731	363330	132615	1371	41541	174157	332449	121344	1384	41935	163279	335091	122308	1407	42632.1	164940	409313	149399.2	1581	47904	197304
MAY	407838	148861	1595	48329	197189	330633	120681	1354	41026	161707	295169	107737	1184	35875	143612	274444	100172	1341	40632.3	140804	274323	100127.9	1133	34330	134458
JUNE	357702	130561	1525	46208	176769	344652	125798	1622	49147	174945	299394	109279	1526	46238	155517	232579	84891	1198	36299.4	121191	238018	86876.57	1253	37966	124842
JULY	435988	159136	1786	54116	213251	316239	115427	1523	46147	161574	425681	155374	1705	51662	207035	421593	153881	1720	52116	205997	402746	147002.3	1606	48662	195664
AUG	384918	140495	1956	59267	199762	401431	146522	1548	46904	193427	387551	141456	1577	47783	189239	404195	147531	1771	53661.3	201192	360350	131527.8	1524	46177	177705
SEPT	400250	146091	1865	56510	202601	345435	126084	1557	47177	173261	372177	135845	1673	50692	186537	349138	127435	1720	52116	179551	412774	150662.5	1717	52025	202688
OCT	449324	164003	1837	55661	219664	366035	133603	1503	45541	179144	401418	146518	1661	50328	196846	437352	159633	1715	51964.5	211598	405410	147974.7	1626	49268	197242
NOV	326027	119000	1505	45602	164601	296903	108370	1177	35663	144033	337893	123331	1536	46541	169872	292351	106708	1260	38178	144886	278121	101514.2	1240	37572	139086
DEC	429303	156695.6	1849	56025	212720	327808	119650	1435	43481	163130	340508	124285	1667	50510	174796	334021	121918	1589	48146.7	170064	314303	114720.6	1589	48147	162867
TOTAL(1-12)	4997645	1667445	21356	591062	2471227	4373489	1596323	18148	549884	2146208	4296262	1568136	18510	560853	2128989	4270536	1558746	18990	527250	2134143	4231412	1544465	18039	546582	2091047
AVERAGE (1-12)	416	152012	1780	53924	205936	364457	133027	1512	45824	178851	358022	130678	1543	46738	177416	355878	129895	1583	47950	177845	352618	128705	1503	45548	174254
						RM TOTAL ENERGY COST SAVING (Yearly) 2016 compare to 2013				325019	RM TOTAL ENERGY COST SAVING (Yearly) 2017 compare to 2013				342239	RM TOTAL ENERGY COST SAVING (Yearly) 2018 compare to 2013				337085	RM TOTAL ENERGY COST SAVING (Yearly) 2019 compare to 2013				380180
						% TOTAL ENERGY COST (Yearly) 2016 compare to 2013				13	% TOTAL ENERGY COST (Yearly) 2017 compare to 2013				14	% TOTAL ENERGY COST (Yearly) 2018 compare to 2013				14	% TOTAL ENERGY COST (Yearly) 2019 compare to 2013				15
						kWh TOTAL ENERGY SAVING (Yearly) 2016 compare to 2013				624156	kWh TOTAL ENERGY SAVING (Yearly) 2017 compare to 2013				701383	kWh TOTAL ENERGY SAVING (Yearly) 2018 compare to 2013				727109	kWh TOTAL ENERGY SAVING (Yearly) 2019 compare to 2013				766233
						% TOTAL ENERGY SAVING (Yearly) 2016 compare to 2013				12	% TOTAL ENERGY SAVING (Yearly) 2017 compare to 2013				14	% TOTAL ENERGY SAVING (Yearly) 2018 compare to 2013				15	% TOTAL ENERGY SAVING (Yearly) 2019 compare to 2013				15

4.2 Carbon Emission Reduction

Greenhouse Gases (GHG) is the gases which trap heat in the atmosphere. Examples of GHG is carbon dioxide CO_2 which enters the atmosphere through burning fossil fuels during electricity generation processes using coal, natural gas and oil.

Table 7: Politeknik Sultan Azlan Shah - Historical Energy Analysis of Energy Saving and Carbon Emission Reduction - Comparison Between 2019, 2018, 2017, 2016 and Baseline 2013

MONTH	2013 (Baseline)	2016	2017	2018	2019
	kWh	kWh	kWh	kWh	kWh
JAN	448630	425420	354637	416075	412109
FEB	376346	376300	330167	349936	327293
MAC	514211	479303	419218	423761	396652
APR	467108	363330	332449	335091	409313
MAY	407838	330633	295169	274444	274323
JUNE	357702	344652	299394	232579	238018
JULY	435988	316239	425681	421593	402746
AUG	384918	401431	387551	404195	360350
SEPT	400250	345435	372177	349138	412774
OCT	449324	366035	401418	437352	405410
NOV	326027	296903	337893	292351	278121
DEC	429303	327808	340508	334021	314303
TOTAL	4997645	4373489	4296262	4270536	4231412

kWh TOTAL ENERGY SAVING (Yearly) 2016 compare to 2013	624156	kWh TOTAL ENERGY SAVING (Yearly) 2017 compare to 2013	701383	kWh TOTAL ENERGY SAVING (Yearly) 2018 compare to 2013	727109	kWh TOTAL ENERGY SAVING (Yearly) 2019 compare to 2013	766233
% TOTAL ENERGY SAVING (Yearly) 2016 compare to 2013	12	% TOTAL ENERGY SAVING (Yearly) 2017 compare to 2013	14	% TOTAL ENERGY SAVING (Yearly) 2018 compare to 2013	15	% TOTAL ENERGY SAVING (Yearly) 2019 compare to 2013	15
kWh TOTAL ENERGY CONSUMPTION from 2016 to 2019					17171699		
kWh TOTAL ENERGY SAVING from 2016 to 2019					2818881		
kg CO2 CARBON EMISSION REDUCTION from 2016 to 2019					1880194		

PSAS Sustainable Energy Management practices shown that the potential of carbon emission or amount of potential GHG emission which has been eliminated by the energy saving measures implementation as shown in Table 7 and calculation below.

Energy saving through energy saving measures from 2016 to 2019 by referring to 2013 as baseline equal to 2,818,881 kWh and emission factor is 0.667 (Anonymous, CDM Electricity Baseline for Malaysia, 2017)

GHG = Energy saving from 2016 to 2019 x Emission Factor (EF)
= 2,818,881 kWh x 0.667
= 1880194 kg CO_2
= 1880.194 tonne CO_2

5. CONCLUSION

To conclude, Energy Saving Measures retrofit strategies such as lighting loads, server room, air conditioners and distribution substation can reduce energy up to 14% on average. The contents had covered retrofit methods that have strong impact on energy consumption through some of the building Energy Saving Measure technique. Even the research has addressed a limited scope of strategies, it is able tu reduce 1880.194 tonne CO_2 GHG emission to maintain the level of environmental sustainability. There are many aspects can

be improved where the role of decision makers and energy management engineers working in the field will thus acquire further significance in the field.

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PENENTU KEPUTUSAN PEMBELIAN PRODUK HIJAU DALAM KALANGAN PELAJAR TVET

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Abstrak. Kesedaran terhadap teknologi hijau di Malaysia perlu diterapkan dalam kalangan generasi muda khususnya pelajar institusi pengajian tinggi. Kesedaran terhadap teknologi hijau diharapkan dapat membantu menangani masalah alam sekitar yang semakin meruncing. Keputusan pengguna untuk membeli produk hijau perlu diberi perhatian khususnya dalam kalangan pelajar Pendidikan Tenikal dan Latihan Vokasional (TVET). Kajian ini bertujuan untuk mengkaji faktor penentu keputusan pembelian produk hijau dalam kalangan pelajar Diploma Akauntansi, Jabatan Perdagangan, Politeknik Sultan Azlan Shah. Pembolehubah yang digunakan di dalam kajian ini adalah Kesedaran Persekitaran (KP), Pelabelan Eko (PE), Harga (H), Pengiklanan Hijau (PH) dan Sikap (S). Seramai 156 orang pelajar semester dua (2) hingga semester enam (6) Diploma Akauntansi telah dipilih sebagai responden menggunakan kaedah pensampelan kluster. Maklumat dikumpul menggunakan borang soal selidik melalui pautan di *Google Form* dan dianalisa menggunakan *Statistical Package for the Social Sciences* (SPSS) versi 23.0. Dapatan kajian mendapati bahawa Kesedaran Persekitaran (KP), Pelabelan Eko (PE), Pengiklanan Hijau (PH) dan Harga (H) mempunyai hubungan yang signifikan terhadap Keputusan Pembelian Produk Hijau (Y). Dapatan ini selari dan menyokong kajian lalu bahawa Sikap (S) tidak mempengaruhi Keputusan Pembelian Produk Hijau (Y).

Kata Kunci: TVET, produk hijau, keputusan pembelian.

1. PENGENALAN

Masalah alam sekitar dan kesannya terhadap kesihatan manusia telah menjadi isu penting dalam kalangan ahli akademik, kerajaan dan organisasi yang berkaitan (Haytko dan Matulich, 2008). Senario ini telah menyebabkan berlakunya perubahan permintaan dan tingkah laku pengguna (Mandleson dan Polonsky, 1995). Perubahan sikap dan tingkah laku dapat dilihat kesan perkembangan tahap keprihatinan dan kesedaran individu terhadap alam sekitar. Keadaan ini menyebabkan semakin banyak pihak menyedari bahawa amalan pembelian dan penggunaan produk boleh memberi kesan kepada kualiti alam sekitar. Pengguna dikatakan telah sedar bahawa amalan penggunaan produk tertentu mungkin menyebabkan kemusnahan terhadap alam sekitar. Kesedaran ini seterusnya telah mengubah dan memotivasikan mereka dalam membuat membuat keputusan pembelian produk mesra alam sekitar seperti pembelian produk hijau. Kebimbangan dan kesedaran mengenai persekitaran ini telah mewujudkan penggunaan mesra alam yang disebut kepenggunaan hijau (Moisander, 2007).

Kerajaan Malaysia telah memperkenalkan beberapa langkah untuk mempromosikan tingkah laku kelestarian dalam kalangan rakyat Malaysia dengan menggalakkan mereka meningkatkan pembelian produk hijau. Dalam konteks Politeknik Malaysia, Program *Blueprint PolyGreen* Politeknik Malaysia yang dilancarkan sejak 1 April 2015 sebagai usaha menyokong inisiatif tersebut. Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK) memperkasakan

lagi program ini menerusi penambahan beberapa elemen utama serta garis panduan pembangunan mapan bagi semua Politeknik serta Kolej Komuniti (KK). Program ini yang dikenali sebagai *Blueprint Smart Green PolyCC* menggabungkan kerjasama strategik dalam melaksanakan amalan hijau terancang selaras dengan keperluan pengurusan dan operasi yang ditetapkan.

The *Nelson Global Survey* (2015) melaporkan tentang tingkah laku kelestarian pengguna merentas 51 buah negara dan mendedahkan bahawa lebih kurang 50% rakyat Malaysia prihatin terhadap isu persekitaran, tetapi majoriti daripada responden tidak bersedia untuk mengubah tingkah laku pembelian mereka. Pengguna muda yang terdiri daripada individu yang berumur di bawah 36 tahun merupakan generasi akan datang. Kumpulan ini dikatakan lebih prihatin terhadap alam sekitar kesan pengaruh daripada mereka yang lebih dewasa berhubung kepentingan keputusan pembelian produk hijau (Naderi dan Steenburg, 2018). Memahami perspektif belia terhadap tingkah laku pro-persekitaran sangat penting kerana mereka adalah pengguna masa depan dan menjadi wakil kepada masyarakat (Kanchanapibul et al. (2014). Walau bagaimanapun sejauhmana tingkah laku kelestarian penggunaan dan penentu kritikal pembelian produk hijau dalam kalangan pengguna muda perlu dikenal pasti. Maka objektif kajian ini adalah seperti berikut:

i) Mengkaji sejauhmana tingkah laku kelestarian penggunaan produk hijau dalam kalangan pengguna muda di Politeknik Sultan Azlan Shah.
ii) Menyiasat penentu tingkah laku kelestarian penggunaan produk hijau (Kesedaran Persekitaran, Pelabelan Eko, Pengiklanan Hijau, Harga dan Sikap) terhadap keputusan pembelian produk hijau.

2. KAJIAN LITERATUR

Bahagian ini membincangkan pemboleh ubah bagi objektif kajian iaitu keputusan pembelian produk hijau, kesedaran persekitaran, pelabelan eko, pengiklanan hijau, harga dan sikap.

2.1 Keputusan pembelian produk hijau (Y)
Dewasa ini, keputusan pengguna untuk membeli produk hijau telah menjadi isu utama dalam penyelidikan. Keputusan atau niat pembelian produk hijau berkisar dalam kalangan pengguna yang prihatin terhadap alam sekitar. Peningkatan niat untuk membuat keputusan pembelian produk hijau dijangka membawa perubahan kepada alam sekitar yang lestari. Walaupun pengguna mempunyai kesedaran terhadap isu alam pencemaran alam sekitar, tetapi tidak diterjemahkan dalam bentuk pembelian. Kotler dan Keller (2009) menyatakan bahawa proses keputusan pembelian terdiri daripada lima tahap, iaitu pengenalan masalah, pencarian maklumat, penilaian alternatif, keputusan pembelian dan pasca pembelian. Pada tahap pembuatan keputusan pembelian, pengguna benar-benar melakukan pembelian. Kajian lampau mendapati terdapat beberapa faktor yang mempengaruhi pembuatan keputusan pembelian sehingga boleh mengubah niat pembelian. Antara faktor yang mempengaruhi keputusan pembelian produk hijau ialah kesedaran persekitaran, pelabelan eko, sikap, pengiklanan hijau, harga, kepercayaan rakan sebaya dan kualiti (Rahman 2018, Tan, Ojo, & Thurasamy 2019). Dalam kajian ini hasrat untuk melakukan tingkah laku khusus merujuk kepada keputusan pembelian produk hijau yang dipengaruhi oleh kesedaran persekitaran, pelabelan eko, sikap, pengiklanan hijau dan harga.

2.2 Kesedaran persekitaran dan keputusan pembelian produk hijau (KP)
Kesedaran persekitaran mencerminkan pengetahuan individu mengenai isu persekitaran dan kesan amalan mesra alam dalam membendung masalah alam sekitar (Boztepe, 2016). Perkara ini merujuk kepada tahap kesedaran individu terhadap masalah persekitaran dan kesediaan mereka untuk menyelesaikannya. Kesedaran ini berupaya membentuk kepercayaan dan sikap terhadap kelestarian persekitaran, yang seterusnya mempengaruhi niat untuk melakukan pembelian produk hijau. Oleh itu, dapat diandaikan bahawa kesedaran persekitaran yang tinggi menyebabkan mereka akan berniat untuk membeli produk hijau.

Kajian lain, Lin dan Nui (2018) menunjukkan bahawa pengguna yang memilih produk hijau biasanya mempunyai tahap kesedaran dan pengetahuan persekitaran serta mahu tingkah laku pembelian mereka seiring dengan tanggungjawab persekitaran mereka. Selari dengan kajian Han, Hsu dan Shue (2010), pengetahuan yang dimiliki menyebabkan pengguna menyedari akibat tidak menjaga alam sekitar seterusnya mampu menjadi penguna produk hijau. Walaupun demikian, dapatan Yeng dan Yazdanifard (2015), mendapati pengguna di Malaysia mempunyai kesedaran yang tinggi tetapi masih membuat pembelian ke atas produk konvensional yang memberikan kesan buruk kepada alam.

2.3 Pelabelan eko dan keputusan pembelian produk hijau (PE)
Pelabelan eko adalah maklumat yang memudahkan pengguna untuk memilih produk hijau. Label eko boleh wujud dalam pelbagai bentuk: penyataan, simbol, grafik pada produk atau label tersendiri pada produk tersebut. Antaranya, di Malaysia skim pelabelan eko SIRIM adalah terdapat pada kertas kertas kitar semula hijau, pembungkusan bahan plastik bebas toksik hijau, produk penjimatan tenaga hijau dan peralatan elektrik serta elektronik (SIRIM, 2020).

Di kebanyakan negara maju, keluaran dan perkhidmatan mesra alam akan memiliki pelekat hijau atau pelabelan selamat untuk alam sekitar ataupun pelabelan eko (Hamdan dan Demiyah 2018). Persepsi awal yang dibentuk oleh seseorang mengenai sesuatu produk boleh mempengaruhi keputusan pembelian produk. Pendedahan awal kepada maklumat yang diberikan pada label produk membantu pengguna mengenal pasti ciri-ciri produk hijau (Wessels, 1999). Pengguna produk hijau akan menyemak label produk untuk mencari justifikasi persekitaran pada produk tersebut. Pelabelan eko diterbitkan sebagai sumber rujukan bagi memudahkan pengguna mengenal pasti produk sehingga berpontensi mengubah tingkah laku pembuatan keputusan yang lebih baik (Carlson, Grove & Kangun 1993). Kajian lepas membuktikan terdapatnya hubungan antaranya pelabelan-eko terhadap minat untuk membeli sesuatu produk (Rashid 2009; Rahbar &Wahid 2013 dan Seminar & Aimi 2017; Taufique, Siwar, Chamburi & Sarah 2016).

2.4 Sikap dan keputusan pembelian produk hijau (S)
Perwatakan individu mempengaruhi tindakbalas pengguna terhadap produk yang mesra alam sekitar. Pengguna yang mempunyai sikap yang positif terhadap perlindungan alam sekitar dikatakan mempunyai respon yang lebih positif terhadap produk hijau (Tucker et al, 2012). Manakala Maniatis (2016) pula mengatakan keputusan pembelian produk hijau dalam kalangan pengguna dikaitkan dengan sikap, persepsi terhadap nilai dan niat tingkah laku terhadap produk mesra alam sekitar.
Kajian yang dijalankan oleh Syaidatina Akila dan Norazah (2013) mendapati sikap terhadap alam sekitar dalam kalangan pengguna di Malaysia berada pada tahap yang tinggi. Dipercayai juga, sikap juga membuatkan pengguna cenderung mendapatkan produk hijau yang boleh mengurangkan kesan kepada alam sekitar (Fazli & Teoh 2006).

Didapati terdapat sesetengah pengguna mempunyai sikap alam sekitar yang positif tetapi masih menggunakan produk konvensional (Taufique, Siwar, Chamhuri, & Sarah, 2016). Kajian tersebut juga membuktikan sikap tidak membawa kepada niat untuk membeli produk hijau selari dengan dapatan Tan, Ojo dan Thurasamy (2019) dalam kajiannya terhadap pengguna muda. Walaupun demikian, kajian lampau masih kurang mengkaji jurang antara sikap terhadap alam sekitar dengan niat pembelian produk hijau dalam kalangan pengguna (Joshi & Rahman, 2015).

2.5 Pengiklanan hijau dan keputusan pembelian produk hijau (PH)
Zinkhan dan Carlson (1995) mendefinisikan iklan hijau sebagai tarikan yang cuba dilakukan memenuhi kehendak dan aspirasi pengguna mengenai masalah alam sekitar dan masalah kesihatan dari pelbagai perspektif termasuk ekologi, kelestarian, dan mesej bebas pencemaran. Seterusnya meningkatkan keyakinan pengguna terhadap manfaat produk hijau yang diiklankan serta kesannya kepada alam sekitar. Masalah pencemaran alam sekitar

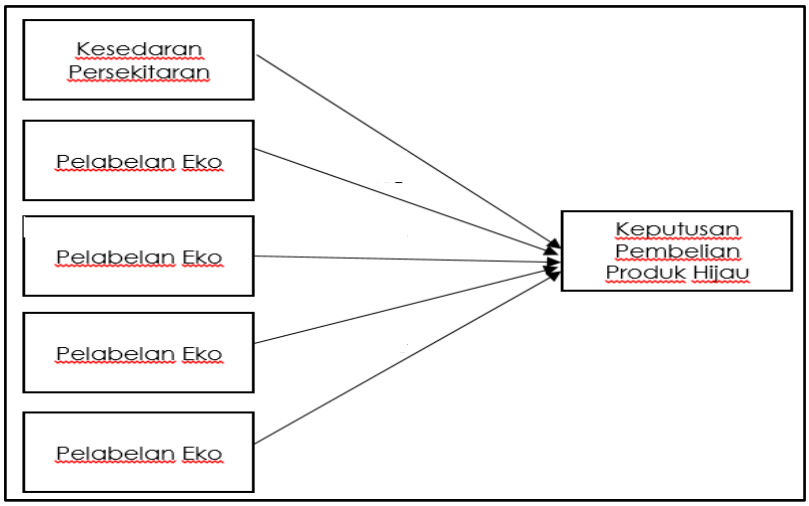
juga telah mendorong peniaga dan kerajaan melakukan usaha mempromosikan produk hijau kepada pengguna (Chen & Chai, 2010).

Pelbagai usaha promosi dilakukan bagi mengubah tingkah laku pembelian pengguna untuk beralih kepada produk hijau yang lebih mesra alam sekitar (Doszhanov & Ahmad, 2015). Dapatan kajian lampau oleh Chase dan Smith (1992) juga menjelaskan bahawa 70% dari keputusan pembelian amat dipengaruhi oleh mesej penjagaan alam sekitar melalui medium pengiklanan. Selain itu, pengiklanan hijau mampu meyakinkan dan meningkatkan imej atau jenama produk hijau di mata generasi muda (Chekima et al., 2015)

2.6 Harga dan keputusan pembelian produk hijau (H)
Harga yang lebih tinggi memberi kesan kepada tingkah laku keputusan pembelian pengguna. D'Souza et al. (2006) mendapati harga yang tinggi membawa kepada pengguna beralih kepada produk lain. Walau bagaimanapun, sesetengah kumpulan pengguna mempunyai sikap yang lebih positif terhadap produk hijau dan mereka sanggup membayar harga yang lebih tinggi. Antaranya, kajian Radman (2005) mendapati pengguna sanggup untuk membayar harga yang lebih tinggi untuk membeli makanan organik. Kajian di Malaysia oleh Suki dan Suki (2015), mendapati 80% daripada responden kajiannya bersedia membayar harga premium untuk mendapat produk yang mesra alam sekitar.

Sebaliknya, Han, Hsu dan Shue (2010), mendapati bahawa keputusan membeli produk hijau akan berkurangan apabila harganya mahal seterusnya terpaksa mengabaikan kelebihan produk tersebut. Kajian di Malaysia oleh Fazli dan Teoh (2006) mendapati harga berkait dengan keputusan pembelian produk hijau dan adalah wajar dikurangkan.

2.7 Berdasarkan perbincangan di atas, model kajian ini ditunjukkan di dalam Rajah1.



Rajah 1: Pemboleh ubah Kajian

3. METODOLOGI

Kajian yang berbentuk kuantitatif menggunakan borang soal selidik digunakan untuk mengkaji penentu keputusan pembelian produk hijau dalam kalangan pelajar Politeknik Sultan Azlan Shah. Kaedah deskriptif dan inferensi digunakan, seterusnya semua data yang telah dianalisis dipaparkan dalam bentuk jadual yang mengandungi maklumat peratusan, frekuensi, min dan sisihan piawai. Dalam kajian ini, ujian regresi berganda digunakan bagi menjawab persoalan kajian. Terdapat enam pemboleh ubah yang terlibat dalam kajian ini iaitu pemboleh ubah bersandar dan lima pembolehubah tidak bersandar. Populasi dalam

kajian ini terdiri daripada 195 orang pelajar semester dua (2) hingga semester enam (6) Diploma Akauntansi. Kajian menggunakan kaedah persampelan kluster bagi mewakili setiap kelas yang diwakili. Maklumat dikumpul menggunakan borang soal selidik melalui pautan di Google Form dan dianalisa menggunakan Statistical Package for the Social Sciences (SPSS) versi 23.0. Item dalam soal selidik diadaptasi daripada kajian oleh Tan et al. (2019) dan telah melalui proses kajian rintis untuk menilai tahap kebolehpercayaan instrumen tersebut. Hasil kajian rintis yang telah dijalankan didapati nilai kebolehpercayaan item ialah a = 0.954.

4. DAPATAN DAN PERBINCANGAN

4.1 Demografi Responden

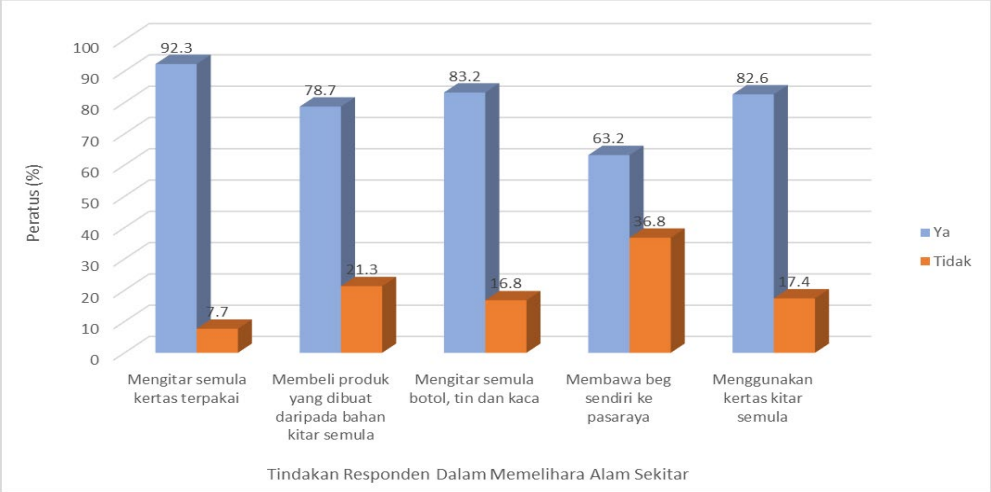
Jadual 1 menunjukkan analisis demografi responden. Didapati (75%) daripada jumlah responden ialah perempuan manakala bakinya (24.5%) adalah lelaki. Responden dari semester empat (4) dan lima (5) adalah peratus tertinggi seramai (23.9%). Ini diikuti oleh responden dari semester tiga (3) seramai (27.7%). Responden dari semester enam (6) dan semester dua (2) masing-masing seramai (14.8%) dan (9.7%). Responden berbangsa Melayu adalah responden paling tinggi seramai (58.7%), diikuti oleh responden berbangsa India seramai (35.5%), bangsa Cina (5.2%) dan lain-lain seramai (0.6%). Seterusnya, jika berdasarkan aspek pendapatan bulanan keluarga, responden dengan pendapatan bulanan keluarga di antara RM1,001 hingga RM3,000 merupakan peratus tertinggi iaitu seramai (52.3%), diikuti oleh responden berpendapatan bulanan keluarga di antara RM3,001 hingga RM5,000 (19.4%), berpendapatan bulanan keluarga bawah RM1,000 (14.8%) dan bakinya berpendapatan bulanan melebihi RM5,001 (13.5%).

Jadual 1: Statistik Deskriptif Demografi Responden

Pemboleh ubah	Pengukuran	Kekerapan (N=155)	Peratus (%)
Jantina	Lelaki	38	24.5
	Perempuan	117	75.0
Semeter pengajian	Dua	15	9.7
	Tiga	43	27.7
	Empat	37	23.9
	Lima	37	23.9
	Enam	23	14.8
Bangsa	Melayu	91	58.7
	Cina	8	5.2
	India	55	35.5
	Lain-lain	1	0.6
Pendapatan bulanan	Bawah RM1,000	23	14.8
	Antara RM1,001-RM3,000	81	52.3
	Antara RM3,001-RM5,000	30	19.4
	Melebihi RM5,001	21	13.5

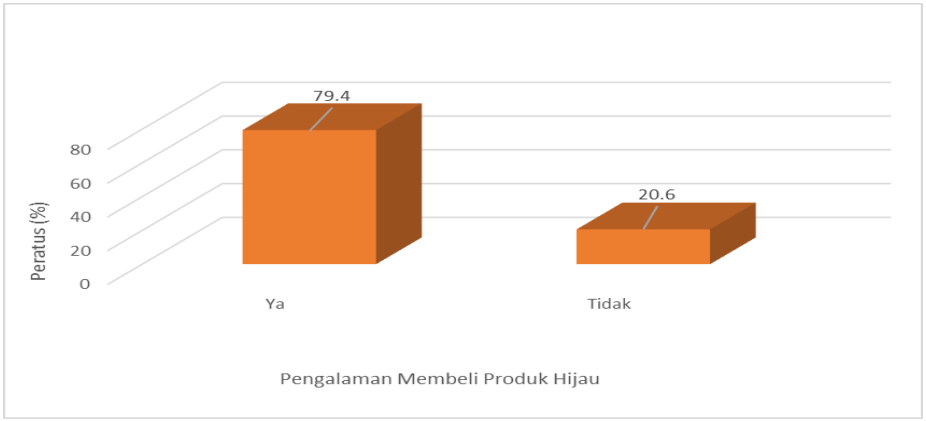
4.2 Tingkah laku Responden Terhadap Produk Hijau

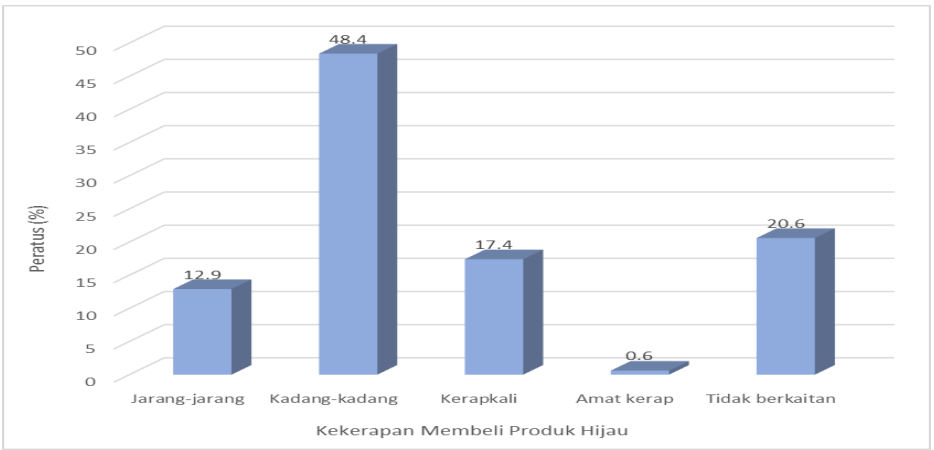
Jadual 2: Tindakan Responden Dalam Memelihara Persekitaran Hijau



Tindakan yang diambil oleh responden untuk memelihara persekitaran telah ditunjukkan dalam Jadual 2. Berdasarkan Jadual 2, mengitar semula kertas terpakai (92.3%) menunjukkan peratus tertinggi dalam usaha responden memelihara alam sekitar. Ini di ikuti oleh tindakan responden mengitar semula botol, tin dan kaca (83.2%).

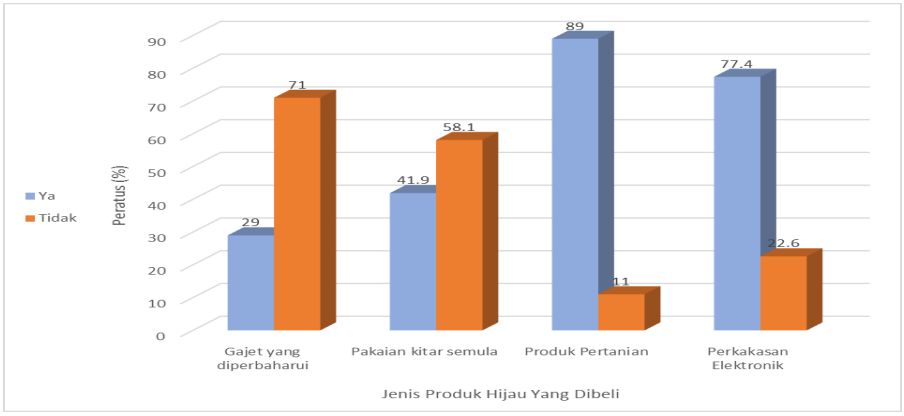
Jadual 3: Pengalaman Membeli Produk Hijau dan Kekerapan Membeli Produk Hijau





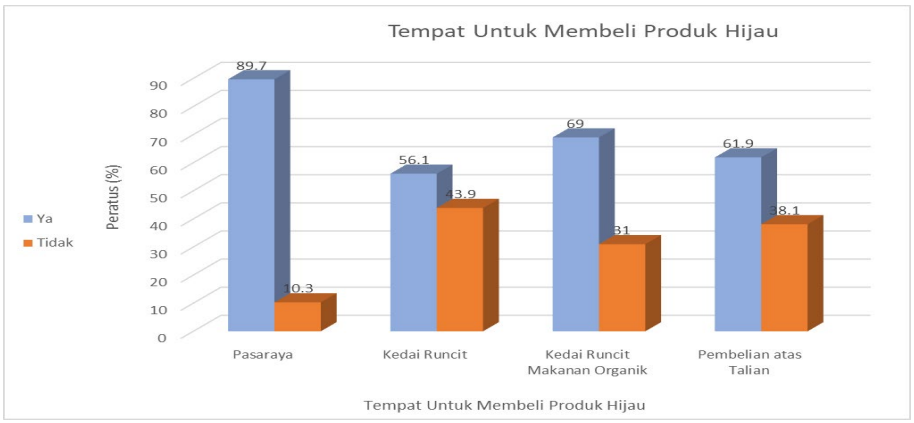
Berdasarkan Jadual 3, majoriti responden membeli produk hijau (79.4%). Seramai (17%) daripada responden bersetuju bahawa mereka kerapkali membeli produk hijau.

Jadual 4: Jenis Produk Hijau yang Dibeli



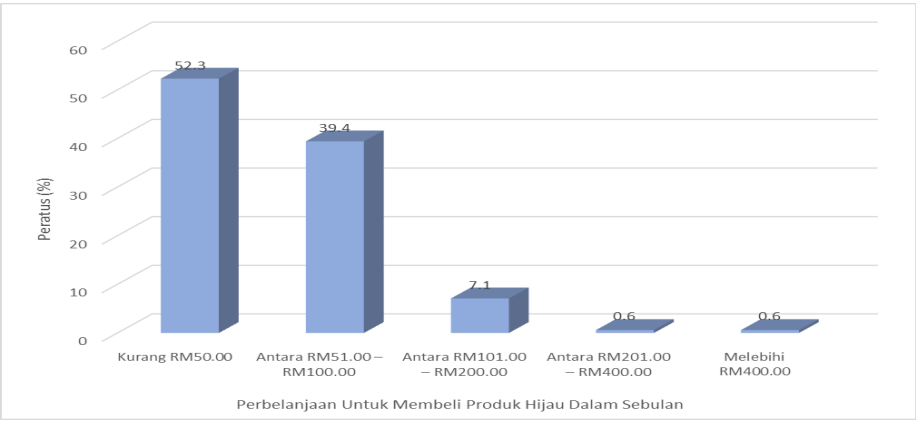
Berdasarkan aspek jenis produk hijau yang dibeli, produk pertanian (89.1%) mencatatkan jenis produk yang paling tinggi dibeli seperti yang ditunjukkan di Jadual 4.

Jadual 5: Tempat Untuk Membeli Produk Hijau



Merujuk kepada Jadual 5, majoriti respoden membeli produk hijau di pasaraya (89.7%) berbanding kedai runcit makanan organik (69.0%), pembelian atas talian (61.9%) dan bakinya di kedai runcit (56.1%).

Jadual 6: Perbelanjaan Untuk Membeli Produk Hijau Dalam Sebulan



Jadual 6 menunjukkan perbelanjaan yang dikeluarkan oleh responden untuk membeli produk hijau dalam sebulan. Seramai (52.3%) responden membeli produk hijau kurang RM50.00 dalam sebulan. Hanya dua (2) responden sahaja berbelanja untuk produk hijau melebihi RM201.00.

Jadual 7 menunjukkan kebolehpercayaan berdasarkan analisis *Cronbach Alpha* bagi kesemua pemboleh ubah jelas menunjukkan konstruk item mempunyai nilai kebolehpercayaan ketekalan dalaman yang tinggi dan baik berdasarkan Tavakol dan Dennick (2011).

Jadual 7: Nilai Kebolehpercayaan *Cronbach Alpha*

Pemboleh ubah	Nilai Alpha
Kesedaran Persekitaran (KP)	0.841
Pelabelan Eko (PE)	0.873
Sikap (S)	0.883
Pengiklanan Hijau (PH)	0.903
Harga (H)	0.903
Keputusan Pembelian Produk Hijau (Y)	0.812

Jadual 8: Dapatan Analisis Regrasi

Pemboleh ubah	*Standardized Beta Coefficients*	Nilai-t	Signifikan
Harga (P)	0.274	4.228	0.000
Pengiklanan Hijau (PH)	0.275	3.298	0.001
Sikap (S)	0.048	0.642	0.522
Pelabelan Eko (PE)	0.219	3.437	0.001
Kesedaran Persekitaran (KP)	0.187	3.222	0.002

Nota: Pemboleh ubah bersandar: Keputusan pembelian produk hijau. R^2 = 0.652, R^2 terlaras = 0.581, F=56.313; P=0.0000 (p<0.05)

4.3 Keputusan Ujian Regrasi

Bagi menganalisis data, kuantitatif Pakej SPSS *(Statistical Package for the Social Sciences)* digunakan untuk menganalisis data-data yang dikutip. Taburan data boleh dianggap normal apabila min, median dan mod berada pada nilai yang hampir sama. Ujian pencongan dan kutosis dengan nilai dalam linkungan -2 dan +2 boleh dianggap sebagai data yang bertaburan normal (Palaniappan, 2009). Plot kebarangkalian taburan normal dan analisis graf juga digunakan, dan hasilnya menunjukkan pemboleh ubah kajian dikatakan bertaburan normal.

Ujian regresi berganda dijalankan untuk melihat kesan penentu kritikal yang diukur melalui pemboleh ubah Kesedaran Persekitaran (KP), Pelebelan Eko (PE), Sikap (S), Pengiklanan Hijau (PH) dan Harga (H) terhadap Keputusan Pembelian Produk Hijau (Y). Regresi berganda menggambarkan set pemboleh ubah yang dapat meramalkan hasil tertentu iaitu Keputusan Pembelian Produk Hijau (Y). Hasil penelitian ujian regresi dalam Jadual 9, dilihat bahawa Kesedaran Persekitaran (KP), Pelebelan Eko (PE), pengiklanan Hijau (PH) dan Harga (H) mempunyai pengaruh positif dan signifikan terhadap Keputusan Pembelian Produk Hijau (Y). Selari dengan kajian lampau, pembolehubah Sikap (P) mempunyai pengaruh yang positif dan tidak signifikan terhadap Keputusan Pembelian Produk (Y) yang dibuktikan dengan nilai (β) sebesar 0.048 dan nilai signifikansi 0.522 > 0.05.

5. KESIMPULAN

Kajian ini membuktikan bahawa penentu kritikal tingkah laku amalan hijau dalam kehidupan seharian mempunyai hubungan dengan keputusan pembelian produk hijau. Hal ini menunjukkan kewajaran pihak pengusaha produk hijau memberi penekanan utama

terhadap aspek pelabelan eko, pengiklanan dan harga. Ini sebagai usaha untuk memastikan kelestarian menjadi agenda dalam kehidupan seharian generasi muda terutamanya yang berkaitan dengan pembelian produk hijau. Sementara itu, kajian ini turut memberikan bukti tambahan bahawa sikap seperti yang dibuktikan dalam kajian lampau tidak mempunyai perkaitan dengan keputusan pembelian produk hijau khususnya dalam kalangan pengguna muda.

Berdasarkan dapatan ini juga, usaha untuk meningkatkan kesedaran amalan hijau boleh juga diterapkan melalui pendidikan yang diperolehi secara formal di Politeknik. Implikasi jangka panjang dalam agenda kelestarian melalui pendidikan ini perlulah dimantapkan melalui pembangunan pendidikan berasaskan amalan hijau. Pihak Jabatan Pengajian Politeknik dan Kolej Komuniti (JPPKK) perlulah merencanakan kelestarian dalam kurikulum dan kokurikulum di Politeknik seperti mewujudkan silibus yang berkaitan dengan kelestarian atau menerapkan unsur kelestarian dalam kursus yang diambil oleh pelajar.

Dapatan dari kajian ini juga boleh membantu kerajaan untuk merealisasikan Pelan Pembangunan Blueprint POLYGreen Politeknik Malaysia yang menjadi rujukan hala tuju strategik amalan teknologi hijau di politeknik seluruh negara. Kajian yang dijalankan ini bertujuan untuk menyokong dasar yang telah dirancang oleh kerajaan dalam membentuk generasi muda yang sensitif terhadap isu kelestarian alam sekitar berasaskan ilmu dan kemahiran untuk membangunkan sesuatu sistem yang lestari dalam jangka masa panjang. Seterusnya, dapat menangani fenomena perubahan iklim yang semakin meruncing. Bagi memastikan aspek pembangunan dan pengurusan amalan teknologi hijau sejajar dengan pengurusan strategik politeknik, maka semua pihak termasuk pelajar dan warga kerja politeknik dapat mengembleng tenaga demi untuk memantapkan dan menambahbaik hala tuju pengurusan strategik politeknik ke arah mencapai pengiktirafan "Politeknik Mapan".

Kajian ini boleh dilanjutkan dengan mengkaji berkemungkinan terdapat faktor lain yang mungkin berinteraksi bersama-sama yang mempengaruhi keputusan pembelian dalam kalangan pelajar. Di samping itu, kajian perbandingan boleh dilaksanakan dengan melakukan kajian merentas sempadan antara Politeknik Malaysia bagi meningkatkan generalisasi.

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KAJIAN PERSEPSI PELAJAR PBM2024-ADVANCED MATHEMATICS 2 TERHADAP PROGRAM RUNNING MATH DI POLITEKNIK MUKAH

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Abstrak. Kajian berbentuk diskriptif ini dijalankan bertujuan untuk mengkaji keberkesanan program Running Math dalam meningkatkan prestasi pelajar yang mengambil kursus PBM2024- Advanced Mathematics 2 di Politeknik Mukah. Kaedah soal selidik digunakan dalam kajian ini. Terdapat 20 item soalan dalam set soal selidik yang telah dibahagikan kepada 5 bahagian. Bahagian A berkaitan dengan demografik responden, Bahagian B, C, D dan E pula digunakan untuk menghasilkan dapatan kajian. Responden kajian adalah terdiri daripada 40 pelajar yang mengikuti program Running Math dan juga yang mengambil kursus PBM2024-Advanced Mathematics 2. Dapatan data soal selidik dianalisis dengan menggunakan Statistical Package of Social Science (SPSS) (Windows version 20.0) dalam bentuk kekerapan, peratus dan skor min untuk menunjukkan responden berminat bagi program Running Math ini. Kajian rintis mencatatkan nilai kebolehpercayaan sebanyak a= 0.828. Secara rumusannya dapat dilihat bahawa program ini mendapat maklum balas yang baik serta persepsi yang positif daripada responden dari segi aspek keberkesanan program ini. Ini terbukti melalui perolehan skor min antara sederhana hingga tinggi iaitu antara 3.700 hingga 4.575.

Kata Kunci: Keberkesanan, Program Running Math, Persepsi, Soal Selidik

1. PENGENALAN

Kaedah pengajaran dan pembelajaran (P&P) yang digunakan oleh tenaga pengajar boleh memberi impak kepada prestasi akademik pelajar. Menurut Kamarul Azmi dan Ab.Halim (2007), kebolehan pendidik dalam menghasilkan P&P yang interaktif dapat mengukur tahap keberkesanan proses pengajaran dan pembelajaran. Kursus Matematik merupakan salah satu subjek penting dalam sistem pendidikan di negara kita (Kamel Ariffin, 2002) mendapati tahap penguasaan Matematik dalam kalangan pelajar di negara ini majoritinya adalah lemah. Tidak dinafikan, kursus Matematik merupakan subjek yang paling digeruni dan kurang diminati oleh pelajar-pelajar. Mereka beranggapan kursus Matematik merupakan kursus yang sukar dikuasai dan membosankan seperti yang dinyatakan dalam instrument kajian (Kong et al., 2003). Oleh yang demikian, kajian ini dijalankan adalah untuk mengkaji persepsi program Running Math dalam peningkatan prestasi pelajar bagi kursus PBM2024-Advanced Mathematics 2.

1.0 Objektif Kajian
Kajian ini adalah bertujuan untuk:
(i) Mengenalpasti persepsi pelajar terhadap PBM2024-Advanced Mathematics secara umum
(ii) Mengenalpasti penglibatan pelajar dalam program Running Math
(iii) Mengenalpasti pengisian program Running Math
(iv) Mengenalpasti keberkesanan program Running Math

2. SOROTAN KAJIAN DAN PEMBINAAN HIPOTESIS

Program Pra–Diploma Sains ini ditawarkan kepada pelajar yang mendapat keputusan kurang

daripada 5 kepujian didalam Sijil Pelajaran Malaysia (SPM) yang menyebabkan pelajar tersebut tidak layak untuk menyambung pelajaran ke peringkat Diploma di Politeknik Malaysia. Program ini diwujudkan bagi memberi peluang kepada pelajar yang kurang berjaya agar mereka dapat menyambung pelajaran ke peringkat Diploma (aliran kejuruteraan dan teknologi maklumat) seterusnya ke peringkat yang lebih tinggi.

Justeru itu, bagi pelajar yang mengikuti program Pra-Diploma Sains ini, perlu mengambil kod kursus PBM2024-Advanced Mathematics 2. Kursus ini adalah kursus teras yang diambil oleh pelajar bagi program Pra-Diploma Sains. Kurikulum yang terkandung didalam kod kursus ini adalah asas kalkulus dan kalkulus lanjutan iaitu pembezaan, aplikasi pembezaan, pengamiran dan aplikasi pengamiran. Mengikut rekod, pada sesi Disember 2016 seramai 52 pelajar ambilan Program Pra-Diploma Sains Polteknik Mukah telah gagal dalam meneruskan pengajian di Politeknik.

Oleh yang demikian, sering disalahertikan oleh semua pihak, bahawa pencapaian seseorang pelajar adalah kesilapan dan kegagalan pensyarah dalam menyampaikan P&P (Rokiah, 1998). Pensyarah sering kali disalahkan dalam memperkenalkan teknik yang kurang sesuai berikutan kurangnya minat pelajar dalam sesuatu kursus itu. Tidak dapat dinafikan bahawa teknik pengajaran yang menarik dapat menarik minat pelajar bagi kursus Matematik khususnya dan perkara ini turut dicadangkan oleh (Noor, 2011).

Menurut Yusof Boon dan Sahibul Bahrin Ahmad (2011), proses P&P akan berjalan dengan lebih cekap dan ceria dengan penggunaan alat bantu mengajar yang baik, sekaligus proses P&P juga dapat dijalankan dalam suasana yang ceria dan menyeronokkan. Kepelbagaian penggunaan teknik pengajaran juga memainkan peranan penting dalam memastikan pembelajaran tersebut boleh diterima oleh pelajar.

Secara umumnya, pencapaian pelajar dalam kursus ini dilihat daripada pelbagai faktor seperti reaksi pelajar, penglibatan pelajar, pengisian program dan lain-lain. Namun yang demikian, menurut Su Swarat (2012), pelajar lebih menumpukan kepada bentuk-bentuk aktiviti dan bukannya kandungan pembelajaran. Pelajar juga menampakkan minat menyelesaikan masalah matematik apabila menjalankan aktiviti secara berkumpulan

3. METODOLOOGI KAJIAN

3.1 Rekabentuk Kajian, Populasi Kajian, Sampel Kajian
Kajian yang dijalankan ini adalah berbentuk kajian kuantitatif bagi mengkaji persepsi program Running Math dalam meningkatkan prestasi pelajar yang mengambil kursus PBM2024-Advanced Mathematics 2 di Politeknik Mukah. Hasil dapatan kajian ini adalah menggunakan kaedah Soal Selidik. Borang soal selidik telah diedarkan kepada pelajar yang menyertai program Running Math iaitu yang terdiri daripada pelajar IPS2A dan IPS2B. Justeru itu, populasi kajian ini adalah semua pelajar yang mendaftar kursus PBM2024-Advanced Mathematics 2 di Politeknik Mukah iaitu sejumlah 52 pelajar. Oleh yang demikian, penyampelan kajian yang diambil adalah sejumlah 40 pelajar.

3.2 Instrumen Kajian
Kaedah soal selidik telah digunakan dalam kajian ini. Bagi pembinaan instrumen soal selidik ini, kajian-kajian yang terdahulu telah dirujuk. Instrumen soal selidik ini adalah terbahagi kepada 2 bahagian iaitu Bahagian I dan Bahagian II. Bahagian I adalah Demografik, yang terdiri daripada jantina, umur, program, pekerjaan dan taraf pendidikan responden.

Manakala, Bahagian II adalah hasil kajian yang telah dipecahkan kepada 4 bahagian yang mewakili soalan yang berkaitan iaitu 5 soalan berkaitan reaksi pelajar terhadap PBM2024-Advanced Mathematics 2 secara umum, 5 soalan berkaitan penglibatan pelajar dalam program Running Math, 5 soalan berkaitan pengisian Program Running Math dan 5 soalan berkaitan keberkesanan program Running Math terhadap pelajar.

4. ANALISIS DAN KEPUTUSAN

4.1 Dapatan Kajian

Hasil dapatan kajian adalah untuk menentukan kekerapan, peratus dan skor min bagi menunjukkan responden berminat kepada program Running Math. Menurut Landell (1997), tahap kecenderungan keputusan responden adalah berdasarkan Jadual 1 di bawah.

Jadual 1 : Tahap Kecenderungan Skor Min

Julat Min	Tahap
1.00-2.49	Rendah
2.50-3.49	Sederhana
3.50-5.00	Tinggi

4.2 Kebolehpercayaan Instrumen

Kajian ini menggunakan *Statistical Packages for Social Science (SPSS)* bagi mengukur nilai kebolehpercayaan untuk mendapatkan nilai *Cronbach's Alpha (a)*. Hasil dapatan ujian yang dijalankan bagi setiap item instrumen pada Jadual 2.

Jadual 2: Nilai Cronbach's Alpha

Bahagian	Bilangan Item	Nilai Cronbach's Alpha
B	5	0.781
C	5	0.858
D	5	0.800
E	5	0.873
Keseluruhan	20	0.828

Nilai Cronbach's Alpha yang diperolehi adalah 0.828, dalam tahap yang baik.

4.3 Analisis Demografik Diskriptif

Jadual 3 : Analisis Demografik Diskriptif

Demografik	Item	Kekerapan	Peratus (%)
Jantina	Lelaki	30	75.0
	Perempuan	10	25.0
Umur	18-20 tahun	33	82.5
	21-30 tahun	7	17.5
	31-40 tahun	0	0.0
	41-50 tahun	0	0.0
Program	IPS2A	16	40.0
	IPS2B	24	60.0
Pekerjaan	Pelajar	40	100.0
	Kerajaan	0	0.0
	Swasta	0	0.0
	Sendiri	0	0.0
	Lain-lain	0	0.0
Taraf Pendidikan	SPM	40	100.0
	Sijil	0	0.0
	Diploma	0	0.0
	Ijazah Sarjana Muda	0	0.0
	Sarjana Muda	0	0.0

4.4 Persepsi Pelajar Terhadap PBM2024-Advanced Mathematics 2 terhadap program Running Math di Politeknik Mukah

Jadual 4 : Persepsi Pelajar PBM2024-Advanced Mathematics 2 terhadap program Running Math di Politeknik Mukah

Persepsi	Item	Min
B. Reaksi pelajar terhadap PBM2024 Advanced Mathematics 2 secara umum	Saya sangat meminati kursus PBM2024-Advanced Mathematics 2	4.450
	Pembelajaran kursus PBM2024-Advanced Mathematics 2 mengalakkan saya berfikir	4.525
	Pembelajaran kursus PBM2024-Advanced Mathematics 2 memberi kesan dalam kehidupan saya	4.225
	Saya yakin bahawa kursus PBM2024-Advanced Mathematics 2 dapat membantu meningkatkan prestasi HNM saya	4.525
	Saya sangat sukar untuk memahami konsep-konsep dalam kursus PBM2024-Advanced Mathematics 2	3.700
C. Penglibatan pelajar dalam program Running Math	Saya diberi peluang untuk memberi pendapat semasa program ini dijalankan	4.250
	Saya sentiasa bekerjasama dalam kumpulan untuk menyelesaikan masalah	4.500
	Saya digalakkan berinteraksi sesama ahli kumpulan dalam mencari jawapan bagi setiap soalan yang diberikan	4.450
	Saya suka mengambil bahagian dalam aktiviti perbincangan	4.325
	Saya sentiasa diberi sokongan oleh rakan dalam menyiapkan kerja-kerja dalam kumpulan	4.375
D. Pengisian program Running Math	Saya merasa selesa mengikuti program ini	4.525
	Saya rasa seronok belajar PBM2024-Advanced Mathematics 2 melalui pendekatan program ini	4.575
	Saya mendapat banyak maklumat tambahan tentang PBM2024-Advanced mathematics 2 dengan menggunakan pendekatan program ini	4.400
	Saya lebih bersemangat belajar PBM2024-Advanced Mathematics 2 dengan adanya program ini	4.400
	Suasana pembelajaran lebih ceria melalui program ini	4.450
E. Keberkesanan program Running Math terhadap pelajar	Saya lebih faham belajar PBM2024-Advanced Mathematics 2 melalui program ini	4.350
	Tahap pemikiran saya terhadap PBM2024-Advanced Mathematics 2 meningkat melalui program ini	4.425
	Saya lebih menghayati PBM2024-Advanced Mathematics 2 hasil pendekatan program ini	4.450
	Saya mampu mengaplikasikan apa yang dipelajari dari program ini bagi menghadapi Peperiksaan Akhir	4.425
	Program ini mampu mewujudkan suasana pembelajaran yang lebih terbuka	4.500

5. KESIMPULAN

Hasil daripada dapatan kajian terhadap Kajian Persepsi Pelajar PBM2024-Advanced Mathematics 2 terhadap Program Running Math di Politeknik Mukah ini, dapat dirumuskan bahawa 4 domain yang dipilih iaitu reaksi pelajar terhadap kursus, penglibatan pelajar terhadap program, pengisian program dan keberkesanan program merupakan antara penyumbang utama yang mempengaruhi persepsi pelajar terhadap kursus PBM2024-Advanced Mathematics 2 di Politeknik Mukah. Ini kerana hasil dapatan kajian menunjukkan faktor- faktor ini mendapat skor min pada tahap tinggi. Justeru itu, implikasi pentingnya dapatan kajian ini adalah menunjukkan bahawa wujudnya faktor-faktor penyebab yang lain, yang dapat membantu dan mempengaruhi minat pelajar dalam kursus PBM2024-Advanced Mathematics 2. Namun begitu, kajian ini hanyalah kajian yang berskala kecil dimana skop kajian hanyalah terdiri daripada pelajar Politeknik Mukah yang mengambil kod kursus PBM2024-Advanced Mathematics 2 pada Sesi Jun 2018. Harapan agar kajian ini dapat diteruskan lagi oleh pengkaji-pengkaji yang akan datang dengan skop kajian yang lebih meluas dan pelbagai.

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DESIGN OF MICROSTRIP PATCH ARRAY ANTENNA WITH REFLECTOR FOR S-BAND APPLICATION

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Abstract. This paper presents a rectangular array microstrip patch antenna with parasitic reflector that able to be operated for S-band application. This antenna is designed using computer simulation tool (CST) to operate at 2.3GHZ by using microstrip line feed mechanism with quarter wavelength impedance transformer to match 100Ω patch element to 50Ω input. The physical parameters of the structure as well as single, separated and conventional (no reflector) parasitic reflector are analyzed. Reflection coefficient (S11), voltage standing wave ratio (VSWR), radiation pattern and efficiency for these single, separated and conventional (no reflector) parasitic reflector carried out. Results are in good agreement between simulated and fabrication measurement which validates the proposed design.

Keywords: Rectangular, Microstrip Patch Antenna, Parasitic reflector, high gain, wide bandwidth, S-band

1. INTRODUCTION

Array designs elements are very popular because of versatility and is used to generate a specific radiation pattern that can't be achieved by single element. Besides that, it expands the bandwidth at a particular resonant frequency, increase the directivity and perform various functions which difficult to achieve by a single element. Both micro-strip which is single element and array need impedance matching and to achieve that, there are two methods are applied to the current design, which is creating a suitable feed network and adding parasitic components to the original structure(Mehul et al., 2009). Through the design and proper fitting of the single reflector, this limitation has been mitigated. This is proven by doing simulation process, that single reflector softens nulls in antenna radiation pattern and improving the number of applications that these antennas (Jayesh et al., 2012).

There are so many designed in Micro-strip antennas, it can be in shapes like rectangular, circular, elliptical etc. (Mehul et al., 2009). Generally Single layer micro-strip antenna is preferred. To feed the antennas, many techniques have been reported nowadays but among them, micro-strip feeding is generally used because of its simplicity. However, a quarter wavelength transformer technique is commonly used to match the input impedance of the antenna with feed line (Mehul et al., 2009). Thus, giving ease to impedance matching to the desired frequency range. Besides that, type of substrate is also give an effect to the result, where to obtain a better bandwidth result without degrading radiation pattern due to superficial waves in substrate a low loss tangent and low dielectric constant or permittivity are been selected (Ignacio et al. 2012).

Due to compact size, patch array antennas faces disadvantages in terms of impedance matching, bandwidth and directivity, the microstrip antenna design should base on an inset fed micro-strip square patch and a reflector patch, where the electromagnetic energy is coupled from the square element to the parasitic patch through space and by surface waves in the substrate, and then reradiated. A gap is inserted in the reflector, so that the feed line is connected to the square patch through this gap which is to maintain the ease of manufacture. Mehul et al. (2009) combined a square and parasitic patch, a wider input

impedance bandwidth will be achieved than the single square patch. This is occurring due to the different sizes of the elements can cause a log-periodic independent phenomenon. When reflectors of an array antenna are joined together to form a single reflector the impedance matching gets better and the bandwidth obtained is significantly expanded, where the reflector needs to be placed very closed to the square patches, due to achieve a certain amount of coupling through surface waves in the substrate. The gap distance between the edges should be less than substrate thickness where it was found by simulation. A small gap between the two patches, almost touching each other, the coupling mechanism must be primary a surface wave effect rather than through radiation. It is important not to situate patches too close because it could result in a narrower bandwidth.

The structure behavior is an important thing to take care off, which is the size of the single reflector of the array antenna. These reflectors have to be long enough to decrease backside radiation, so that an acceptable front to back radiation can be obtained, where to confirm that a simulation has been execute and as the results, a larger length is unnecessary to reduce the backside radiation and it just causes a worsening on the antenna directivity. However, the reflector must be wide enough, but not too much in order to achieve a proper bandwidth (Mehul et al., 2009). Besides that, according to Peng et al. (2012), the reflector should place approximately $\lambda/4$ behind the array patch or radiator, because the in phase wave from the reflector enhances the unidirectional radiation.

The contact location transmission between feeding line and a microstrip patch antenna is used to control the impedance. An inset feed technique are used to integrate patch antenna with a single planar substrate on the microstrip feed. These input impedance are varies and it similar to the coaxial probe feed patch, as the inset depth of the feed line changes. A microstrip transmission line technique are the simplest and most commonly used as a feed technique, where it connected directly to the patch and induce excitation. The main advantage is the patch and the feed line can be printed on the substrate in the same layer.

The impedance behavior of the inset feed on rectangular patch are not systematically investigate on the same extent as the probe feed patch, where the same cosine square function is used to design a patch geometries. An earlier measurement is pointed out that the dependence of input resistance on feed position is differ between inset-fed patches and probe feed (Gargm et al., 2001). The corporate feed network technique with multiple section of quarter wavelength impedance transformers are been chosen because it give a better simulation result in antenna responses and impedance matching (Mehul et al., 2009). However, a quarter wavelength transformer technique is been used to obtain a proper impedance matching (Balanis, 1997)where it is to match the source and antenna impedance such that maximum power to be transferred, by optimized the width of the quarter wavelength transformer (Collin, 1992).

2. DESIGN OF ANTENNA

2.1 Antenna Geometry

This project will focus on the design and result analysis of microstrip array antenna with which is shown in Figure 1(a), which consists of a rectangular microstrip array, inset feed line by a corporate feed network using quarter wavelength impedance transformer that match 50Ω feed line and a ground plane, where Figure 1(b) was added an separated parasitic patch and Figure 1(c) has a single parasitic patch added. The antenna is designed on a FR4 substrate with overall area of 100mm x 70mm and thickness of 1.6mm. Comparison has been performed between no reflector, separate reflector and single reflector. The details of antenna dimension has been shown in Table 1.

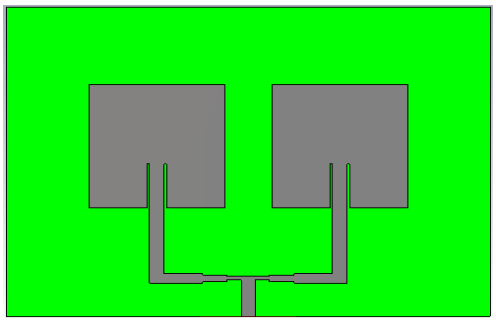


Figure 1(a): Microstrip array antenna with quarter wavelength impedance transformer feed network.

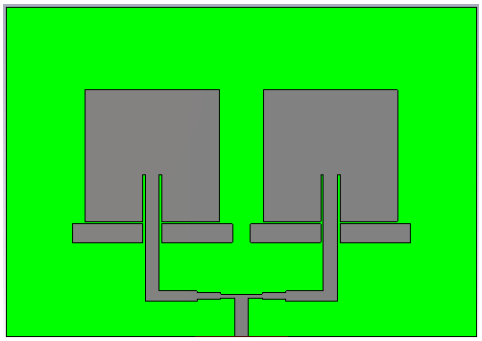


Figure 1(b): Microstrip array antenna with separated reflector and quarter wavelength impedance transformer feed network.

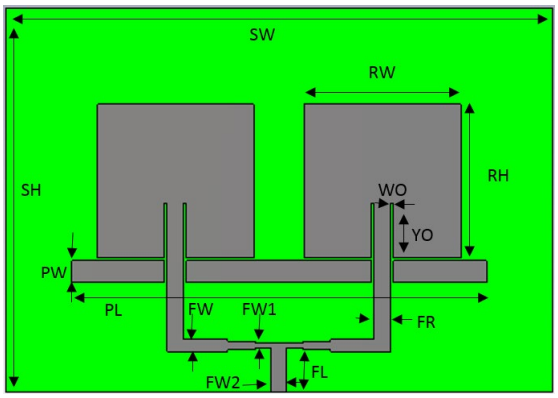


Figure 1(c): Microstrip array antenna with single reflector and quarter wavelength impedance transformer feed network.

Table 1: Dimension of microstrip array antenna design

Parameter	Value(mm)	Parameter	Value(mm)
SW	100	FW1	0.8
SH	70	FW2	2.84
RW	28.6	FL	8.2
RH	28	PW	4
YO	10	PL	75.84
WO	0.5	PEC	0.035
FR	3.7	Substrate Thickness	1.6
FW	2.2		

2.2 Design Steps

The design procedure can be described as below

Step 1: A rectangular microstrip patch antenna was designed using CST with feed line without reflector. This antenna was designed to be operated for single band which ranges of 2.3 GHz.

Step 2: Then the microstrip patch antenna was designed with the same dimension but with separate and single reflector.

Step 3: Analyze and perform comparison on reflection coefficient in decibel (dB), radiation pattern, gain and efficiency between conventional, separate reflector and single reflector design.

Step 4: Fabricate and perform reflection coefficient and radiation pattern tests on best design to compare measured and simulation results.

2.3 Parametric Analysis

In this paper, we aim to investigate between no reflector, separate reflector and single reflector designs results on reflection coefficient, bandwidth, radiation pattern, gain and efficiency. The simulated result of reflection coefficient, S11 for single reflector, separated reflector and conventional (without reflector) has been shown in Figure 2(a). By comparing among these antennas, Single Reflector has shown the best reflection coefficient result with -23.84dB because it rejected all unwanted radiation. Also, the simulated result of radiation pattern has been shown in Figure 2(b). Single Reflector still result the best radiation pattern with gain 5.77dB. Comparison results has been summarized in Table 2. As shown in Figure 2(c), the polar plot view radiation pattern obtained is omnidirectional with main lobe directed at an angle of 0°, having angular beam width of 64.2° and this shows that the signal can be transmitted directional with less losses. The magnitude of the main lobe is 5.8dB.

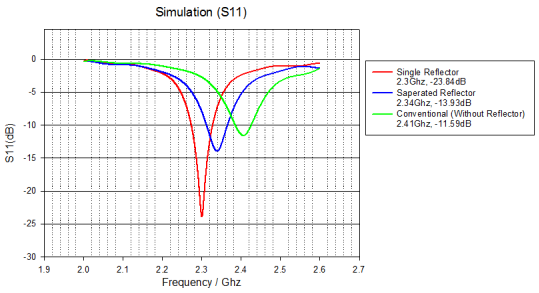


Figure 2(a): Reflection Coefficient comparison for Single Reflector, Separated Reflector and Conventional (without reflector).

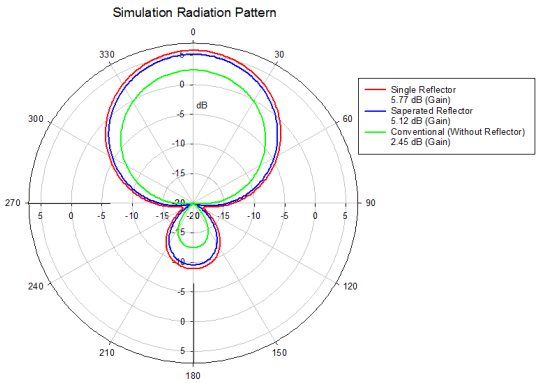


Figure 2(b): Radiation Pattern comparison for Single Reflector, Separated Reflector and Conventional (without reflector).

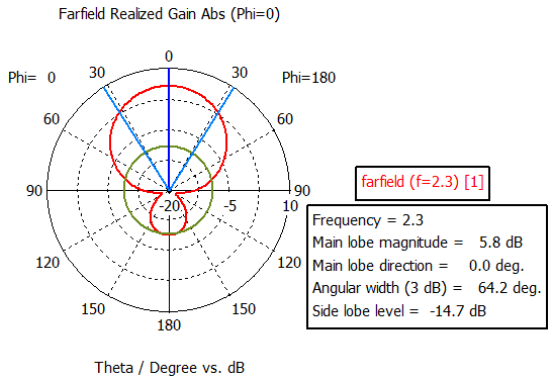


Figure 2(c): Gain of Fully Ground designed Antenna.

TABLE 2: Comparison Result Summary

Antenna	S11 (<-10dB)	Gain (dB)
Single Reflector	-23.84	5.77
Separated Reflector	-13.93	5.12
Conventional	-11.59	2.45

3. MEASURED RESULTS

The three proposed a microstrip patch antennas for conventional, separated reflector and single reflector were initially simulated and only the best simulation result was fabricated as shown in figure 3(a) and measured. In this section, simulation and measured result were presented.



Figure 3(a): Single Reflector Antenna.

3.1 Reflection Coffecient, Bandwidth and Voltage Standing Wave Ratio (VSWR)
The antenna has been fabricated where the simulated and measured reflection coefficient S_{11} of the proposed antenna by using Vector Network Analysis (VNA) and it shown that the measured result are in good agreement. The little discrepancies might be due to factors such as fabrication and measurement tolerances. It can be seen that the antenna can operate in three distinct frequency bands centered at 2.3GHz. This frequency band able to cover Malaysia WiMax application. Figure 3(b) has shown the simulated and measured reflection coefficient result for single reflector antenna. Reflection coefficient or known as return loss or S_{11}, is the difference between forward and reflected power, in dB, generally measured at the input to the coaxial cable connected to the antenna. If the power transmitted by the source is Pt and the power reflected back is Pr then the return loss is given by Pr. For maximum power transfer the return loss should be as small as possible. This means Pr/Pt should be as small as possible or expressed in dB, the return loss should be as large a negative number as possible (Constantinem, A., Balanis, 2009). Simulated result has proved a better reflection coefficient compared to measured result with almost 2.3 GHz resonant frequency as shown in Table 3. Bandwidth is defined as "the range of frequencies within which the performance of the antenna, with respect to some characteristic, conforms to a specified standard". The

bandwidth can be considered to be the range of frequencies, on either side of a center frequency (usually the resonance frequency for a dipole), where the antenna characteristic (such as impedance, pattern, beam width, polarization, side lobe level, gain, beam direction, radiation efficiency) are within an acceptable value of those at the center frequency (Constantinem, A., Balanis, 2009). By reviewing Voltage Standing Wave Ratio (VSWR) averagely at 1.5 indicates 4% of power delivered to the receiver reflected back to the transmission lines (96% of the power is delivered to the antenna). Note that a reflected power of 0 dB indicates all of the power is reflected (100%), whereas -10 dB indicates 10% of the power is reflected. If all the power is reflected, the VSWR would be infinite. In general, if the VSWR is under 2 the antenna match is considered very good and little would be gained by impedance matching (Allen, B., Dohler, M., Okon, E., E., Malik, W., Q., Brown, A., K.,& Edwards, D., J., 2007). Through simulation, the bandwidths obtained for Single Reflector, Separated Reflector and Conventional are 54MHz, 52.8MHz and 39.6MHz respectively. As in Figure 3(c), Voltage Standing Wave Ratio (VSWR) has shown an acceptable range for resonant frequency of 2.3 GHz with value 1.1365.

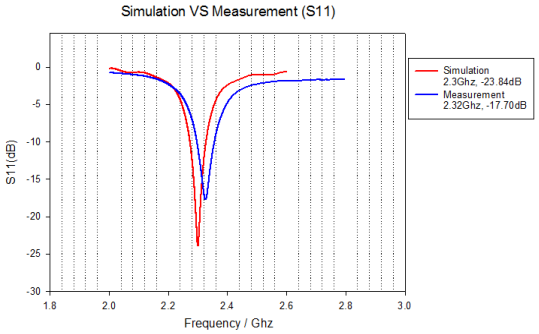


Figure 3(b): Simulated and measured result of Reflection Coefficient for Single Reflector Antenna.

TABLE 3: Reflection Coefficient Summary

Single Reflector	Frequency (GHz)	S11(<-10dB)	BW (MHz)
Simulated	2.3	-23.84	54
Measured	2.54	-17.23	41

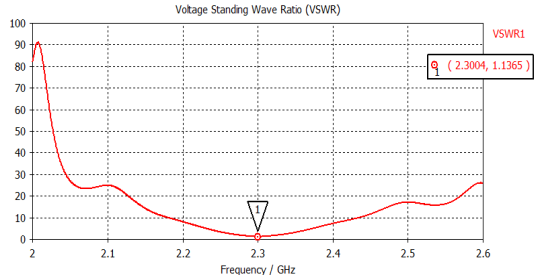


Figure 3(c): Voltage Standing Wave Ratio (VSWR) Result for Single Reflector Antenna.

3.2 Radiation Pattern, Gain and Efficiency

The radiation patterns, gain, and efficiency are measured using the antenna measurement equipment Anechoic Chamber facilitated in campus. The anechoic environment eliminates all reflections and allows precise and repeatable measurements to be made. The device under test is typically rotated 360 degrees in multiple orientations to determine the shape of the radiation pattern from various directions (Theile, & Stutzman, 1998). Before any measurement is done, calibration is carried out by using the standard antennas procedure. Figure 3(d) has presented radiation pattern result between simulated and measured for Single Reflector antenna. Antenna gain is defined as the ratio of the intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna is radiated isotropically. The radiation intensity corresponding to the isotropically radiated power is equal to power accepted (input) by the antenna divided by 4π. When the

direction is not stated, the power gain is usually taken in the direction of maximum radiation (Constantinem, A., Balanis, 2009). It is given as:

$$\text{Gain} = 4\pi \times \frac{\text{radiation intensity}}{\text{total input (acceptable) power}}$$

The comparison results of radiation pattern has been summarized in Table 4.

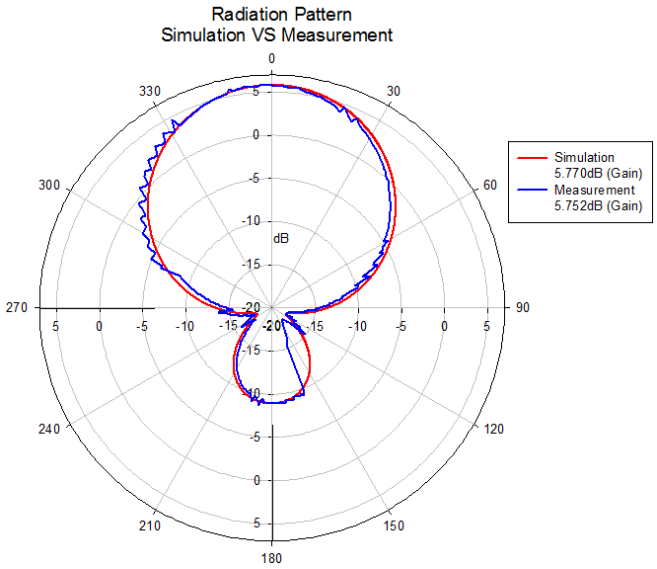


Figure 3(d): Simulated and measured result of Radiation Pattern result for Single Reflector Antenna

Table 4: Radiation Pattern Summary

Single Reflector	Gain(dB)	Efficiency (%)
Simulated	5.770	78.94
Measured	5.752	79.68

3.3 Varying the size of the Parasitic Reflector

Through the design of a single parasitic reflector this limitation has been solved, where it improve many other antenna responses such as return loss, bandwidth, radiation pattern and efficiency. In these designs patches would have different lengths and width, resulting different but proximate resonant frequencies, so that the antenna bandwidth would be significantly increased. By simulation results it has been proved the benefits of using single reflectors in microstrip patch array antennas instead of separated reflector, and the versatility of these patches in different structures.

The effect of varying the width and length of parasitic reflector at the rectangular array patch as shown in Figure 4 for return loss characteristic. From these parameter sweep process in CST, It is clearly seen that the return loss will change when the width and length of parasitic reflector is verify. The result show that, when varying the width and length of the single parasitic structure the value of return loss S11 will also change while Figure 5 shows the value of the length and width which have been varied and selected through the parameter sweep analysis. From the parameter sweep, it shows that the Run 1 give a better return loss (S_{11}) result than others.

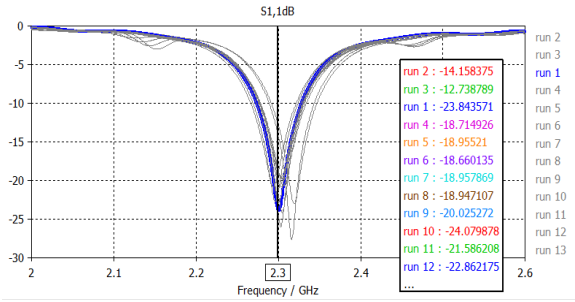


Figure 4: Simulation results of return loss, S11 for the antenna when the width and length of the single parasitic patch is varied

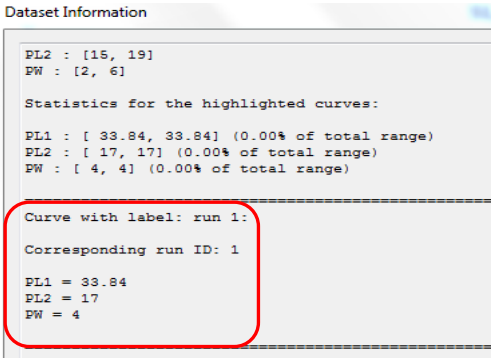


Figure 5: Value of Parameter Sweep at Run 1 when the width and length of the single parasitic patch is varied

4. CONCLUSION

From the analysis of the simulated result of the proposed antenna, it is clear this design is good to work in required frequency range with an optimum gain and reflection coefficient. The proposed antenna is possible to be implemented in practical field for WiMax applications at 2.3Ghz band. In the future, a further work can be carried out to improve the design in order to practically operate in multiband frequency range and having much higher gain and lower reflection coefficient.

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PROGRAMMABLE PWM AND INVERSE PWM USER INTERFACE WITH H-BRIDGE DRIVER

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Abstract. A Pulse Width Modulation (PWM) is widely used in different areas of control systems, such as robotics, industrial process control, power control systems. Generating pulse width modulation signal using integrated circuit (IC) gives an implication on cost and space to keep the equipment. A graphical user interface (GUI) is developed which will adjust the value of frequency and the duty cycle for control the position and the speed of DC motor. The user will be able to enter the desired value of set point on the GUI and the motor speed can high or low. The H-Bridge Driver circuit is to drive the DC motor position which is controlled by PWM signal change from counterclockwise or anticlockwise. The interface was used to connect the H-Bridge Driver circuit with PWM signal. Overall, it provides a user-friendly GUI presentation so that the control and monitoring process will be simple and convenient.

Keyword: Pulse Width Modulation (PWM), Graphical User Interface (GUI) and Direct Current (DC)

1. INTRODUCTION

1.1 Research Background

Pulse-width modulation (PWM) of a signal or power source involves the modulation of its duty cycle, to either convey information over a communications channel or control the amount of power sent to a load. There are many applications of PWM. One particular application of PWM that is common to industrial robotics, industrial process control, power control systems, etc. is in switch-mode servo amplifiers.

Pulse Width Modulation (PWM) technique is employed to control motor speed. A VI (virtual instrument) is developed with LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) that allows the DAQ to read a user selected reference voltage continuously. The VI also generates a suitable triangular wave that with the help of the reference signal produces the desired PWM signal. PWM is an analog signal that switches between two predefined limits. The switching interval of the PWM controlled by the reference signal determines the average power delivered to the motor circuit. The PWM signal is sent through the output port of the DAQ by the VI which in turn controls the motor speed. User from the front panel of the VI may input the duty cycle and the frequency of the square wave, sampling rate of the reference signal, and the desired amplitude of the PWM. As the reference voltage increases, the width of the PWM (duty cycle) increases which in turn. A DC motor position control system is developed using National Instrument's LabVIEW software and Data Acquisition Board. A path generation technique is utilized to compute a speed profile of the motor. The path generation for motor position can be easily adjusted with the software which saves project development time.

1.2 Problem Statement

Generating pulse width modulation signal using 555 integrated circuit (IC) is also very popular, it gives an implication on cost and space to keep the equipment. Basically, function generator or Pulse Width Modulation (PWM) generator circuit was used to control the DC motor manually as

the result it gives more power losses and not efficient. To overcome this problem, the Programmable Pulse Width Modulation (PWM) user interface was developed where the pulse width modulation is easily obtained with the LabVIEW software. The hardware component of the motor rotational control system can be varied in 2 direction compare to conventional method that controlled motor in 1 direction. The software also allows adjusting the performance characteristics of the signal with little effort besides, it can provide as interactive learning for student on learning the concept of PWM.

1.3 Research Project Objectives

The main objectives of this project can be described as:

(i) To develop user interface of PWM signal in PC for H-Bridge driver that can be used to drive an electric motor

(ii) To control the frequency, amplitude and duty cycle of Pulse Width Modulation (PWM) in software environment.

(ii) To improve the controlling system in drive the electric motor which is varies speed, rotational and direction.

1.4 Research Project Scope

This project will focus on the design and development circuit and graphical user interface (GUI) to interconnect an H-bridge driver and a dc motor to a single personal computer. The method to interface the circuit to the personal computer will be studied and developed. Thus, the scopes are:

(i) GUI–Generate PWM user interface using LabVIEW 7.1 software (Visual Programming Language)

(ii) Interface Module – Used NI USB 6008 Data acquisition card (DAQ) that most compatible with LabVIEW software

(iii) Used DMOS H-Bridge driver to control the speed of DC Motor

(iv) Control the duty cycle of PWM in the range of 0 to 100%

2. LITERATURE REVIEW

In this section, analyze an impressive list of earlier works about Programmable PWM interface H-Bridge Driver. It is also including the review, and summarized related previous project in term of programmable Width Modulation (PWM), interface module control method and LabVIEW software. All the sources are from the books, internet and also the journal.

2.1 Programmable Width Modulation (PWM)

PWM is the factor industrial standard for high efficiency power transfer in a variety of high-performance applications, which include motor speed drives, dc to ac inverters and switch mode Power Supply. Pulse Width Modulation (PWM) technique is employed to control motor speed (Olden et al., 2015; Jayapandian, 2015). It can be also generated using software alone, by hardware alone or by using both. Many micro controllers such as AT Mega series and some PICs today have in built PWM channels which are fully software independent (Michael 2016).

Three commonly used PWM techniques are Sinusoidal PWM technique, Space Vector PWM technique and Hysteresis (bang-bang). The pulses of a symmetric PWM signal are always symmetric with respect to the center of each PWM period. The pulses of an asymmetric PWM signal always have the same side aligned with one end of each PWM period (Dodson et al., 1990).

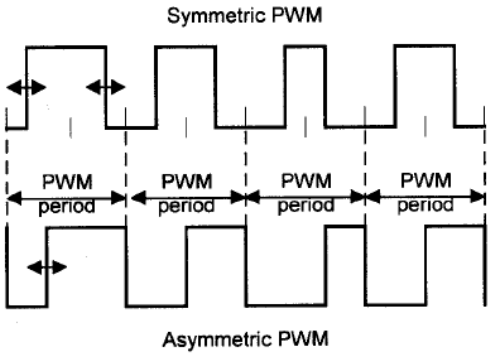


Figure 1.1: Output of Pulse Width-Modulation

The most efficient method of controlling the output voltage is incorporate PWM control within the inverters. In this method, a fixed DC input voltage is supplied to the inverter and controlled AC output voltage is obtained by adjusting the on and off periods of the inverter devices. According to Mohan et al. (2000), the PWM control has the following advantages:

i. The output voltage control can be obtained without any additional components.
ii. With this type of control, lower order harmonics can be eliminated or minimized along with it output voltage control. Therefore, the filtering requirements are minimized as higher order harmonics can be filtered easily.

Pulse Width Modulation (PWM) is widely used in different areas of control systems, such as robotics, industrial process control, power control systems (Michael, 2016; Mohan et al., 2000; Dodson 1990). A PWM circuit converts a DC voltage into a series of pulses, so that the pulse duration is directly proportional to the value of DC voltage.

Basically, the majority of applications use a 555 IC timer as pulse-width modulator (Michael, 2016; Mohan et al., 2000; Dodson 1990). The concept of PWM inherently requires timing. The classic 555 timer chip and some potentiometers can be used to generate PWM. The pots are manually adjusted for the desired duty cycle. However, if used a PC, it can automatically change the duty cycle and PC can control motor's speed (Michael, 2016).

The switching control of the PC's fan motor is fairly conventional pulse-width-modulation (PWM) technology for a single-phase, non-reversing motor (Djuro & Zrilic. 2006; Barr, 2001). While the control of the motor is rather straightforward, the system aspects of cooling can be quite complex. In PC applications, the motor has a two-, three-, or four-wire connector from the processor. The fan connector provides both an interface and a barrier. In (Michael 2016), the prevalent method currently used for controlling fan speed in PCs is low-frequency PWM control. In this approach, the voltage applied to the fan is always either zero or full-scale avoiding the problems experienced in linear control at lower voltages.

The PWM signal is sent through the output port of the DAQ by the Virtual Instrument (VI) which in turn controls the motor speed as discussed (Kelvin et al., 2002).

3. MATERIALS AND METHODOLOGY

This chapter will focus on how this system will be program or the way to complete this system. In this chapter, all the material, method or equipment will be explained detail. Figure 2.1 shows that the block diagrams of this project.

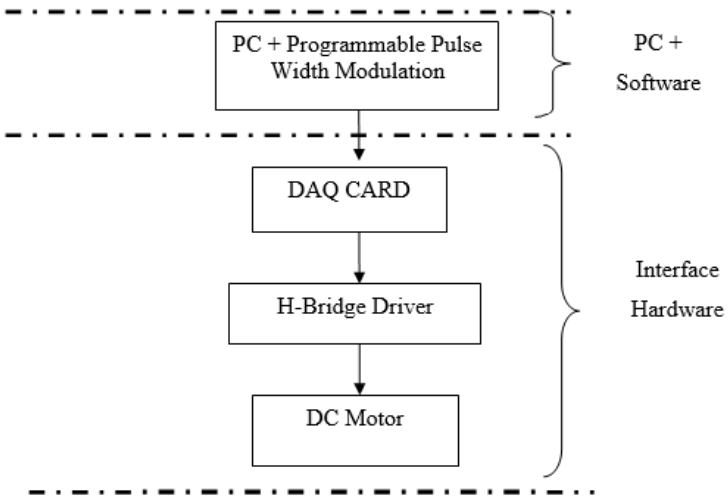


Figure 2.1 Block Diagram of Interfacing PWM with H-Bridge Driver.

3.1 Basic Operation

The major components of the complete system include are PC & Programmable Pulse Width Modulation, DAQ CARD, H-Bridge Driver and DC Motor. A PC graphical user interface (GUI) will be developed using LabVIEW 7.1 Student Edition. On the PC, a graphical user interface (GUI) will be developed which will adjust the value of frequency, amplitude and the duty cycle for control the position and speed DC motor.

The Virtual Instrument (VI) developed by LabVIEW software communicates between input and output PWM. The VI developed with LabVIEW software performs the following functions such as, samples the reference signal continuously at the user supplied rate, generates a triangular wave, and produces a PWM signal that switches at the intersection of the reference signal and the triangular signal.

The output of the PWM (reference signal) from LabVIEW is connected to the input port or channel of the DAQ. The PC will be connected to the DAQ CARD using the USB port. The output DAQ card receives PWM signal through the H-Bridge Driver.

The H-Bridge hardware was used to drive DC motors that are controlled by PWM (Pulse Width Modulation) signal because H-bridge is an electronic circuit which enables DC electric motors to be run forwards or backwards. The user will be able to enter the desired value of set point on the GUI and the speed for this motor can high or low and the position for DC motor change from counterclockwise or anti clockwise. Overall, this project will provide a user-friendly graphical presentation so that the control and monitoring process will be simple and convenient.

3.2 PC Graphical User Interface

A Graphic user interface (GUI) is been developed using LabVIEW 7.1 Student Edition because the frequency, amplitude and duty cycle of PWM can be varied and the value for parameter will be displayed from this software. National Instruments LabVIEW is an industry-leading software tool for designing test, measurement, and control systems. LabVIEW has the flexibility of a programming language combined with built-in tools designed specifically for test, measurement, and control. It can create applications that range from simple temperature monitoring to sophisticated simulation and control systems. No matter any project, LabVIEW has the tools necessary to make successful quickly. Figure 2.2 that obtained from (Robert, H., Bishop. 2017)shows that the LabVIEW 7.1 Student Edition.

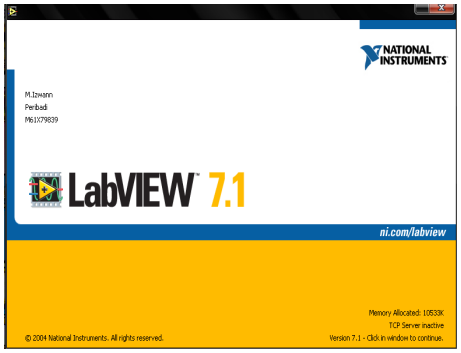


Figure 2.2: Labview 7.1 Student Edition

3.2.1 LabVIEW *Program*
In this development, LabVIEW software was used to generate the switching frequency PWM and INVERSE PWM to drive the DC motor. Figure 2.3 below is the Block Diagram in LabVIEW

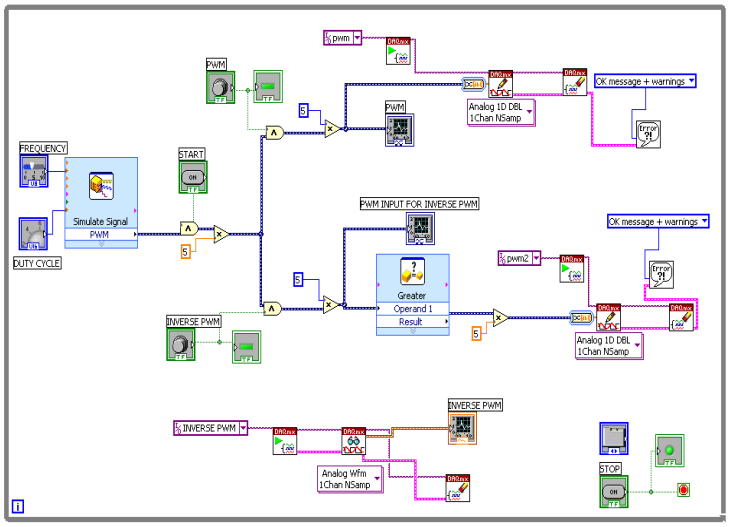


Figure 2.3: Block Diagram in LABVIEW

4. RESULTS AND ANALYSIS

4.1 Research Project Hardware
After making a testing in hardware and software was finish then it was combining to obtain the output from this project, beside make some analysis such as output voltage, frequency and speed of motor rotational. Figure 3.1 show that the combination between hardware and software where the input circuits are connected from adjustable power supply and DAQ card. DAQ card is an interfacing device to interface between LabVIEW software and DC motor. The output circuit was connected into DC motor and voltmeter to capture the supply output voltage.

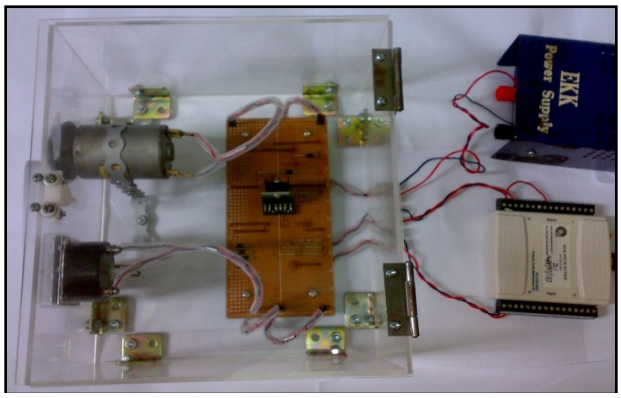


Figure 3.1 Combination hardware and software

4.2 LabVIEW Programming

The program of this project is designed by using LabVIEW 7.1 for signal receiving, processing, controlling and displaying. The front panel of the program is shown as Figure 3.2.

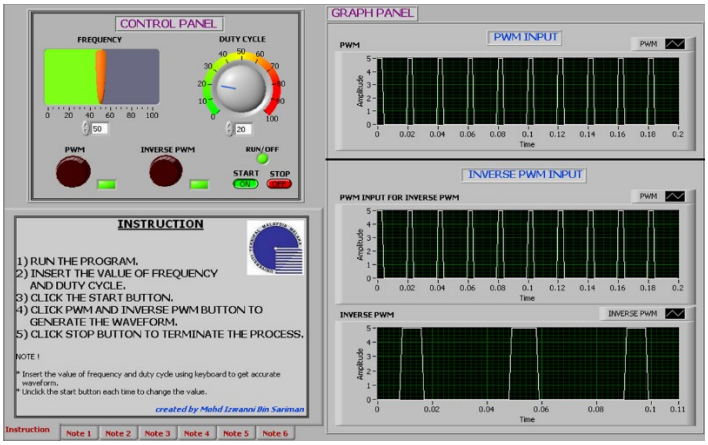


Figure 3.2 Front panel program

Front panel generally is used to control the settings such as frequency and duty cycle. User can press the "start: button in the front panel to start the process. Next, user can choose to press "PWM" button or "INVERSE PWM" button. If user choose the PWM input and adjust the value of frequency and duty cycle, motor can operate in forward direction with different speed. When user press "INVERSE PWM" button the motor can rotate reverse direction and the circuit operation can be seen in figure 3.5. The value of voltmeter may increase if duty cycles increase. If users press the button "INVERSE PWM" and "PWM" at same time, motor can stop, it is because input from PWM and INVERSE PWM can be zero voltage. The speed of motor can control using duty cycle, when the value of duty cycle increase, the speed of motor become faster.

In front panel of LabVIEW, it can see that button run/off. It was show that, when button PWM and INVERSE PWM was press, button run will be green lamp and if no operation, red lamp was display. From the graph panel, it can see that, the input and output PWM and INVERSE PWM. The graph was plot is voltage versus time. The maximum voltage is 5Volt and this is because PC (personal computer) can supply only 5Volts.

On the PC, a graphical user interface (GUI) was developed which will adjust the value of frequency and the duty cycle for control the position and speed DC motor. From front page, it has instruction for run this program and note based on the H-Bridge and PWM that may give extra information to understand the operation of PWM and H-Bridge driver.

By using digital multimeter, digital tachometer and ac/dc digital clamp meter testing the analysis about the DC motor has been done. The analysis result was shown in table 3.1 and from that when the value of duty cycle was increasing the value of voltage and speed of motor also increase but the current is decrease.

Table 3.1: Result Testing

Duty cycle	Voltage (input 12V)	Ampere (input 0.13A)	Rpm
20%	2.37v	0.027A	24rpm
50%	5.6v	0.025A	61rpm
80%	9.5v	0.023A	97rpm
100%	11.6v	0.03A	178rpm

4.3 Analysis using Digital Phosphor Oscilloscope

By using digital phosphor oscilloscope, analysis the output from LabVIEW can be done to know that the research project is success or not. The value of duty cycle was adjusted, to see the output for PWM and INVERSE PWM. Four value of duty cycle was choosing such as 20%, 50 %, 80% and 100% duty cycle. It is because when duty cycles change the output waveforms also change and it will affect the output voltage. Figure 3.3 shows that the output PWM with value of 50% duty cycle and it was measure using digital measurement oscilloscopes.

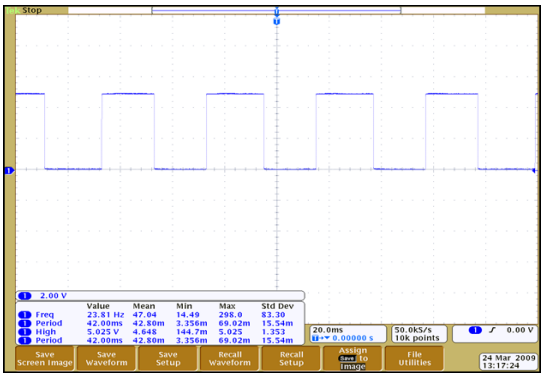


Figure 3.3 Output PWM at 50% duty cycle

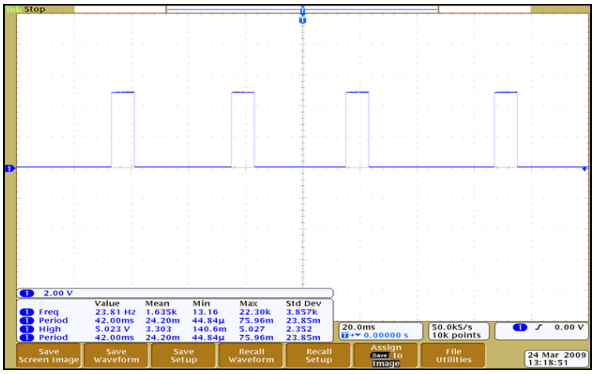


Figure 3.4: Output INVERSE PWM at 20% duty cycle

From digital phosphor oscilloscope, the output of INVERSE PWM waveform also can be seen. From this waveform it can see that when duty cycles increase the frequency for 1 cycles also increase. Figure 3.4 show that the different wavelength when we adjust the value of 20% duty cycle.

Based on graph PWM and INVERSE PWM, the value for frequency and voltage can be calculated. The value that is calculated was shown in Table 3.2.

Table 3.2: Result from graph

	PWM	INVERSE PWM
Duty Cycle	Frequency(Hz)	Frequency(Hz)
20%	23.53	23.53
50%	23.53	23.53
80%	23.53	23.53

Analysis using the oscilloscopes has been done to get the accurate value for frequency. It is because from LabVIEW software, the value of frequency that has been generated is 50 Hz but at oscilloscope the value is 23.53 Hz as calculate. Apart from this, the situation occurred because of a large time delay by using an USB as transferring data module and use directly on-board card may give an accurate value beside reduce the delay time during transferring data.

CONCLUSION

Programmable PWM can control speed and motor direction which implement it with H-Bridge driver circuit, where power is supplied to the motor in square wave of constant voltage but varying pulse width or duty cycle. Duty cycle refers to the percentage of one cycle during each pulse is on and PWM is the variation of the duty cycle of a continuous train of pulses. Since the frequency is held constant while the on-off time ratio is varied, the duty cycle of PWM is determined by the pulse width. Thus, the power increases with duty cycle in PWM.

LabVIEW student edition 7.1 was used for this project because it limits the coding experience and reduced time frame when compared to more conventional or competing systems and the suitable interface module for LabVIEW software is NI USB-6008 DAQ CARD because it can control the DC motor by using computer as the controller through USB (Universal Serial Bus) port. Graphical User Interface (GUI) is developed to provide useful help on handling machine process and at the same time save time and energy.

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THE STUDY ASSEMBLY IMPROVEMENT PROCESS THROUGH JIG IMPLEMENTATION FOR B-SEGMENT SUV MODEL

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Abstract. This article discusses the assembly improvement process through jig implementation for rear door trim. Jig is an important tool or device that used in machining or assembling process where it assists and guide the part to be machined or assembled. Jigs are special purpose tools which are used to facilitate production like machining, assembling and inspection operations. There are many advantages for using jigs in production. Jigs eliminate individual making mistake, positioning and frequent checking. This reduces operation time and increase productivity. There is no need for selective assembly. The objective of this project is to reduce cycle time in process assembling rear door trim.

Keywords: jig, cycle time, rear door trim, child part

1. INTRODUCTION

Jig is an important tool or device that is used in the machining or assembling process where it assists and guides the part to be machined or assembled. Jigs are special purpose tools which are used to facilitate production like machining, assembling and inspection operations (Rushikesh et al., 2017).

Figure 1.1 and 1.2 shows the child part and mother part which is plastic clip and rear door trim that are the focus of this study.



Figure 1.1: Plastic clip

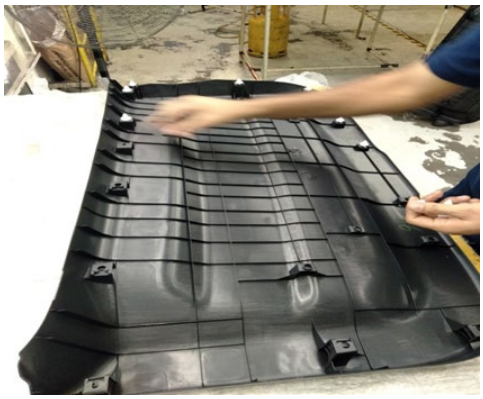


Figure 1.2: Rear door trim

The cycle time issues occur in the production line of rear door trim. At the production line, the only way to run the production is by using manpower. So, when only manpower is used, the cycle time to produce one part of the rear door trim increases.

To reduce the problem issue, a jig needs to be developed in the rear door trim of B-Segment SUV at the production line. The research needs to be performed to achieve the goals or target of this project.

2. LITERATURE REVIEW

2.1 Introduction to Jig
A Jig is characterized as a device that holds and finds a work piece, aids and controls at least one cutting instrument (Ahmad Mohamed, 2004). A jig is normally made of metal which finds and holds the workpiece(s) in a positive way and furthermore controls the cutting tools (Sangale et al., 2017).

Jig is very important in manufacturing industry. This tool is needed to make sure that the manufacturing process in the production line goes smoothly and eases the operator to do their job. Jig helps the operator to hold the parts which will be processed or in operation. In terms of production rate, using jigs increased the productivity because it will minimize the production time (Joshi, 2010).

2.2 Type of Jig
The quantity, type, and complexity of jigs and fixtures used to depend on the type of work to be machined and the scale of production required, A new simple type of jigs are described below.
Following are the different types of jig.

i. Template jig
ii. Plate jig
iii. Channel jig
iv. Sandwich jig
v. Leaf jig

2.3 Door Trim
Vehicle doors are door types, usually hinged, but sometimes attached by other mechanisms such as tracks, in front of openings used for entering and exiting vehicles. Vehicle doors can be opened to provide access to opening or closed to secure them. The exterior of the door is designed like steel similar to the outer part of the vehicle (Jindo & Hirasago,1997).

On the other hand, the interior side of the vehicle door usually consists of a variety of materials, sometimes vinyl and leather, other clothes and other fabrics as shown in figure 2.1. As the car door panel is usually meant to match the entire style used in the interior of the car.



Figure 2.1 Example of door trim

3. METHODOLOGY

3.1 Data Collection of Cycle Time

The cycle time is being taken during the working time at the door trim workstation. The time is measured between one process to another process until the final process of the door trim assembly. The cycle time of both parts is taken ten times to get the average data. For this method, the data is taken by using a stopwatch such as Figure 3.1.



Figure 3.1 Stopwatch

Table 3.1 Cycle time for door trim process

Process	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Cycle time(s)
Machine door opens	5	5	5	5	5	5	5	5	5	5	5
Take part from machine	13	12	12	11	12	12	12	13	11	12	12
Place the part on the table	4	3	3	2	3	4	3	3	2	3	3
Machine door closes	5	5	5	5	5	5	5	5	5	5	5
Cut off runner gate	3	3	2	3	4	3	3	2	4	3	3
Flaming	6	6	7	6	5	7	6	6	6	5	6
Install clip	9	9	9	9	8	9	9	10	9	9	9
Place part on the rack	2	2	3	2	2	2	2	2	2	2	2
CYCLE TIME	47	45	46	43	44	47	45	46	44	44	45

3.2 Design of jig

For this project, CATIA software is been used because the geometrical configuration of composite parts can make designing these parts complicated, increasing the risk of errors in design accuracy.

The two ideas then are drawn as Figure 3.2 and 3.3 using CATIA software by following the child part's dimension. In the stage of designing the jig, it is important to measure the diameter of the child part so that it can be easily inserted into the main part through the slot and matched for assembling. Successful jig design begins with a logical and systematic plan. The two designs of these jigs for the part assembly have their own advantages and disadvantages.

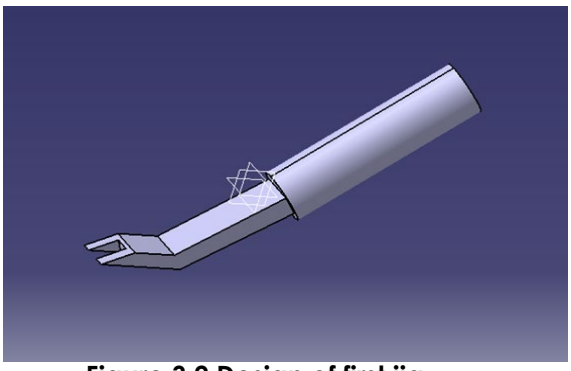


Figure 3.2 Design of first jig

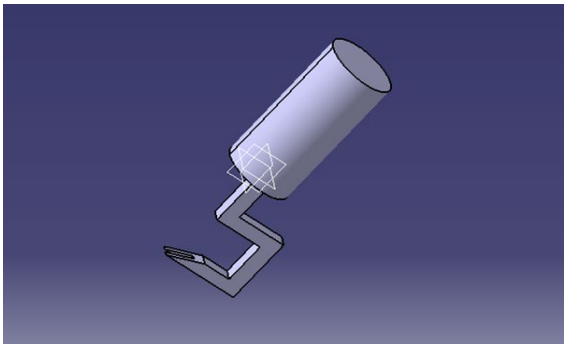
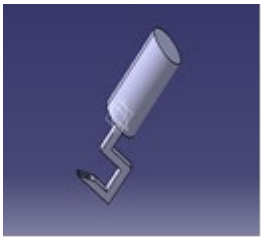


Figure 3.3 Design of second jig

Table 3.2 Advantage and disadvantage of jig

Product	**Jig Type 1**	**Jig Type 2**
Product Design		
Height (cm)	20	20
Weight (g)	200	150
Material	Steel	Steel
Fabrication time	3 hours	4 hours
Advantage	Easy to insert clip	
Disadvantage		Difficult to insert clip

4. RESULTS AND ANALYSIS

4.1 Cycle time improvement

A process duration study has been done at the sequential construction system. Both process durations when utilizing new jig were recorded. All the information about the time taken to complete the part was gathered by utilizing the standard check sheet structure typically used.

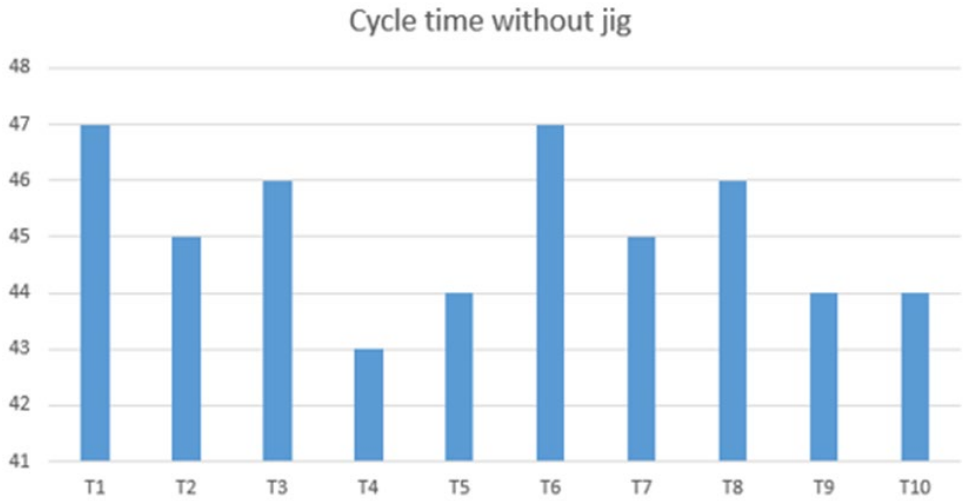


Figure 4.2 Cycle time using jig

Figure 4.1 and 4.2 shows the duration taken for the exercises at the mechanical production system for door trim before and after the usage of the jig. Each process duration exercise has their own process duration taken.

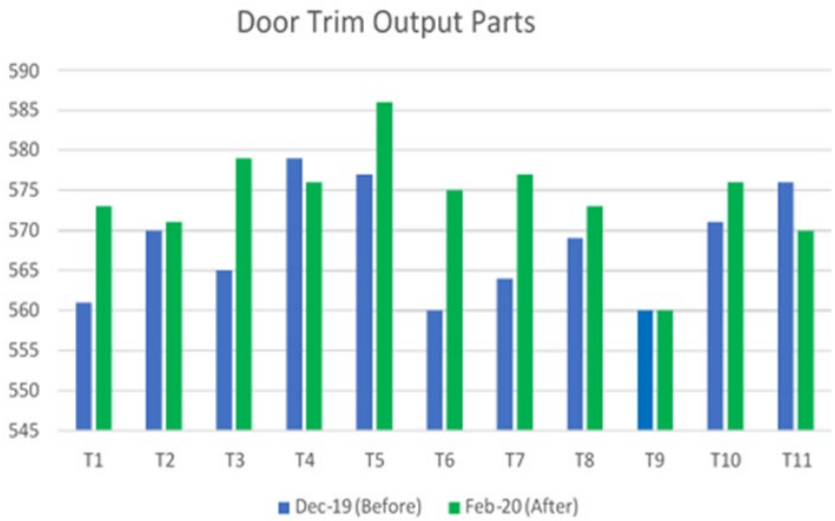


Figure 4.3 Output part before and after using jig

By utilizing the bar graph in figure 4.3, the quantity of dismissals of the part can be clearly seen. This bar outline is used to analyze the part during the execution before and after implementation of jig.

5. CONCLUSION

The conclusions that can be made from this whole project are problem solving can be done with continuous monitoring as well as by collecting data and recording data for the purpose of analyzing the problem in the future. The importance of objective is the focus on the

statement that needs to be accomplished to solve the problem. In this case, time-related problems can be overcome by continuous research and the use of Jig can help reduce the child part installation time in the Rear Door Trim process.

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DESIGN AND DEVELOPMENT OF AUTOMATIC RAPID MANUFACTURING FOR LAYERED CAKE MACHINE (ARM-LC)

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Abstract. Layered Cake *(Kek Lapis)* is a type of cake served in Malaysia and very popular in Sarawak because of its unique taste and colorful layered design. Currently, the amount of layered cake produced for every worker is 2 cakes per hour. This is not productive enough to cater to a larger demand for a layered cake. Automatic Rapid Manufacturing for Layered Cake machine (ARM-LC) is developed to replace the manual method and produce a bigger amount of layered cake in a shorter time. ARM-LC applies baking process using liquid petroleum gas (LPG) to maintain the originality of layered cake. It includes all basic processes viz., filling, baking, layering, pressing and cooling. The novelty of ARM-LC using chain conveyor to move tray on a special pallet for the baking process and the use of pneumatic presser to compress every cake layer. 12 trays can be placed in one production line. Each layer of cake can be filled into the tray by using 3 different hoppers. The machine is controlled by a Programmable Logic Controller System (PLC). ARM-LC able to produce 12 cakes with 12 layers each in 1 hour, which makes 288 layered cake per day continuously. Through a test-run baking process, it has been proved that the automatic method has increased the productivity up to 6 times compared to the conventional method. ARM-LC is also user friendly and easily maintained. It has the advantage of reducing the number of workers, ovens, workers exhaustion, injuries risk and cause of burns. The machine is hygienic and has excellent anti-corrosion because most of the materials are using SUS 304 Austenite Stainless Steel making it suitable for food products. This project prospect is focused on layered cake *(kek lapis)* entrepreneurs. The machine can help the companies in terms of time savings, production and realize their mission and target in the future.

Keywords: layered cake machine, baking process,

1. INTRODUCTION

Layered cake (Kek lapis) Sarawak is a layered cake, traditionally served in Sarawak, Malaysia on special occasions. Sarawak layered cake is a signature product as a souvenir to visitors who come to Sarawak. Its unique taste and colorful layered design. The basic ingredients for layer cake are just butter, eggs, sugar, flour and milk. The baking process starts with baking layer by layer. Minimum layers are 10-12 layers. The worker has a lot of patience to get this cake done. The industry contributed almost RM 3 million a year to the entrepreneur. However, the companies had produced various layered layer cake using the conventional method. The tedious traditional process is unable to cope with the demand. The manual process dependent on worker skills has a direct influence on the quality of cakes produced. Sometimes their finger was burnt (Hazira Ahmad Zaidi, 2020). Layered cake offers a variety of flavors, with layers of neon colors and trippy patterns. The layer cake is baked by workers manually using hand.

Currently, layer cake is baked manually by the worker. The amount of layer cake for every worker is 4 layered cake per 1 hour by using the existing technique. Normally the company

baked about 32 cakes per day. Due to high demand in their layer cake, especially during the festive Hari Raya season, the company is facing a pressure to produce a more layered cake (Zora Chan, 2010). Hence, the manual method to baking the layer cake is no longer practical, tedious, not economical and ergonomically not feasible to workers and financially unsustainable to the company. "The development of the Sarawak Layered Cake Industry is affected by several factors, especially by the increasing trend of prices of its basic ingredients, the traditional non-productive method of production and the imperfect competition in the market structure. To ensure the growth of this industry there is a need for innovation". (Dahlia Johari, 2014)

Automatic Rapid Manufacturing for Layered Cake (ARM-LC) is a mini production line using to replace the manual method baking process by the worker. "Muhamad Halil Abdul Manaf, a director of sales in marketing Di Wannie's layer cake Sarawak, our cakes are still made manually, so it will take us 56 days to fill up one container with simple designs to be ship to the peninsula," he explained. He said this challenge could be addressed if simple layered cakes could be done with automated machines.

The concept idea of ARM-LC chosen consist of baking the layer cake in one process and match with various production lines, such as normal cake, crispy cake, walnut cake or cookies. ARM-LC machine is capable to produce faster than manual production with large capacity and high efficiency of layer cake. The automatic method has increased the productivity maximum to 12 trays can be placed in one production line compared to manual. 12 layers in one hour make the speed of production increase almost six time's larger quantity or 288 cakes per day compared to the manual process method. Workers tiredness and exhaustive can be reduced because the production is continuous. This new automation process which also will make less risk of injuries and cause of burning.

The ARM-LC has 8 main steps for the whole process to be completed in one cycle, and the process is continuous until getting the needed number layers. The system consists of DC motors, PLC control system, chain conveyor and 1 unit isolated open flame gas oven. All movement is using DC motors, chain conveyor and control by PLC control system. The benchmarking of the existing machine is considering the temperature and movement of the layer cake tray during the baking process. Researchers having difficulty to design the layering device and oven which is too many constrain and need to be considered especially size inside and shape of the tray to allow for better heat circulation during the baking process and the movement of the conveyor. The right temperature affects the final quality of the layer cake. Many redesigns to be made until the best mechanism design for the machine has found.

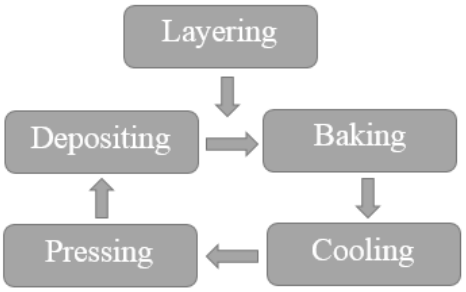


Figure 1: Flow process of the cycle of layered cake production.

The materials selected for the food is very hygiene that makes almost all of the materials is using a stainless-steel frame, plate and aluminum, which is more costing than other materials. Stainless steel has been proved in clinical tests to be significantly more hygienic than other food-contact surfaces. Made of SUS304 stainless steel, easy for operation, cleaning,

assembling and repairing. The production speed can be adjusted. Multifunctional filling by using filling hopper makes the dough easy to refill between layers.

Table 1: Mechanical properties of SUS304 steel and SS304 Steel.

Mechanical Properties	SUS304 Steel	SS304 Steel
Density (kg/m3)	8000	7984
Hardness HB	92	90
Tensile Strength (Mpa)	520	495
Yield Strength (Mpa)	240	230
Poisson's Ratio	0.3	0.29

1.2 Research Background

This project focuses on the layered cake supplier using a gas oven for the baking process as their main equipment. Because of the customer need is very high, the company need to expand the company in term of production, space, and marketing. Due to the growing demand for the layered cake product on the market, the effectiveness of the layered cake processing machine must be improved. This also helps the companies in terms of time savings and thus will increase product sales. The project will help the company to realize its mission and target in the future.

1.3 Problem Statement

Nowadays, most of the layer cake made manually. Various layered cake has produced using the manual method, and it is very tedious. The high demands of baking the layered cake, there is the need to company for using a simple mechanical device to make the process easy (Kamaldeen, 2013).

Therefore, several companies have innovated to simplify the process of baking the layered cake. Most of the products on the market processing layered cake used machine automatically but baking and pressing process is still done manually. The process of inserting or baking is also done manually and needs a long time to finish numbers of layer cake at a certain time. The thickness of each layer is also not in uniformity and standard.

Normally, in two hours, only one layered cake was produced due to several layers have to be cooked separately then gluing or bonding together before finally cook. It is not economical for the company to embark in a bigger order of layered cake. Workers tiredness and exhaustive occur due to the long period of the manual baking process of each layer of cake.

1.4 Project objectives

The objective of the project is:

i. To Design and development an automation manufacturing system that able to produce a layered cake in larger quantities called Automatic Rapid Manufacturing for Layered Cake (ARM-LC)

ii. To increase productivity per day compared to the conventional baking method.

iii. To reducing the production cost and time

The outcome of the project is crucially important to ensure the company competitiveness in the market and which is from the innovation of traditional method to automatic machine for baking the layered cake and produce larger quantities to fulfil market demands.

1.5 Research scope

The research was done at Fiska Kek Lapis and Mira Kek Lapis; a company in Taiping Perak and Sarawak. The research names as ARM-LC by the researcher for the purpose to change the manual operation to the automatic operation to produce the layered cake. ARM-LC will increase the production, time and worker.

1.6 Significant of Project
The machine can help the companies in terms of time savings, productivity, product sales and realize their mission and target in the future.

2. LITERATURE REVIEW

This chapter is present about the literature review of layered cake and layered cake oven machines such as origin, description and the other else from previous studies. Layered cake (kek lapis) is a well-known cake in Southeast Asia especially in Indonesia, Malaysia and Singapore, usually serve during festive occasions and holidays. The cake directly translates to a layer cake, because it is made up of multi-layered thin sponge. Each layer is bake using open flame on only top heat in the oven. The cake is sweet and moist.

Layered cake machine it's the machine that includes from beginning dough filling until the compressing process. Mostly these machines are not totally in automation which the filling, compressing and baking process is done manually. There are several ovens that we adaption from the previous method, design and development.

2.1 Two Deck Traditional Gas Oven Machine with Stand
A typical oven widely used at present that has a price range of RM250-RM600 per unit which bakes four cakes only at a time. The oven also does not have timers and temperature control, thus causing high temperatures in the production area and putting the workers in discomfort. Use gas as energy. The machine does not use electrical power, so it safe to operate. Manufactured using stainless steel and make the quality of food products is guaranteed and unpolluted. The baking process manually is a complex task, requiring skill and patience. However, the baking process is done manually by the operator. The operator would expose in danger (finger burnt) if the operator or user do not operate the machine properly.



Figure 2: Two Deck Conventional Gas Oven with Stand

2.2 DreamSpoint Oven Machine
It is an electric oven with 380Vas seen in Figure 3. It was fit with fully automatic thermostat. Allow the baking temperature to stay at the best baking condition with temperature range 0-400℃. This oven includes infrared radiant heating elements to make sure the heating evenly. The heating control by the top and bottom. Complete hardened glass doors, not only stylish but also offers perfect viewing of baking in progress without heat loss. It's also built-in original Schneider elements ensure the oven working durability and stability.



Figure 3: Dream Spoint Oven Machine

2.3 Wiberda Oven Machine

The machine uses electrical energy directly making it safe to operate. Manufactured using stainless steel and make the quality of food products is guaranteed and unpolluted. Inclusive of supporting frame (Tray Slot Available). Fully digital, touch screen and auto cleaning features. Baking process manually is a complex task, requiring skill and patience. However, the baking process is done manually by the operator.



Figure 4: Wiberda Oven Machine

2.4 Imbaco Gas Oven 1 Deck 1 Tray (E1D1TIM)

This oven uses gas as energy and does not use electrical power directly, making it safe to operate. Manufactured using stainless steel and make the quality of food products is guaranteed and unpolluted. Baking process manually is a complex task, requiring skill and patience. However, the baking process is done manually by the operator.



Figure 5: Imbaco Gas Oven 1 Deck 1 Tray (E1D1TIM)

Finally, the design and ideas of Automatic Rapid Manufacturing for Layered Cake Machine is an adaptation from all of these previous oven machine concept. The concept baking that we used is similar to **Two Deck Traditional Gas Oven Machine** on the principle of the baking method. The combination of the chain conveyor, presser, filler, and PLC controller system in one process will get the layered cake with the standard layer.

3. RESEARCH METHODOLOGY

The Rapid Manufacturing for Layered Cake Machine (ARM-LC) is to replace the manual method using one oven by the worker. The ARM-LC is estimated to produce a maximum of 288 cakes per day. The automatic method has increased the productivity up to maximum 6 times compare to the manual baking method. ARM-LC mechanism consists of continuous movement of chain conveyor and can carry 12 trays per one cycle in one process. That means, 12 Layered cake produced in one cycle process.

3.1 Hypothesis

This project was conducted according to a study on the efficiency and effectiveness of the machinery for the product to be produced. The results are based on time savings and the total number of products to be produced by a machine through an established process. From this theoretical framework, 4 factors influence to find the best processes of the Automatic Rapid Manufacturing for Layered Cake (ARM-LC), which is filling process, baking process, compress process and conveyor speed control.

3.2 Theoretical Framework

In Malaysia, layer cake processing companies still performed on a small scale because the demand is still at a small scale among Malaysians. Another challenge is to prolong the cake's shelf life. The company do not use preservatives in the cakes, so the shelf life of the cakes is between two and three weeks in room temperature, and up to six months if refrigerated. To demand requires speed in the production process and thus will be able to produce a standard size to avoid wasting raw material costs.

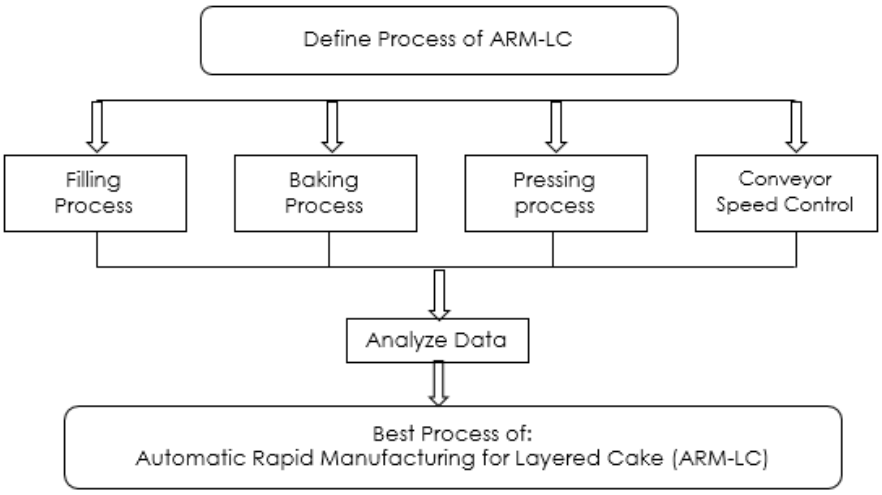


Figure 6: Framework for Action on ARM-LC

4. PROJECT EXECUTION

4.1 Design Phase

In this research, the researchers only consider several stages in the production process. There are five stages included, with is design, material selection, machine fabrication, machine assembly, and finally machine testing. At this stage, all of the design consideration will refer to the industry's feedback to increase the production of layered cake.

The Automatic Rapid Manufacturing for Layered Cake Machine (ARM-LC) is to replace the manual method where the process using hand by the worker. The ARM-LC is estimated to produce a maximum of 288 cakes per day. The automatic method has increased the productivity up to 6 times compared to the manual baking method. The mechanism of ARM-LC consists of continuous moving chain conveyor which can place 12 trays every cycle or layer. 4 to 5 minutes per cycle. Bellow shows the finalize design for ARM-LC.

Figure 7 shows the schematic diagram of ARM-LC. The cake trays moving in a counter-clockwise direction by a motor connected to the chain conveyor and roller conveyor system. The chain conveyor is used for straight-direction on two parallel lines, while roller conveyor is used for curve-direction on two curves to get a complete loop moving system. In a time, 12 cake trays are used simultaneously. Three hoppers used to fill three layers of dough with different colors and tastes. The cake is cook layer by layer in the oven during the cake tray moving in a loop system. Therefore, each layer takes one loop. LPG is used to fuel the oven.

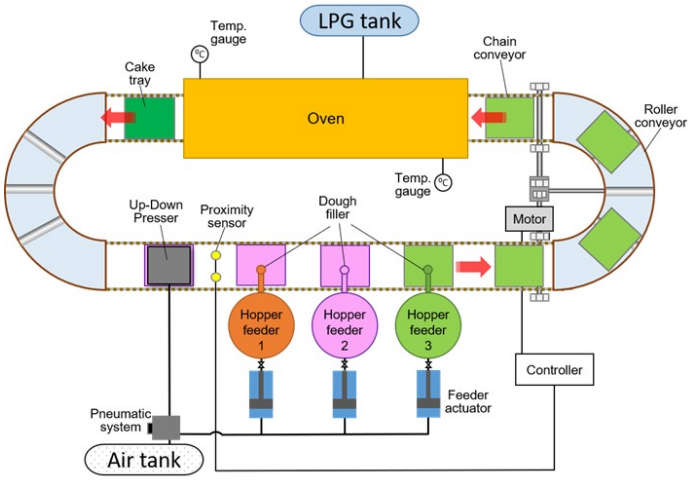


Figure 7: Schematic Diagram of ARM-LC

4.2 Fabrication Phase

In the fabrication phase, there are few main processes involved, which are CNC process, milling and lathe machining, welding, and grinding process. Most of the materials are quite hard to be found especially the presser and filler.

All the materials need to be calculated and design properly to avoid the waste of the materials. In the machining process, the tools selection also needs to be done carefully because it can damage the work piece and the nib of the instrument. The conveyor system modification process was taking a long time to finish, which is a critical design of the machine. There are two parts of conveyor curve conveyor and chain conveyor.



Figure 8: Conveyor System Modification Process

4.3 Installation Phase

The installation phase involved the electrical wiring part and the mechanical part after the fabrication process. The installation of a motor linked to the chain to move the tray forward. Controller used to set the speed of the conveyor and to detect the tray for compress and filling process. PLC systems are used to control the process.

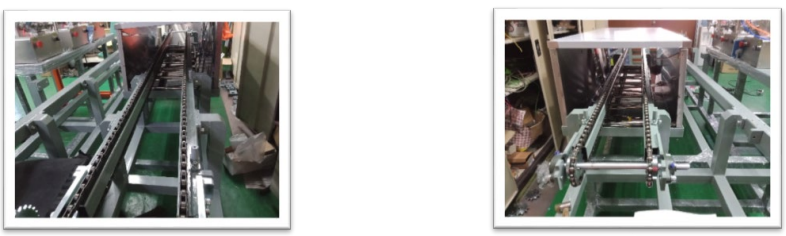


Figure 9: ARM-LC Frame and Oven Installation Process



Figure 10: Hopper Installation Process



Figure 11: Wiring and Electrical Parts Installation Process

4.4 Testing Phase

After the installation completed, there goes the testing phase. This phase, the operation of the machine has been tested in terms of the mechanical, electrical and PLC programme;

i. The chain and curve conveyor speed.
ii. The filling mechanism and sequence.
iii. The oven temperature.
iv. The presser mechanism.
v. All the machine sensor.

PLC programme is designed to ensure the process of making the layered cake is similar to the manual method.

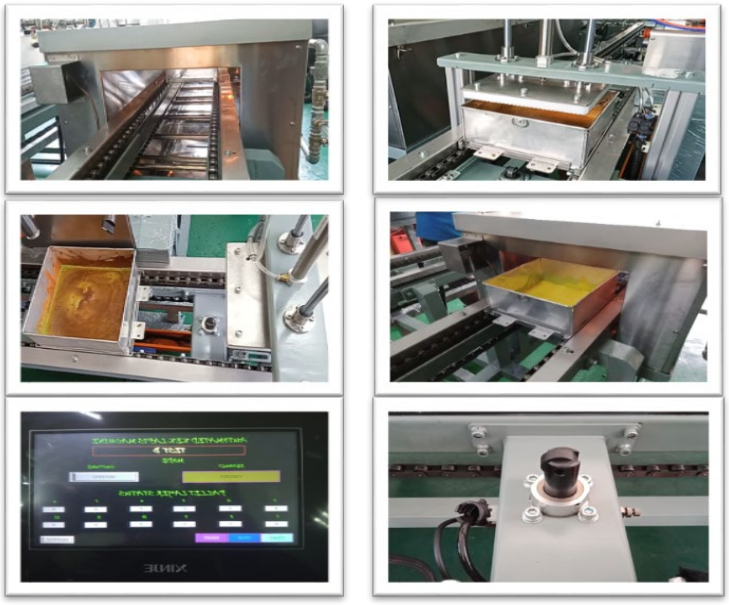


Figure 12: Test-Run Process

5. DATA ANALYSIS AND RESULTS

After the project finish, several things will give a higher impact to the company of layered cake, instead of the cost, workforce, sales, market, time and productivity. The results and benefit for the company are:

i. The quantity of production increases up to 6 times per day compared to manual method. The company can produce in large quantities within a short period, less labour cost and oven
ii. Workers job scope can be reduced from dough filling to baking process into one process. Hence, the salary cost can be reduced
iii. Workers tiredness and exhaustive due to the long period of standing works can be reduced due to the combination in one process as monitoring the machine works.

Table 2: Result of Test-Run Baking Process on ARM-LC

No.	Layer Colour	Complete Baking Time Per Layer (second)	Complete Baking Time Per Layer (minute)
1	Yellow	240s	4.00
2	Red	245s	4.08
3	Blue	235s	3.92
	Average	240s	4.00

Table 3: Data and result analysis for comparison productivity before and after implementation

No.	Productivity	Before (Manual)	After (Using ARM-LC)
1	Baking process	Manually	Continuous
2	Total number of workers for three shifts.	3	3
3	Total productivity / hour	2 cakes	12 cakes
4	Total time to produce / day	24 hours	24 hours
5	Total productivity / day	48 cakes	288 cakes
6	Worker productivity for three shifts.	16 cakes per worker	96 cakes per worker

Referring to the table 3 above, can be concluded the worker's productivity increased up to 6 times or 600%, which is from 16 cakes per worker to 96 cakes per worker, while total productivity per day increase from 48 cakes to 288 cakes. This show that ARM-LC has been able to increase productivity.

Table 4: Saving rate on the cost of wages after applying ARM-LC machine.

Workers' Wages	After the implementation of ARMLC	Cost of machine
RM1200 (minimum per worker) x 20 workers = RM24,000 monthly and RM288,000 per year.	The company only hire 3 workers to supervise the machine every 3 shift. 1 worker for 1 shift.	RM70,000 can be covered after the 4-month operation. After 4 months, the company manage to reduce wages cost around RM20,400 for every month.

6. CONCLUSION

The growing demand for the product on the market layered cake led by many companies to seek an alternative way to increase their sales by increasing production. Production and cost saving is the main priority for the company. The layered cake will also be able to compete against the foreign product in the market.

The project of ARM-LC is to make the baking process for layered cake become automation and reduce the production cost of the company. Present to produce layered cake requires one worker mainly in dough filling, layering, compress and baking process. The time allocated for each process is longer compared to the automatic machine. ARM-LC using Chain Conveyor System (CCS) can speed up the process to produce the cake. The concept of CCS is to make the layer cake process easier and faster. ARM-LC will increase the production rate of produce layered cake which also will increase the production turn around. The size and thickness of the layer cake will become standard and will decrease the waste of dough.

ARM-LC is an automatic layered cake machine that had full capability to perform all similar processes in a single machine and can produce 288 trays per machine in a day. ARM-LC increased up to 6 times the production rate. By comparison, the machine is expected to improve the factory production rate by 600% at reasonable cost of MYR 70,000. It is hoped that the machine can be commercialized and applied to the layered cake industry.

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KESELAMATAN DAN KESIHATAN PEKERJAAN PERSEKITARAN KERJA DI POLITEKNIK MALAYSIA

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Abstrak. Keselamatan dan kesihatan adalah isu global yang sering kali diperkatakan di pelbagai ruang. Merujuk kepada sektor pendidikan tinggi fokus kepada tenaga kerja Politeknik Malaysia, kajian ini bertujuan untuk menerokai tahap kesediaan setiap individu untuk memainkan peranan masing-masing dalam mengenalpasti bahaya serta mewujudkan keselesaan di tempat kerja. Keprihatinan mereka terhadap ruang kerja, faktor persekitaran, pengetahuan sedia ada dan rasa tanggungjawab akan menjurus kepada keselamatan dan kesihatan yang diperlukan. Kajian ini dijalankan dalam bentuk kuantitatif dan borang soal selidik digunakan bagi mendapatkan data-data yang diperlukan. Persampelan yang digunakan merujuk kepada warga kerja Politeknik Malaysia yang terdiri daripada pelbagai latar belakang pendidikan dan kepakaran yang berbeza. Hasil kajian menunjukkan bahawa ramai yang ambil peduli mengenai keperluan keselamatan dan kesihatan pekerjaan di tempat kerja. Namun begitu, beberapa inisiatif boleh diterapkan bagi memastikan kepentingan keselamatan dan kesihatan warga kerja Politeknik Malaysia berada pada tahap yang terbaik.

Kata Kunci: Keselamatan dan Kesihatan Pekerjaan

1. PENDAHULUAN

Bermula dari awal era 1900, keselamatan dan kesihatan pekerjaan telah menjadi agenda utama dalam menentukan hasil kerja samada dari sektor perkhidmatan, perindustrian, pertanian dan lain-lain lagi. Pelbagai akta telah diperkenalkan dan di Malaysia beberapa akta telah digunapakai seperti Akta Dandang, Keselamatan Mesin, Jabatan Alam Sekitar, Kilang dan Jentera dan sebagainya. Terkini pelbagai sektor pekerjaan telah menggunakan Akta Keselamatan dan Kesihatan Pekerjaan yang bermula pada tahun 1994. Ia adalah bertujuan untuk menjaga keselamatan dan kesihatan pekerjaan serta turut meliputi keselamatan mesin, jentera, alam sekitar, bangunan, aset dan lain-lain perkara berkaitan (Niosh, 2005). Justeru itu, kajian ini dijalankan dengan merujuk kepada dua objektif iaitu :

i. Mengenalpasti kesediaan pekerja mengenai bahaya di tempat kerja.
ii. Melihat keprihatinan kakitangan terhadap keselamatan dan kesihatan pekerjaan.=

1.2 Skop kajian

Keselamatan dan kesihatan pekerjaan merangkumi pelbagai aspek meliputi pecahan seperi kerjaya, tahap pengetahuan, rasa tanggungjawab dan sebagainya. Merujuk kepada kajian yang dijalankan, ia lebih bertumpu kepada para pegawai atau staf Politeknik Malaysia. Kajian menjurus kepada aspek-aspek keselamatan dan kesihatan pekerjaan berkenaan dengan ruang kerja dan persekitaran sedia ada di kampus pendidikan Politeknik Malaysia berdasarkan kepada dapatan atau semakan data yang diperolehi dari kalangan warga kerja khasnya.

Namun yang demikian, hasil dapatan kajian ini tidak hanya fokus kepada para staf atau pegawai semata-mata. Ia ini akan turut berupaya memastikan para pelajar sedia ada di kampus yang dianggarkan sekitar 100000 orang dengan bilangan yang bergraduan mencapai hampir 20000 orang pelajar setahun berada dalam keadaan yang selamat dari segala keadaan yang boleh mengancam keselamatan dan kesihatan mereka.

2. KAJIAN LITERATUR

2.1 Faktor Persekitaran

Faktor persekitaran adalah salah satu penyebab utama berlakunya kemalangan. Menurut Mustazar Mansur dan Ho Shu Peng (2009), teori Heinrich menyatakan berkenaan keadaan persekitaran yang tidak selamat berupaya mengakibatkan kemalangan berlaku di tempat kerja. Justeru itu, pihak majikan dan penyelia perlulah memastikan keadaan tempat kerja benar-benar selamat dari segala perkara yang boleh menjejaskan keselamatan dan kesihatan pekerjaan para pekerja.

2.2 Budaya Kerja

Budaya kerja atau amalan kerja yang tidak selamat turut memainkan faktor utama dalam melaksanakan sesuatu tugasan atau kerja. Tindakan tidak mengikut amalan kerja selamat atau bekerja dalam keadaan yang tidak serius atau fokus boleh mengakibatkan kecelakaan. Menurut Siti Nakiah Mohd Shaain, Noor Raudhiah Abu Bakar & Azharuddin Hashim (2015) amalan kerja sambil lewa, kelakuan kerja tidak selamat atau tidak peka mengakibatkan 85%-98% kecederaan atau kemalangan boleh terjadi di bengkel atau kawasan kerja. Oleh itu, tahap kesedaran pekerja tentang amalan kerja selamat perlu ditingkatkan untuk kepentingan semua pihak.

2.3 Latihan dan Peranan Pihak Pengurusan

Menurut Mustazar Mansur dan Ho Shu Peng (2009), konsep amalan latihan yang berkala di tempat kerja perlulah diterapkan bagi memastikan para pekerja sentiasa melakukan kerja dengan teratur dan mengikut prosedur yang telah ditetapkan. Ini adalah kerana peranan pihak pengurusan dalam memastikan langkah-langkah pencegahan kemalangan dapat dipertingkatkan. Selain daripada itu, pihak pengurusan juga berkeupayaan untuk mempengaruhi para pekerja melalui pendekatan latihan, kawalan secara pentadbiran seperti seliaan yang berkala dan sebagainya. Oleh itu, peranan pengurusan dan majikan boleh mengelakkan kejadian yang tidak diingini berlaku di tempat kerja.

2.4 Kompetensi

Tahap Pendidikan para pekerja boleh dianggapkan sebagai kebenaran mereka menceburi sesuatu bidang atau pekerjaan yang khusus. Jika para pekerja tidak mempunyai ilmu pengetahuan dalam melaksanakan sesuatu tugas, ia berkemungkinan besar akan mengakibatkan atau memudahkan kemalangan berlaku.

Menurut Hamirul Adli Hashim (2013) beberapa perkara boleh dijadikan rujukan seperti hadir latihan, kemahiran sedia ada, pengalaman bekerja dan tahap umur boleh menjadi penentu aras kepada prestasi dan tahap keselamatan bekerja. Oleh yang demikian, para pekerja yang menjalankan kerja-kerja spesifik atau memerlukan kepakaran tertentu, mereka seharusnya berkeupayaan terlebih dahulu dari segi kemampuan merujuk kepada kompetensi diri bagi mengelakkan kejadian atau kemalangan yang tidak diingini daripada berlaku.

3. METODOLOGI KAJIAN

Merujuk kepada kajian yang dijalankan, penyelidik menyerta dan menekankan kepada beberapa perkara yang meliputi persampelan, analisis data, instrumen kajian serta reka bentuk kajian. Ia turut dikenali sebagai tatacara kajian ini dijalankan. (Mohamad Najib, 1999). Kajian ini dilaksanakan secara keseluruhannya melalui kaedah edaran borang soal

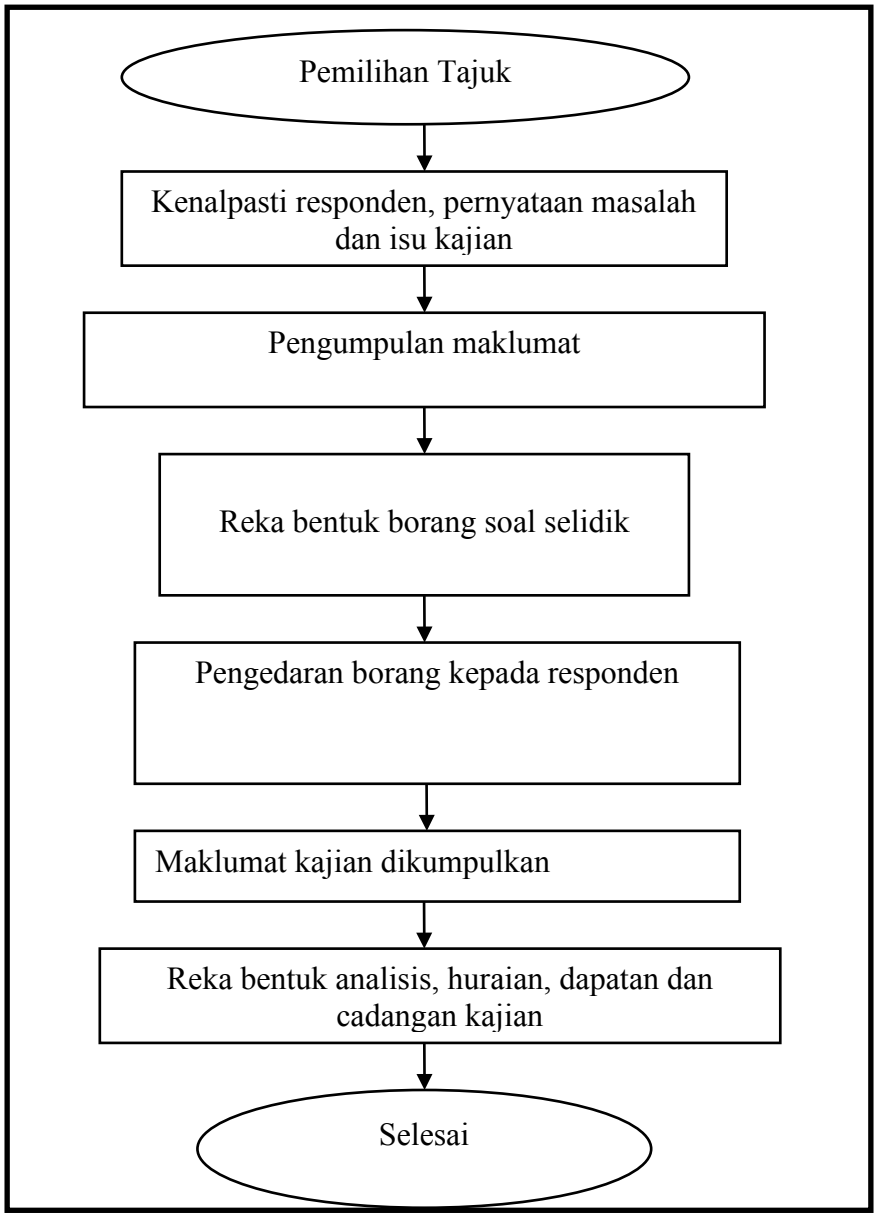
selidik dan diakhiri dengan pemprosesan data melalui kaedah peratuasn berdasarkan terimaan data sedia ada.

3.1 Reka Bentuk Kajian

Reka bentuk kajian yang dilaksanakan oleh penyelidik adalah berdasar teknik tinjauan. Ia secara keseluruhannya berupaya mendapatkan data-data yang diperlukan bagi memenuhi kriteria analisis dan objektif yang telah ditetapkan oleh penyelidik. Berdasarkan Sabitha Marican (2005), kaedah ini sesuai diaplikasikan bagi memperolehi maklumat menerusi populasi yang menggambarkan elemen penilaian yang lebih kecil.

Kaedah taburan borang soal selidik menjurus kepada dapatan kajian bercorakkan kuantitatif. Ia berupaya membantu penyelidik mengupas segala data yang diperolehi serta dalam masa yang sama mencapai matlamat untuk mewujudkan keselesaan dan keprihatian terhadap ruang kerja, faktor persekitaran, dan pengetahuan sedia ada berkenaan keselamatan dan kesihatan pekerjaan di sistem Pendidikan Politeknik Malaysia.

3.2 Tatacara Kerja



Rajah 1: Tatacara Kerja

Rajah 1 menunjukkan tatacara panduan kerja yang dibuat bagi mencapai objektif kajian. Penyelidik memulakan dengan aktiviti pemilihan tajuk, pemilihan responden, pernyataan masalah dan diselesaikan melalui analisis, huraian, dapatan dan cadangan kajian.

3.3 Persampelan Bertujuan

Kajian ini dijalankan dengan merujuk kepada kaedah persampelan bertujuan. Merujuk kepada Sabitha Marican (2005) ia tidak menunjukkan pendapatan penyelidik semata-mata. Justeru itu, ia adalah menjurus kepada data sebenar melalui teknik persampelan yang dijalankan.

Penyelidik juga telah menetapkan individu yang akan dirujuk sebagai sampel kajian. Ia telah dipertimbangkan terlebih dahulu oleh penyelidik sebelum kajian dijalankan (Mohd Majid, 2004). Umumnya, pemilihan individu yang terlibat akan melambangkan kualiti kajian yang dijalankan berdasarkan kesesuaian, situasi dan keperluan (Sabitha marican, 2005). Ia dilestarikan dengan kajian berkaitan keadaan tempat kerja. Oleh yang demikian, pemilihan responden dibuat dengan melibatkan para pegawai atau staf Politeknik Malaysia sendiri. Penyelidik percaya, ia akan membawa kepada dapatan data yang lebih tepat dan memenuhi spesifikasi yang telah ditetapkan.

3.4 Populasi Kajian

Penyelidik menghadapi kesukaran dalam mendapatkan data dari kalangan semua pegawai atau staf Politeknik Malaysia. Justeru itu, penyelidik menggunakan kaedah persampelan bagi mendapatkan data dari populasi yang telah ditetapkan. Ia dikuatkan dengan Mohamad Najib (1999) di mana menyatakan kelompok individu adalah mewakili populasi kajian.

Pengembangan data yang diperolehi oleh penyelidik meliputi warga kerja Politeknik Malaysia yang mempunyai perbezaan data demografik seperti agama, budaya, umur, jantina dan tempat bekerja. Ia merangkumi staf dan pegawai dari 36 buah politeknik yang berbeza dan turut mencakupi jumlah 10000 orang warga kerja. Oleh yang demikian, merujuk kepada jadual penentuan saiz sampel ia melibatkan sekitar 370 responden. Jesteru itu, bagi memenuhi keperluan data dari segi populasi, penyelidik menentukan saiz sampel melalui Jadual 2 Krejecie dan Morgan dalam Johnson (2000).

3.5 Instrumen Kajian

Maklumat-maklumat kajian yang dilaksanakan oleh penyelidik untuk mendapatkan data adalah melalui borang soal selidik yang diedarkan kepada para responden. Justeru itu, ia secara tidak langsung telah membantu penyelidik mencerap setiap data-data yang diperlukan.

3.6 Pengumpulan Data

Penyelidik melalui Mohd Majid (2004) menyatakan bahawa proses perancangan dan pelaksanaan kajian adalah salah satu daripada elemen pengumpulan data. Oleh yang demikian, kaedah yang digunakan bagi mendapatkan data adalah melalui cerapan borang soal selidik yang terlebih dahulu diedarkan kepada para responden.

3.7 Kaedah Analisis Data

Data deskriptif melalui dapatan kajian telah menjelaskan kaitan responden atau populasi dengan yang dilaksanakan oleh penyelidik. Ia diterjemahkan melalui gambaran carta, purata, peratusan yang diperolehi (Sabitha Marican, 2005). Oleh yang demikian, ia telah memaparkan fenomena populasi yang dinilai berdasarkan ketetapan penyelidik dengan menjurus kepada objektif asal kajian.

4. DAPATAN KAJIAN

Kajian ini meliputi responden yang hadir dari pelbagai latar belakang yang berbeza meliputi 36 buah Politeknik di Malaysia. Ia mewakili 56.8% dari kakitangan lelaki dan 43.2% warga pekerja wanita di mana 89% adalah terdiri daripada warga pendidik manakala 11% adalah terdiri dari staf atau kakitangan sokongan.

Tempoh perkhidmatan responden adalah terdiri daripada mereka yang telah berkhidmat lebih daripada 10 tahun iaitu sebanyak 80.6% manakala mereka yang berkhidmat kurang dari 10 tahun adalah sekitar 19.9%. Selain itu, sebanyak 28.4% pernah menyatakan keterlibatan mereka dalam Jawatankuasa Keselamatan dan Kesihatan Pekerjaan manakala 71.6 pula menyatakan sebaliknya.

Penglibatan staf yang pernah terlibat dalam kursus-kursus berkaitan keselamatan dan kesihatan pekerjaan pula menunjukkan sebanyak 31.5% tidak pernah melibatkan diri berbanding 68.5 menyatakan pernah mengikutinya. Selain itu, sebanyak 94.8% staf menyatakan mengetahui istilah bahaya di tempat kerja manakala 93.6 pula faham tentang keadaan berbahaya di tempat kerja.

80.1% pula menyatakan tahu untuk membuat penilaian tahap bahaya di tempat kerja. 35.6% dari kalangan warga kerja Politeknik Malaysia menunjukkan mereka tidak mengetahui samada kawasan kerja mereka selamat. Selain daripada itu, hampir 33% menyatakan kawasan tempat kerja mereka adalah berisiko. Soalan dari soal selidik nombor 14 menyatakan sebanyak 92.5% kawalan risiko di tempat kerja masing-masing boleh dipertingkatkan dari semasa ke semasa.

Hampir 20% menyatakan kawasan kerja mereka berupaya mewujudkan keselesaan kepada warga kerja manakala kewujudan kemudahan sedia perlu dinaik taraf dari semasa ke semasa. Selain itu, 37.1% menyatakan sebaliknya iaitu kemudahan sedia ada sudah memadai bagi mereka menjalankan tugas.

Selain itu, 65.3% menunjukkan bahawa ramai di kalangan AHLI mengikuti kursus, program dan penyusunan kerja berdasarkan pertimbangan JK Pemudah. Secara teknikalnya mereka yang telah berkursus akan mengetahui cara-cara melakukan tindakan awal. Justeru itu, 44.2% menunjukkan mereka tahu untuk melakukan bantuan menyelamat jika sesuatu kejadian yang tidak dingini berlaku. 30.11% menyatakan bahawa mereka tidak setuju bagi setiap pelaporan kemalangn dilaksanakan oleh pegawai yang terlibat dengan Jawatankuasa Keselamatan dan Kesihatan Pekerjaan. 91.9% pula menyatakan bahawa kakitangan sekerja perlu mengikuti kursus ini.

Tahap kesihatan dan kebersihan tempat kerja dan persekitaran berada pada tahap terbaik menunjukkan peratusan sebanyak 53.8%. Akhir sekali, 95.1% daripada responden menunjukkan kepentingan tahap keselamatan dan kesihatan perlu diterapkan sejak dari awal atau zaman persekolahan lagi.

5. KESIMPULAN DAN CADANGAN

Merujuk kepada kajian yang telah dilaksanakan, ia menunjukkan bahawa beberapa penambahbaikan boleh dilakukan oleh Ketua-ketua Jabatan atau pengurusan tertinggi Politeknik Malaysia. Selain daripada itu, kebergantungan kepada Jawatankuasa Keselamatan dan Kesihatan Pekerjaan yang dilantik juga menunjukkan bahawa prosedur amalan kerja tidak dijalankan dengan baik. Ia menjurus kepada proses pelaporan, mengenalpasti bahaya serta keupayaan menilai serta mengurangkan keadaan yang berbahaya. Ia sepatutnya tidak terlalu bergantung harap dengan Jawatankuasa Keselamatan dan Kesihatan Pekerjaan yang dilantik semata-mata.

Merujuk kepada tanggungjawab pekerja serta majikan, kedua-duanya perlu saling bekerjasama bagi memastikan kemalangan tidak berlaku atau setidak-tidaknya berjaya dikurangkan serta dielakkan. Pemantauan, semakan dan pemeriksaan berkala dari pihak majikan serta pekerja perlu seiring dengan objektif keselamatan dan kesihatan pekerjaan di tempat kerja.

Jika tiada pertautan yang erat, ia akan menjejaskan secara keseluruhan perancangan samada dari segala aspek terutamanya berkenaan keselamatan dan kesihatan pekerjaan. Justeru itu, penerapan unsur-unsur keselamatan dan kesihatan pekerjaan perlulah dikekalkan dan ditambah baik dari semasa ke semasa. Ia boleh dilaksanakan dengan penglibatan segenap golongan warga kerja Politeknik Malaysia yang kini seperti memandang ringan dengan kepada keselamatan dan kesihatan pekerjaan.

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EFFECTS OF LANDSCAPE ENVIRONMENTAL SETTINGS ON MICROCLIMATE IN ENHANCING PEDESTRIAN WALKING DISTANCE IN TROPICAL CAMPUS ENVIRONMENT

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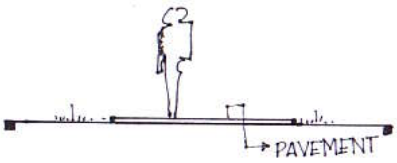
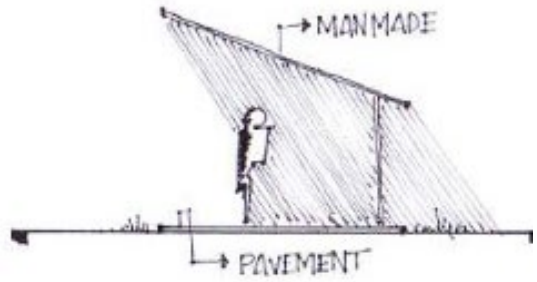
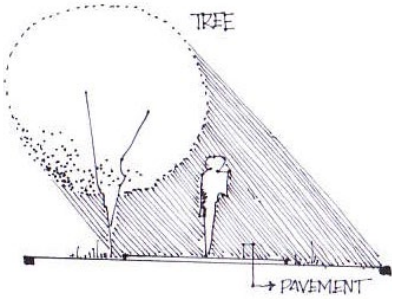
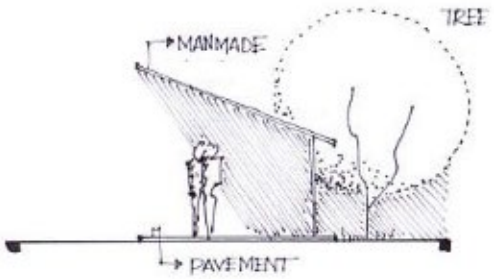
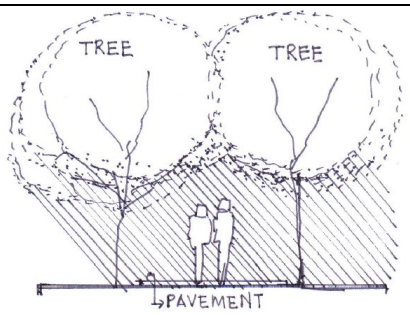
Abstract. Pedestrian walking distance is one essential factor in enhancing walkability in cities and campuses in countries with a hot and humid climate. This study evaluates the relationship between pedestrians' thermal comfort and comfortable walking distance in various landscape settings. If pedestrians are comfort, then we can promote walking to city dwellers and the campus community. Data collection involved a field survey with 57 participants enrolled in this study. It was conducted in a university campus in Malaysia under five different types of LESP (Landscape Environmental Settings for Pedestrian) sites: No shade (Type 1), Metal deck (Type 2), One row of trees (Type 3), Combined deck and trees (Type 4), and Two rows of trees (Type 5). Results evidence that the impact of LESP on comfortable walking distance in a tropical environment is related to pedestrians' thermal comfort. The more LESP influences pedestrians' thermal comfort, the longer will be the comfortable walking distance. LESP Type 5 can provide a 1.0 km comfortable walking distance. The findings provide new knowledge for landscape architects and urban planners in specifying appropriate microclimatic interventions to improve pedestrian comfort in tropical environments.

Keywords: Landscape settings; walkability; pedestrians' thermal comfort; tropical environment; urban design.

1. INTRODUCTION

Hot and humid always be a reason why walking is not popular among the campus community in tropical countries (Rodríguez et al., 2016). Promoting walking to the city dweller and campus community is one way to reduce the demand for fuel transportation. It also can reduce the problem of traffic-jammed in the city centre. Majority of Asian cities are facing the problem of traffic-jammed (Cubukcu, 2013). (Cubukcu, 2013) also highlighted that the idea of promoting walking among the city dweller would increase the business demand in the area. Walking is much related to health and build an environment of the area. Kasim, Shahidan, & Yusof (2018) introduced five types of landscape environmental settings for pedestrian (LESP). The result of their studies revealed that different types of LESP have potential in providing a better campus environment and lifestyles. Based on the Kasim et al., (2018), field measurements of five microclimatic parameters were collected under five different types of LESP sites: No shade (T_1), Metal deck (T_2), One row of trees (T_3), Combined deck and trees (T_4), and Two rows of trees (T_5) in a university campus in Malaysia (Kasim, Shahidan, Ujang, & Dahlan, 2019). Kasim et al.,(2019) found that with the suitable microclimate of pedestrian can increased the thermal comfort and will encourage walkability. However, the study by Kasim et al.,(2019) was measured only on the physical environment of the 5 LESP types. There is a need to validate with perceptions of the pedestrian who are using the walking path. Table 1.0 shows the five types of LESP.

Table 1.0: Five Types of LESP

Types of LESP	Illustrations	Descriptions
Type 1 No shade 		Pavement is the only landscape element in walkway environment.
Type 2 Metal deck 		There are two landscape elements in the walkway environment, which are pavement and man-made shading.
Type 3 One row of trees 		There are two landscape elements in the walkway environment which are pavement and tree shading.
Type 4 Combined deck and trees 		There are three landscape elements in the walkway environment which are pavement, man-made shading and tree shading.
Type 5 Two rows of trees 		There are three landscape elements in the walkway environment which are pavement and two rows of tree shades.

Source: (Kasim et al., 2018)

2. LITERATURE REVIEW

Human thermal comfort is determined by the overall thermal comfort and the assessment of environmental quality when they are in a building, outside of a building, or when they are in a semi-structured environment such as car porch, terrace or a gazebo. It does not depend solely on physical parameters because the human body's physiological and psychological also respond to the environment (Potchter, Cohen, Lin, & Matzarakis, 2018). So, it is highly subjective and therefore, difficult to measure. Human thermal comfort depends on the air temperature, humidity, radiant temperature, air velocity, metabolic rates, and clothing levels and individual experiences these sensations a bit differently based on his or her physiology stage. The determination of what will make someone feels comfortable needs consideration on a range of environmental and personal parameters, and thus, it is difficult to define human thermal comfort (Kazkaz & Pavelek, 2013). Therefore, this study observed various landscape settings and their microclimate parameters that influence pedestrians' thermal comfort.

Distance is a crucial factor in people's decision making whether to walk to any destinations. For instance, the distance to the nearest facility turned out to be an important impact factor influencing the frequency of shopping trips on foot (Scheiner, 2010). (Millward et al. (2013) did research on walking frequency, length of walking and detailed aspects of walking behaviour for a medium-sized North American city. It is revealed that most walks are shorter than 600 m, and very few exceed 1200 m. They also agreed to the assumption employed in the walkability literature that one should restrict the neighbourhood of opportunity' to walking destinations within 1000 m of the home. In another study conducted in China by Sun et al. (2016) found that the mean walking time from a metro station to a residential destination in Beijing was 8 minutes. This was also similar with distance from recreational areas and offices to the metro station.

It is quite clear from the previous discussion that there are studies done on this topic in a tropical environment where the walking distance is believed to have a relationship with the pedestrian microclimate (Naharudin, Ahamad, Farhan, & Sadullah, 2017). Diyanah et al.,(2012) have made a comparison on walking behaviour between urban and rural residents in Malaysia. They found that in a rural area, people will walk up to 600 meters as compared to only 400 meters in the urban area. Therefore, walking distance of 400 meters is used in urban studies in Malaysia (Naharudin et al., 2017). However, according to Azmi & Karim (2012), a 400 meters distance from home to the community facilities is not ideal for Malaysian neighbourhoods. Most of the respondents in the study felt that it was inconvenient to walk that distance. They highlighted that in Malaysia, people preferred walking if the walking distance is less than 200 meters. This leads to the need to measure the comfortable walking distances for a tropical environment.

Studies on the pedestrians' thermal comfort and comfortable walking distance are related to the effects of surrounding environment towards pedestrians such as urban geometry, H/W of the street canyon, and pedestrian level greening (Djekic et al., 2018; Jamei et al., 2016; Lusk, Ferreira, and Dobbert, 2018). Middel et al. (2014) highlighted that the thermal comfort of pedestrians is strongly related to solar radiation and local shading patterns. They investigated the impact of urban form and landscaping types on the mid-afternoon microclimate in semi-arid Phoenix, Arizona, USA. The result was supported by (Hwang et al., 2015; Krüger, Drach, and Broede, 2017; Makaremi et al., 2012; R. Emmanuel, a, 2007) when they examined the micro-scale thermal conditions of outdoor thermal comfort towards a pedestrian in the tropical climate. However, studies looking on how outdoor thermal comfort relates to walkable distance environment is limited.

Solar radiation and terrestrial radiation are two components of radiation received by a pedestrian in a walkway environment (Brown.R.D & Gillespie.T.J, 1995). Two components of radiation then will be split into several sources depending on the landscape environmental

settings of the walkway. There are four sources of radiation namely i) direct solar radiation (S), ii), diffuse solar radiation received directly (D), iii) terrestrial radiation emitted by objects/ground (P), iv) radiation/ transmitted radiation reflected by pavement (R). Figure 1 shows the microclimate interaction of human outdoor thermal comfort in a typical outdoor pedestrian environment with no shade. Pedestrians received four sources of radiation directly: direct solar radiation (S), diffuse solar radiation received directly (D), terrestrial radiation emitted by objects/ground (P), and radiation reflected by pavement (R).

In an outdoor setting, the microclimate environment will determine user's thermal comfort and its level can be estimated by considering all flows of energy towards and from a person's body (Brown and Gillespie, 1995). For example, if a user walks along an in a walkway with no shade (Figure 1), then his/her thermal comfort level is equal to the energy supplied minus the energy consumed. The energy supplied is from his metabolic rate and radiation observed (S+D+P+R / from the sun and surrounding objects), and the energy consumed is through evaporation and convection.

Therefore, measuring pedestrian thermal comfort is important to understand how outdoor thermal comfort relates to walkable distance environment and also the surrounding environment. Thus, this study will also measure the comfortable walking distance based on pedestrian landscape environment settings in five types of LESP of the tropical campus environment.

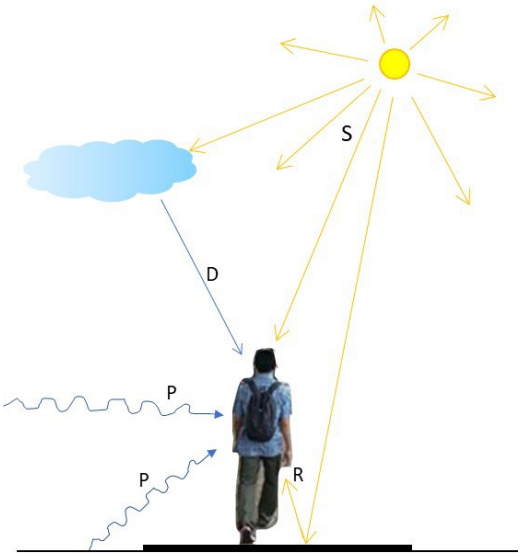


Figure 1: Microclimatic interaction between human outdoor thermal comfort in tropical climate

3. RESEARCH METHODOLOGI

Data collection involved a field survey with 57 participants enrolled in this study. The field survey was conducted in order to assess pedestrians' perceptions of their thermal comfort and walking distance in five types of LESP in the tropical campus. The survey was also to evaluate the relationship between pedestrians' thermal comfort and comfortable walking distance in five types of LESP in the tropical campus. The field survey was conducted in a university campus in Selangor at the five types of LESP site: No shade (T1), Metal deck (T2), One row of trees (T3), Combined deck and trees (T4), and Two rows of trees (T5).

3.1 Field Survey

The questionnaire consisted of two parts: Section A for personal details and observation and section B: Rating on the perception and preference of thermal comfort and comfortable

walking distance. Section A: Personal Details and Observation (6 questions) included sex, gender, age group, whether they stay on campus, name of residence college if stay on campus, clothing, food and drink consumption. They were categorised into ten age groups: 15 to 19 years old; 20 to 24 years old; 25 to 29 years old; 30 to 34 years old; 35 to 39 years old; 40 to 45 years old; 46 to 49 years old; 50 to 54 years old; 55 to 59 years old; and 60 > years old. The age group from 15 to 60 was chosen using rationale based on the general age of students in Malaysian universities. All seventeen names of residential colleges in the campus were provided for in the questionnaire.

Section B: There were four questions in this Section. The questions consisted of thermal rate rating (1 questions), thermal comfort rating (1 questions), walking comfort rating (1 questions) and to keep walking or not (1 questions). Participants' thermal rate perception was given according to the 7-points Fanger's scale ranging from 'cold' (1) to 'hot' (7) (Fanger, 1970). Participants' thermal comfort rate perception and comfortable to walk perception were given according to ASHRAE 7-points scale ranging from 'very uncomfortable' (1) to 'very comfortable' (7) (Shahidan, 2011). Table 2 shows the description of questions in Section B.

Table 2: Description of questions in Section B

Code	Question	Scale type
B1	Rate how warm or cold you feel	Thermal rate ('cold' to 'hot')
B2	What is your thermal comfort now?	Thermal comfort ('very uncomfortable' to 'very comfortable')
B3	Do you still feel comfortable to walk?	Comfort of walking ('very uncomfortable' to 'very comfortable')
B4	Do you still want to keep walking?	'yes' or 'no'

Section B of the field survey elicited the Thermal Rate (Tr), Thermal Comfort (Tc), Walking Comfort (Wc), and Walking Distance (Wd) of the 5 LESPs. Tr was categorised into 7 categories. These are i) Cold (1 to 1.5), ii) Cool (1.5 to 2.5), iii) Slightly Cool (2.5 to 3.5), iv) Neutral (3.5 to 4.5), v) Slightly Warm (4.5 to 5.5), vi) Warm (5.5 to 6.5), and vii) Hot (6.5 to 7).

3.2 Subjective Measurement Procedures

Field survey was carried out from 24th of April to 3rd of May 2018 on the hottest part of the day (12:00 to 15:00). The data was collected only in one LESP type per day. Fifty-seven (57) participants were recruited from university students. They were given and returned the written consents. Participants were advised to be at the starting point within the prescribed time between 12:00 to 15:00. They had to complete items in Section A before they started the walking procedure (Figure 2, left). They walked to the first checkpoint to answer items in Section B and repeated answering the same items in Section B at the next checkpoint (Figure 2, right). The survey ended once the participants decided to quit walking at any checkpoint along the walkway. Items in Section B were repeated for all 21 checkpoints. The last checkpoint was Check Point 21 (equal to 1050m) as 1000m was the maximum of comfortable walking distance (Millward et al., 2013; Scheiner, 2010a).



Figure 2: (Left) Participants Were Given Questionnaire and Answer Section A Before Start Walking. (Right): Participants Walked to First Check Point to Answer Items in Section B at the Next Check Point.

4. ANALYSIS AND RESULTS

The data were analysed quantitatively to find the difference and evaluate the relationship between pedestrians' thermal comfort and comfortable walking distance. Data from field survey (questionnaire) were generated using SPSS Version 24 and presented in the form of tables and figures using Microsoft Word and Excel. The results presented descriptively (frequency, percentages, mean values) with the use of graphs and tables. Data from participants' thermal comfort and their walking distance proved the relationship between pedestrian thermal comfort and comfortable distance.

Table 2: Result for participants' perception in LESP Type 1

Perception	N	Mean	Std. Deviation	Minimum	Maximum	Range
Tr	57	6.2	0.6266	5.00	7.00	2.00
Tc	57	2.5	1.1958	1.0	6.0	5.0
Wc	57	2.5	1.1995	1.0	6.0	5.0
Wd	57	338.6	141.1	150	850	700

Table 2 summarises the results in terms of Tr, Tc, Wc, and Wd from 12:00 to 15:00 in LESP Type 1. The results show that LESP Type 1 offers "warm" for Tr with mean of 6.2. Tr ranges from 5.0 to 7.0, which mean LESP Type 1 is in "warm" to "hot" Tr. This is due to participants being 100% exposed to the sun in this LESP Type 1.

Table 3: Results for participants' perception in LESP Type 2

Perception	N	Mean	Std. Deviation	Minimum	Maximum	Range
Tr	57	4.6	0.7320	2.71	6.06	3.35
Tc	57	3.8	0.8225	2.17	5.86	3.69
Wc	57	3.9	0.7974	2.44	5.46	3.41
Wd	57	658.8	241.8	250	1050	800

Table 3 summarises the results in terms of Tr, Tc, Wc, and Wd from 12:00 to 15:00 in LESP Type 2. The results show that LESP Type 2 offers "slightly warm" for Tr with a mean of 4.6. Tr ranges from

2.71 to 6.06, which mean LESP Type 2 ranges from "slightly cool" to "warm" Tr. This could be due to participants receiving some man-made shading from solar radiation. The results of Tc show that the LESP Type 2 offers "neutral" with a mean of 3.8. Tc ranges from 2.17 to 5.86 show a wide range from "uncomfortable" to "comfortable". Wc ranges from 2.44 to 5.46 ("uncomfortable" to "slightly comfortable") and a mean of 3.9 ("neutral"). Participants felt neutral in regards to Tc and also neutral to walk in LESP Type 2 condition. Mean for Wd is 658.8m. Wd has a range of 800m with 250m for a minimum to 1050m maximum.

Table 4: Results for Participants' Perception in LESP Type 3

Perception	N	Mean	Std. Deviation	Minimum	Maximum	Range
Tr	57	4.1	0.7134	2.29	5.50	3.21
Tc	57	4.2	0.8191	2.70	6.00	3.30
Wc	57	4.3	0.8741	2.43	6.12	3.69
Wd	57	630.7	272.5	100	1050	950

Table 4 summarises the results in terms of Tr, Tc, Wc, and Wd from 12:00 to 15:00 in LESP Type 3. The results show that LESP Type 3 offers "neutral" in Tr with mean of 4.1. Tr ranges from 2.29 to 5.5, which mean LESP Type 3 ranges from "cool" to "slightly warm" Tr. This is because participants were shaded by trees in this LESP Type. Tc for LESP Type 3 is "neutral" with a rating of mean of 4.2. Tr ranges from 2.70 to 6.0, which is a wide range from "slightly uncomfortable" to "comfortable". Wc ranges from 2.43 to 6.12, which is from "uncomfortable" to "comfortable" with a mean of 4.3 ("neutral"). Participants felt neutral in regards to Tc and also neutral to walk in this LESP Type 3. The mean of Wd is 630.7m. The distance has a range of 950m with 100m of minimum to a maximum of 1050m.

Table 5: Results for Participants' Perception in LESP Type 4

Perception	N	Mean	Std. Deviation	Minimum	Maximum	Range
Tr	57	4.3	0.8883	2.00	6.00	4.0
Tc	57	4.4	0.8883	2.00	6.00	4.0
Wc	57	4.4	0.9092	2.15	6.00	3.85
Wd	57	798.2	247.1	300	1050	750

Table 5 summarises the results in terms of Tr, Tc, Wc, and Wd from 12:00 to 15:00 in LESP Type 4. The results show that LESP Type 4 offers "neutral" in Tr with a mean of 4.3. Tr ranges from 2.00 to 6.00, which mean LESP Type 4 ranges from "cool" to "warm". This is due to the two kinds of shading: trees and man-made shading. The results of Tc show that LESP Type 4 is "neutral" with a mean of 4.4. Tc ranges from 2.0 to 6.0, which is a wide range from "uncomfortable" to "comfortable". Meanwhile, Wc ranges from 2.15 to 6.0 ("uncomfortable" to "comfortable") and a mean of 4.4 ("neutral"). Participants felt neutral in regards to Tc and also neutral to walk in this LESP Type. The mean of Wd is 798.2m. The distance has a range of 750m with a minimum of 300m and a maximum of 1050m.

Table 6: Results for Participants' Perception in LESP Type 5

Perception	N	Mean	Std. Deviation	Minimum	Maximum	Range
Tr	57	3.3	1.00906	1.55	5.86	4.31
Tc	57	5.1	1.02606	3.10	6.67	3.57
Wc	57	5.2	1.01694	3.14	7.00	3.86
Wd	57	996.5	119.47	400	1050	650

Table 6 summarises the results in terms of Tr, Tc, Wc, and Wd from 12:00 to 15:00 for LESP Type 5. The results show that LESP Type 5 offers "slightly cool" in Tr with mean of 3.3. Tr ranges from 1.55 to 5.86, which mean LESP Type 5 is in "cool" to "warm" designation. The results of Tc show that the LESP Type 5 offers "slightly comfortable" with mean of 5.1. Tc ranges from 3.10 to 6.67, which is from "slightly uncomfortable" to "very comfortable". The trend of Tc supports the results of Wc with a similar range from 3.14 to 7.0 ("slightly uncomfortable" to "very comfortable") and the mean of 5.2 ("slightly comfortable"). This means that participants felt comfortable with regards to Tc and also very comfortable to walk in this LESP Type. The mean of Wd recorded in LESP Type 5 is 996.5m. The distance has a range of 650m with a minimum of 400m and a maximum of 1050m.

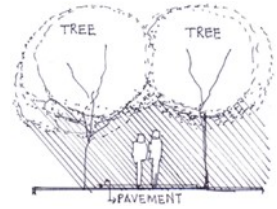
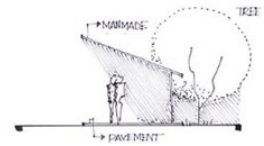
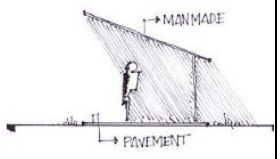
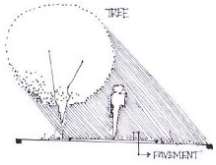
4.2 Pedestrians' Thermal Comfort

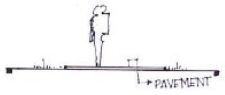
Table 7 shows the summary of field surveys all types of LESP in this study. The influence of 5 types of LESP on pedestrians' thermal comfort and comfortable walking distance can be clearly seen from these results. The LESP ranking in terms of pedestrian thermal comfort (Tc) and comfortable walking distance (Wd) in ascending order is i) LESP Type 5, ii) LESP Type 4, iii) LESP Type 2, iv) LESP Type 3, and v) LESP Type 1. The findings indicate that LESP 2 provides more comfort to pedestrians as compared to LESP Type 3 due to the discontinuous tree shading in LESP Type 3.

Participants experienced "warm" situations and "uncomfortable" thermal condition in LESP Type 1, and this is supported by the microclimate parameters indicating "hot" condition due to solar radiation exposure and heat from the surfaces. In LESP Type 2, participants felt "slightly warm" both for thermal rate and thermal comfort, and the microclimate parameters measured also indicated agreeable readings. However, in walkway environment having tree shades (LESP Type 3, 4 and 5) participants' felt better than the microclimate parameter readings. This is seen in LESP Type 3, when participants perceived as "neutral" the thermal rate and thermal comfort. However, the microclimatic measurement indicated readings "warm". Then, in LESP Type 4 and LESP Type 5, the measurement results are "slightly warm" in their readings. However, participants perceived them as "neutral" and "slightly cool" in LESP Type 4 and LESP Type 5, respectively.

In general, results of the field measurement and field survey suggest that different types of LESP have a different impact on pedestrians' thermal comfort. This finding is supported by (Bakar & Gadi, 2016), in a study on thermal comfort on a university campus in Kuala Lumpur. Their study also suggests that different sites produced different microclimates and highlighted that solar radiation plays an important role in influencing pedestrian thermal comfort. The results clearly indicate that the thermal environment for walkway without shading (LESP Type 1) is hotter than one row of trees walkway (LESP Type 3) and the one row of trees walkway is hotter than the covered walkway (LESP Type 2/ Type 4) and two rows of trees walkway (Type 5). In addition, good quality shading by trees can provide thermal ameliorating effects (LESP Type 5).

Table 7: Summary Results of Field Survey in 5 Types of LESP

Types of LESP	Perception & Walking Distance	Content of LESP
LESP Type 5  	Tr: Slightly cool Tc: Slightly comfortable Wc: Slightly comfortable Wd: 996.5m Round to thirty: 1000m <u>Field measurement:</u> PET: Slighty warm (32.7°C) (Kasim et al., 2019)	Pavement and two rows of trees are the landscape elements in the walkway environment. Results from field measurement and field survey are in agreement with the prediction that pedestrians felt most comfortable and comfortably walk longest in this type of LESP environment. Trees with dense and wide canopies acting as a shading device moderate the heat transfer from direct solar radiation to the ground.
LESP Type 4  	Tr: Neutral Tc: Neutral Wc: Neutral Wd: 798.2m Round to thirty: 800m <u>Field measurement:</u> PET: Warm (34.0°C) (Kasim et al., 2019)	Pavement, trees, and man-made shade are the landscape elements in the walkway environment. Results of field survey show that participants' felt better for Tr, Tc and Wc where they rated neutral on all three factors. Both results are not similar to an earlier prediction that pedestrian will feel comfortable in this type of environment. Thus, results proved that trees and man-made shading (covered walkway) provide a comfortable walkway environment.
LESP Type 2  	Tr: Slightly warm Tc: Neutral Wc: Neutral Wd: 658.8m Round to thirty: 650m <u>Field measurement:</u> PET-Slighty warm (33.3°C) (Kasim et al., 2019)	Pavement and man-made shade are the landscape elements in the walkway environment. Results indicate that man-made shading (covered walkway) does provide a comfortable walkway environment.
LESP Type 3  	Tr: Neutral Tc: Neutral Wc: Neutral Wd: 630.7m Round to thirty: 630m <u>Field measurement:</u>	Pavement and trees are the landscape elements in the walkway environment. Results of field survey show that participants' felt neutral for Tr, neutral for Tc, and neutral for Wc. The results suggest that trees are a significant, influential factor to the perception of pedestrian thermal

	PET:Warm (35.3°C) (Kasim et al., 2019)	comfort. Results suggest that tree shading provides a comfortable walkway environment.
LESP Type 1  	Tr: Warm Tc: Uncomfortable Wc: Slightly uncomfortable Wd: 338.5m Round to thirty: 330m <u>Field measurement:</u> PET:Warm (39.4°C) (Kasim et al., 2019)	Pavement is the only landscape element in the walkway environment. The results indicate that LESP Type 1 create a hot environment leading to heat stress and thus, does not promote walking comfort to pedestrians.

4.3 Comfortable Walking Distance (Wd)

Table 8 summarises the results of comfortable walking distance from a field survey in each type of LESP by using mean. The ranking of LESP for Wd (in descending order) is: i) LESP Type 5, ii) LESP Type 4, iii) LESP Type 2, iv) LESP Type 3, v) LESP Type 1. Results show that the comfortable walking distance for students in the tropical campus is 330 m if they are walking along a walkway without any shade (LESP Type 1). Pedestrians will feel uncomfortable heat stress as there is no shade available. Pedestrians will feel moderate heat stress when they walk along walkways discontinuous trees shadings (LESP Type 3). The comfortable walking distance is 630 m. In the case of man-made shading (LESP Type 2), pedestrian users will feel slight heat stress, but it does not affect much their comfortable walking distance which at 650 m, almost similar to LESP Type 3 walking distance.

Table 8: Comfortable Walking Distance (Wd) in 5 Types of LESP

Types of LESP (Rank)	Walking distance (m)	PET (°C)(Kasim et al., 2019)
LESP Type 5	1000	Slightly heat stress (32.7)
LESP Type 4	800	Slightly heat stress (34.0)
LESP Type 2	650	Slightly heat stress (33.3)
LESP Type 3	630	Moderate heat stress (35.3)
LESP Type 1	330	Strong heat stress (39.4)

In a situation where there is both man-made and tree shading presence (LESP Type 4), pedestrians will feel slight heat stress (similar in LESP Type 2) along the walkway, but their ability to walk comfortably was much further at 800m. This is due to the effect of natural shading providing cooler and thus more comfortable of walking to the pedestrians than man-made shading alone. Finally, full shades from two rows of trees (LESP Type 5) provide the longest comfortable walking environment (1000m) even though pedestrian users may experience slight heat stress. Based on these findings, this study suggests that 400m is a suitable walking distance in a tropical environment due to walkways that are generally mixed of all five types of LESP and this is supported by Naharudin et al. (2017).

In terms of walking experience and physiological stress level, participants experienced better than the measured physiological stress level. This is in line with the results in all types of LESP. For example, participants felt "slightly uncomfortable" when they walked in LESP Type 1

where the mean walking distance is 338.5m, even though the measurement result showed "strong heat stress" in the physiological stress level. The same is true with LESP Type 3, where participants felt "neutral" with a mean walking distance is 630.7m while physiological stress level is "moderate heat stress.". Furthermore, in LESP Type 2 and LESP Type 4 participants felt "neutral" when the stress level indicated "slightly heat stress." The walking distance mean values of in LESP Type 2 and 4 are 658.8m and 798.2m respectively. In LESP Type 5, the physiological stress level indicates "slightly heat stress" while participants felt "slightly comfortable" at the mean of walking distance of 996.5m.

5. CONCLUSION

In conclusion, it is important to modify the solar radiation in a walkway environment by having continuous shade from trees or man-made shade (covered walkway) together with tree shades along walkways. Man-made shading structures can only provide full shade, but the heat reflected from their surfaces can be quite considerable. Tree, however, provide additional cooling effects as they reduce the radiation and provide additional cooling advantage through evapotranspiration (Lusk et al., 2018). The findings of this study may offer solutions to some issues and problems in enhancing pedestrian thermal comfort. Besides, they may provide some contributions to the literature in the field of Landscape Architecture, Urban Design and the related fields of study:

i. The microclimate interactions between human outdoor thermal comfort on LESP is an extension of knowledge to the microclimatology and energy budgets model. It is helpful for discussion of outdoor thermal comfort, pedestrian thermal comfort and microclimate of landscape environmental settings for a pedestrian in tropical climates.
ii. Research on outdoor thermal comfort, particularly on pedestrian thermal comfort, is increasing and is being studied from various perspectives. Nevertheless, there remains a need to explore the existing conditions of the pedestrian environment in tropical climates; little has been done on the landscape environmental settings of pedestrian walkways. In addition, identifying types of LESP in a tropical environment, including university campuses, is essential as a reference to the existing conditions of pedestrian environments.
iii. The study provides a basic database in creating comfortable walking environments to sustain walkable and sustainable campuses, especially in tropical climates. Therefore, suitable LESPs should be provided on these campuses to encourage their communities to walk more. This study hopes to create awareness of the potential role of LESP in microclimate amelioration to enhance pedestrians' thermal comfort in the tropical outdoor environment. Eventually, this could lead to a healthier and better lifestyle. Good landscape environmental settings create a better cooling effect that can enhance campus walkability.

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KAJIAN EMPIRIKAL TERHADAP KEBOLEHPASARAN GRADUAN TVET

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Abstrak. Stigma sesetengah industri bahawa Pendidikan dan Latihan Teknikal dan Vokasional (TVET) merupakan pilihan kedua dalam bidang akademik dan tanggapan negatif terhadap pekerjaan separa mahir perlu dikikis. Kajian ini adalah untuk mendapatkan data awalan kebolehpasaran graduan Politeknik Sultan Azlan Shah (PSAS) bagi tempoh 3 tahun yang lepas, mengenalpasti kebolehpasaran (status bekerja/tidak bekerja/sambung belajar) graduan PSAS dan menganalisis sektor pekerjaan graduan sama ada mengikut bidang yang diceburi atau tidak. Kajian ini dijalankan secara kaedah kuantitatif dengan menggunakan data-data dari Unit CISEC PSAS bagi tempoh tiga tahun iaitu 2017 sehingga 2019. Analisis dijalankan dengan menggunakan perisisan SPSS Versi 26 secara analisis deskriptif. Hasil kajian mendapati bahawa 78.1% daripada responden telah bekerja sejurus tamat pengajian dan 56.6% daripadanya mendapat pekerjaan dalam bidang yang sama mereka ceburi semasa di PSAS. 80.4% daripada responden yang bekerja berjaya menempatkan diri dalam sektor swasta. Kajian ini juga mendapati hanya 2.9% sahaja graduan yang masih belum bekerja dan masih mencari pekerjaan yang sesuai dengan kemahiran. Rumusan daripada kajian ini dapat disimpulkan bahawa graduan bidang TVET berpeluang mendapat pekerjaan mengikut bidang pengajian mereka.

Kata Kunci: kebolehpasaran, TVET, politeknik, majikan

1. PENGENALAN

Pendidikan dan Latihan Teknikal dan Vokasional (TVET) di Malaysia bukanlah perkara yang baharu. Pendidikan teknik dan vokasional bermula semasa British menjajah Tanah Melayu sekitar tahun 1900. Orang-orang Melayu menjadi tenaga pengajar di sekolah-sekolah Melayu berdekatan Kuala Lumpur. Mereka berkemahiran dalam seni meganyam, menyulam dan mengukir (Khairul & Anas, 2009). Pendidikan berbentuk TVET mempunyai objektif utama iaitu menghasilkan graduan kompeten, berkemahiran dan berdaya saing sebelum menempuhi alam pekerjaan. Walau bagaimanapun, sehingga kini TVET sering dikaitkan sebagai pilihan kedua atau pilihan terakhir dalam meneruskan pengajian. Ini kerana pendidikan yang bersifat akademik dan saintifik lebih mendapat perhatian di kalangan pelajar dan ibu bapa. Kajian oleh Khadijah Alavi & Rahim Md. Sail (2015) mendapati bahawa tahap penerimaan ibu bapa terhadap latihan kemahiran dan teknikal secara keseluruhannya berada di tahap rendah. Golongan pelajar dan ibu bapa masih lagi meletakkan bidang akademik sebagai pilihan utama. Pandangan dan tohmahan skeptikal masih meragui peluang masa depan kerjaya bidang TVET ini. Pelbagai usaha dan strategi oleh kerajaan dan pihak industri telah dilaksanakan bagi memperkasakan bidang TVET di Malaysia. Usaha-usaha ini penting bagi menyediakan modal insan berkemahiran yang diperlukan industri sendiri.

Sistem Kajian Pengesanan Graduan TVET merupakan sebuah perisian aplikasi web yang dibangunkan khusus untuk mendapatkan maklumat profil graduan lepasan institusi latihan/kemahiran di bawah tujuh kementerian terlibat iaitu Kementerian Pendidikan Malaysia (KPM), Kementerian Pembangunan Luar Bandar (KPLB), Kementerian Pertanian dan Industri

Makanan (MOA), Kementerian Kerja Raya Malaysia (KKR), Kementerian Belia dan Sukan (KBS), Kementerian Sumber Manusia (KSM) dan Kementerian Pelancongan, Seni dan Budaya Malaysia (MOTAC). Pelbagai kajian yang dibuat sebelum ini bertujuan untuk melihat kebolehpasaran graduan institusi yang berbeza. Selain itu, ada juga kajian untuk melihat tahap pengangguran di kalangan graduan TVET.

Justeru, selain untuk mengenalpasti kebolehpasaran graduan TVET khususnya di PSAS kajian ini juga memberi fokus untuk menganalisis kesepadanan antara pekerjaan yang diceburi dengan bidang pengajian semasa menuntut PSAS. Menurut Fatima (2016), kebolehpasaran merujuk kepada keupayaan individu untuk mendapatkan pekerjaan dan kekal dalam pekerjaan tersebut serta mampu menyesuaikan diri dengan kehendak industri. Rata-rata graduan TVET diterima bekerja dalam sektor dan industri pekerjaan sebaik tamat pengajian mereka. Namun, beberapa persoalan masih lagi menghantui graduan TVET dan kepercayaan dari pihak industri untuk mengambil graduan TVET sebagai pekerja.

1.1 Pernyataan Masalah

Walaupun banyak institusi pendidikan kerajaan mahupun swasta yang menawarkan kursus-kursus yang berkait dengan TVET namun didapati ianya tidak mampu menarik minat pelajar lepasan sekolah untuk menjadikan TVET sebagai pilihan utama mereka. Ini lebih merumitkan lagi apabila penawaran program oleh peneraju program TVET yang berbentuk silo yang tidak mempunyai permintaan samada oleh industri dan agensi luar. Oleh itu kajian perlu bagi mengenal pasti jurang yang menjadikan TVET sebagai pilihan pelajar yang kurang kompeten, disamping penolakan lulusan TVET oleh industri.

1.2 Objektif Kajian

Kajian ini adalah untuk mendapatkan data kebolehpasaran graduan Politeknik Sultan Azlan Shah (PSAS) bagi tempoh tiga tahun (2017 sehingga 2019), mengenal pasti status kebolehpasaran (status bekerja/tidak bekerja/sambung belajar) graduan PSAS dan menganalisis sektor pekerjaan graduan sama ada mengikut bidang yang diceburi ataupun tidak.

2. SOROTAN KAJIAN

2.1 Cabaran Masa depan Pendidikan TVET ke Era Digital

Dunia pekerjaan melalui transformasi yang pesat impak dari perubahan teknologi yang membawa kepada Revolusi Perindustrian Keempat (4IR) (Schwab, 2016) memberi kesan mendalam terhadap pasaran buruh global. Ini memberi kesan kepada bentuk kemahiran dan pembelajaran yang diperlukan untuk masa depan pekerjaan. Teknologi telah mengubah keperluan kemahiran pekerjaan, namun sistem pendidikan semasa tidak berupaya untuk membekalkan tenaga kerja untuk perubahan ini, menyebabkan berlakunya jurang dari segi kurikulum dan kemahiran yang diperlukan dalam pekerjaan dan antara hasil pendidikan dan keperluan majikan.

Peralihan ekonomi yang disebabkan oleh 4IR memberi implikasi terhadap pekerjaan dan jenis kemahiran yang diperlukan untuk era digital. Ianya mendorong kaedah kerja yang baru yang mana melibatkan sistem automasi dan robotik ataupun secara *artificial intelligence*, sebagai kesan pengembangan teknologi (Evans dan Schmalensee, 2016). Ini mengakibatkan keperluan kepada tenaga manusia menjadi berkurangan dimana unit-unit organisasi akan semakin mengecil.

Oleh itu kemahiran lulusan TVET perlu dipelbagaikan/diperluaskan secara holistik dengan tahap kemahiran yang lebih tinggi dimana tidak memfokuskan kepada satu kelayakan sahaja bagi menuntut peluang pekerjaan yang lebih luas. Ini bagi memenuhi keperluan pasaran kerja yang berubah dengan pantas. Laporan Pertubuhan Buruh Antarabangsa (ILO), 64 juta belia menganggur di seluruh dunia (ILO, 2019), rasionalnya banyak peluang pekerjaan tidak dapat diisi disebabkan belia yang tidak berpendidikan, tiada latihan dengan kadar 20 peratus.

Kajian oleh McKinsey, (2016) melaporkan bahawa 39 peratus majikan yang dikaji menyebut kekurangan kemahiran sebagai pendorong utama untuk kekosongan tersebut.

Kebolehpasaran harus menjadi komponen utama sistem pendidikan untuk menghindari ketidaksepadanan kemahiran di pasaran tenaga kerja. Dalam pengertian ini, kerjasama erat antara industri dan kerajaan adalah kunci untuk memastikan bahawa kurikulum sistem latihan sesuai dengan permintaan tenaga kerja. Disebabkan itu, TVET dan jenis pembelajaran berasaskan kerja menjadi penting untuk menutupi jurang ini. Pembelajaran berasaskan kerja dan TVET adalah konsep yang saling berkaitan yang diaplikasikan oleh sistem TVET untuk mengatasi jurang yang berlaku antara penawaran buruh dan bidang kemahiran yang diperlukan majikan. Menurut Stephen et. al (2014), pembelajaran berasaskan kerja "merangkumi berbagai pengaturan formal dan tidak formal, termasuk latihan praktikal, pembelajaran tidak formal mengenai pekerjaan, dan penempatan kerja dari berbagai jenis yang menjadi sebahagian dari kelayakan vokasional berasaskan sekolah." Ianya bukan hanya dalam pekerjaan tradisional (iaitu, pembinaan dan pembuatan) malahan bagi bidang pekerjaan yang terkini (iaitu, teknologi maklumat, perhotelan, dan pengurusan). Sistem TVET mesti meningkatkan perkongsian strategik dengan majikan untuk memastikan bentuk pembelajaran yang sesuai dan akses ke kemahiran bertaraf dunia untuk mempromosikan pekerjaan baru secara berterusan yang sesuai untuk ekonomi berkemahiran tinggi dan bentuk pekerjaan yang baru muncul. Beberapa amalan terbaik TVET yang dikenalpasti perlu melaksanakan polisi:

i. untuk mengkaji hasil pasaran pekerja pendidikan umum, TVET dan universiti awam;
ii. untuk meneroka keperluan pendidikan dan kemahiran untuk pekerjaan yang berbeza; dan
iii. untuk membuat perbandingan di antara pendidikan akademik berbanding TVET (Spöttl & Loose, 2014)

Manakala, bagi melonjakkan bidang TVET seiringan dengan bidang professional yang lain yang bertunjangkan akademik maka langkah-langkah berikut telah dikenalpasti.

i. Kerjasama dari universiti tempatan perlu dipertingkatkan untuk menerima pelajar TVET walaupun dengan kewujudan universiti teknikal (MTUN) dan mengembangkan program TVET. Langkah ini bagi mengiktiraf kualiti pelajar TVET yang diletakkan dalam kategori pilihan kedua bagi pengajian peringkat tinggi.
ii. Menangkis anggapan TVET sebagai pilihan *drop-out* dimana program pengajian teknikal TVET yang dilaksanakan tidak berfokuskan kepada satu bidang pekerjaan sahaja tetapi laluan dari TVET boleh membuat pilihan bidang lain apabila meneruskan pengajian diperingkat universiti.
iii. Terdapat kekurangan maklumat mengenai keperluan pekerjaan, pasaran buruh, dan laluan akademik (universiti) berbanding TVET
iv. Hanya sedikit maklumat mengenai penilaian impak sistem TVET. Oleh itu sistem pembangunan seharusnya diperkukuhkan dalam reka bentuk TVET dan meningkatkan pemantauan dan penilaian sistem TVET.
v. Negara membangun lebih memerlukan bidang TVET berbanding negara maju (Ra, Chin & Liu, 2015)

3. METODOLOGI KAJIAN

Kajian ini melibatkan graduan PSAS sejak tahun 2017 sehingga tahun 2019. Data kajian terdiri daripada semua graduan PSAS dari empat buah jabatan iaitu Jabatan Kejuruteraan Awam, Jabatan Kejuruteraan Elektrik, Jabatan Kejuruteraan Mekanikal dan Jabatan Perdagangan yang menghadiri upacara konvokesyen pada tahun mereka graduasi. Kajian ini menggunakan kaedah kuantitatif dengan menggunakan soal selidik sebagai instrumen kajian yang dibangunkan oleh Kementerian Pendidikan Malaysia. Ia dijalankan secara atas talian (online) sebulan sebelum berlangsungnya majlis konvokesyen. Walau bagaimanapun, di PSAS graduan perlu mengisi borang yang telah dicetak terlebih dahulu. Borang tersebut akan

diserahkan sewaktu graduan ingin mengambil jubah konvokesyen. Ini bagi memastikan bahawa graduan mengisi maklumat yang tepat dan tidak akan menjejaskan data kajian. Graduan perlu mengisi borang soal selidik ini tidak kira sama ada hadir atau tidak hadir ke majlis konvokesyen. Borang soal selidik tersebut merangkumi tujuh bahagian utama, iaitu:

i. Maklumat latar belakang
ii. Status terkini
iii. Bekerja
iv. Belum / Tidak bekerja
v. Melanjutkan pengajian
vi. Pengalaman semasa mengikuti pengajian di institusi
vii. Persetujuan

Data daripada soal selidik yang diperoleh dianalisis menggunakan perisian *Microsoft Excel 365 dan Statistical Package for the Social Sciences Versi 26 (SPSSV26)*.

4. ANALISIS DAN KEPUTUSAN

Politeknik menerusi Unit Industri Korporat dan Kebolehpasaran PSAS (CISEC) yang bertanggungjawab dalam memantau perkembangan graduan berkenaan kebolehpasaran graduan TVET adalah melalui kaedah-kaedah secara atas talian antaranya 1L5G, soal-selidik kepada graduan dan *exit survey* yang bertujuan untuk kajian mengenai lulusan TVET merangkumi gambaran mengenai kebolehpasaran siswazah, peratusan pasaran pekerjaan siswazah dan trend pekerjaan termasuklah mobiliti pekerjaan. Dalam konteks ini, lulusan TVET dari politeknik yang dikategorikan sebagai bekerja termasuklah graduan yang menyambung pengajian dengan anggapan bahawa mereka telahpun mempunyai kemahiran dan telah bersedia untuk bekerja tetapi mereka telah memilih untuk melanjutkan pengajian berdasarkan jadual berikut.

Objektif kajian 1: Mendapatkan data awalan kebolehpasaran graduan Politeknik Sultan Azlan Shah (PSAS) bagi tempoh 3 tahun yang lepas iaitu tahun 2017 hingga tahun 2019.

Jadual 1: Kadar Respon Graduan PSAS

	Bilangan Graduan	Bilangan Responden	Kadar Respon (%)
2017	1 145	1 145	100
2018	1 431	1 222	85.39
2019	1 311	1 146	87.40

Jadual 1 menunjukkan kadar respon terhadap soal selidik yang dijalankan bagi tempoh tiga tahun berturut-turut iaitu 2017 hingga 2019. Pada tahun 2017, 100% graduan menjawab soal selidik tetapi bilangan tersebut menurun pada tahun 2018 iaitu seramai 85.39% graduan telah menjawab soal selidik. Pada tahun 2019, bilangan responden meningkat kepada 87.40%.
Objektif kajian 2: Mengenalpasti kebolehpasaran (status bekerja/tidak bekerja/sambung belajar) graduan PSAS.

Jadual 2: Kadar Kebolehpasaran Graduan PSAS

Bil	Status	2017		2018		2019	
		R	%	R	%	R	%
1.	Bekerja	829	72.4	984	80.6	931	81.3
2.	Melanjutkan Pengajian	153	13.4	180	14.7	198	17.3
3.	Menigkatkan Kemahiran	2	0.2	3	0.2	5	0.4
4.	Menunggu Penempatan Pekerjaan	73	6.4	50	4.1	5	0.4
5.	Tidak Bekerja	88	7.6	5	0.4	7	0.6
	Jumlah	1 145	100	1 222	100	1 146	100

Analisis status kebolehpasaran dalam kalangan graduan PSAS dilakukan untuk melihat status graduan sama ada telah bekerja, belum mendapat pekerjaan ataupun sedang menyambung pengajian ke peringkat yang lebih tinggi. Jadual 2 menunjukkan kadar kebolehpasaran graduan PSAS. Berdasarkan Jadual 2, kebolehpasaran graduan PSAS dibahagikan kepada 5 kategori iaitu bekerja, melanjutkan pengajian, meningkatkan kemahiran, menunggu penempatan pekerjaan dan tidak bekerja. Analisa mendapati bahawa peratusan graduan bekerja adalah paling tinggi setiap tahun iaitu 78.11%, diikuti dengan status melanjutkan pengajian sebanyak 15.12%, menunggu penempatan pekerjaan 3.64% dan meningkatkan kemahiran sebanyak 0.28%. Sebanyak 2.85% graduan berstatus tidak bekerja bagi ketiga-tiga tahun tersebut. Agihan taraf pekerjaan bagi graduan PSAS yang telah bekerja ditunjukkan melalui Jadual 3 di bawah.

Jadual 3: Taraf Pekerjaan Graduan PSAS

Bil	Taraf Pekerjaan	2017		2018		2019	
		R	%	R	%	R	%
1.	Swasta (termasuk NGO)	668	80.7	703	71.4	837	89.9
2.	Bekerja dengan keluarga (ada upah)	12	1.4	132	13.4	30	3.2
3.	Bekerja dengan keluarga (tiada upah)	2	0.2	3	0.3	2	0.2
4.	Bekerja sendiri (usahawan)	29	3.5	107	10.9	28	3.0
5.	Kerajaan	118	14.2	39	4.0	34	3.7
	Jumlah	829	100	984	100	931	100

Berdasarkan Jadual 3, taraf pekerjaan graduan PSAS dibahagikan kepada 5 kategori iaitu bekerja dengan pihak swasta (termasuk NGO), bekerja dengan keluarga dan diberi upah, bekerja dengan keluarga tetapi tidak diberi upah, bekerja sendiri atau menjadi usahawan dan bekerja dengan kerajaan. Analisa mendapati bahawa graduan PSAS cenderung untuk bekerja dengan pihak swasta dengan peratusan sebanyak 80.47%, diikuti dengan kerja kerajaan sebanyak 7.00%, bekerja dengan keluarga (diberi upah) sebanyak 6.34%, menjadi usahawan sebanyak 6.00% dan bekerja dengan keluarga (tidak diberi upah) 0.26%.

Objektif kajian 3: Menganalisis sektor pekerjaan graduan sama ada mengikut bidang yang diceburi atau tidak.

Jadual 4: Kadar Graduan PSAS Yang Bekerja Dalam & Luar Bidang

Bil	Bidang	2017		2018		2019	
		R	%	R	%	R	%
1.	Dalam Bidang	453	54.6	536	54.5	564	60.6
2.	Luar Bidang	376	45.4	448	45.5	367	39.4
	Jumlah	829	100	984	100	931	100

Berdasarkan Jadual 4, data graduan yang telah bekerja dianalisis bagi mengetahui sama ada bidang pekerjaan yang diceburi sama dengan bidang pengajian atau tidak. Analisa mendapati bahawa 56.60% graduan berjaya mendapat pekerjaan dalam bidang yang sama dengan pengajian manakala selebihnya iaitu 43.40% graduan bekerja luar dari bidang pengajian.

5. KESIMPULAN

Graduan lepasan dari institusi TVET seperti politeknik sentiasa berpeluang mendapat pekerjaan dalam industri terutamanya pekerjaan mengikut bidang pengajian mereka. Kegusaran tentang kesukaran untuk mendapat pekerjaan mahupun untuk menyambung pengajian ke peringkat yang lebih tinggi perlu dihapuskan memandangkan peratusan kebolehpasaran graduan TVET sentiasa meningkat setiap tahun sehingga mencapai 99% pada tahun 2019 berbanding 92% pada tahun 2017. Selain itu, lebih 50% graduan berjaya mendapat pekerjaan mengikut bidang yang sama dengan bidang pengajian di PSAS. Ini membuktikan bahawa bidang pengajian di institusi TVET menepati kehendak dan keperluan di industri. Masyarakat dan industri perlu menyedari bahawa pendidikan TVET di Malaysia memberikan masa depan yang cerah dalam kerjaya kepada graduannya. Pihak institusi TVET juga sentiasa berusaha memberikan perkhidmatan pendidikan dan latihan yang terbaik dalam usaha mempersiapkan graduan lepasan TVET yang lebih kompeten dan mempunyai kemahiran yang baik dalam pekerjaan. Selain itu, strategi pemasaran yang baik dan program bantuan perlu dilaksanakan bagi membantu pelajar-pelajar terutamanya dalam kalangan keluarga B40 untuk melanjutkan pengajian ke peringkat yang lebih tinggi dalam bidang TVET. Dalam konteks ini, TVET memainkan peranan penting dalam menyediakan tenaga kerja mahir dan separa mahir yang diperlukan untuk transformasi ekonomi negara. Dengan tujuan untuk memperhebatkan kadar kebolehkerjaan lulusan TVET, sistem TVET nasional harus diubah dari segi kecekapan, kualiti dan prestasinya agar dapat melengkapkan tenaga kerja negara dengan kompetensi yang diperlukan untuk ekonomi yang kompetitif dan berasaskan pengetahuan.

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ALTERNATIVE INTERLOCKING PAVING BLOCK BY USING VARIOUS LDPE/SAND RATIOS

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Abstract. Interlocking paving blocks (IPB) are like a puzzle piece that is widely used in the less durable areas as an alternative to bitumen and concrete pavements. It provides a hard surface and has been successfully used for road surfaces, especially in the operating areas and environmental constraints. The main objective of this research is to fabricate a new alternative interlocking paving block (known as Alternative-IPB) by using plastic waste as a binder to replace cement content with emphasizes on sustainable, lightweight and cost-effectiveness construction materials. The alternative-IPBs were prepared in four different LDPE/sand ratios are 1:1, 1:2, 1:3 and 1:4. The performance of the alternative-IPB was evaluated via physical and mechanical characteristics, including density, waste absorption and strength performance. Based on results obtained, it has been shown that the 1:2 LDPE/sand blend ratio indicates the high compressive strength of 20.09 MPa. Besides being used as a potential material for civil engineering purpose, it was since helped minimize the overall volume of plastic waste at the landfill.

Keywords: Interlocking Paving Block (IPB), Plastic bag (LDPE) waste, LDPE/sand ratios, Compressive Strength

1. INTRODUCTION

Interlocking paving block (IPB) is one of the construction material used in many instances to build a pavement surface in a difficult position or heavy duty roads (Shanmugavalli et al., 2017). It has been alternative material to bitumen and concrete pavements. John (2009) stated that the clay and concrete IPBs are the two basic types of IPB extensively used in Malaysia and other developing countries. IPB is designed so every paver suit to the next, like a puzzle piece. This makes it possible to carry out remedial work under the paving floor without leaving a permanent mark as soon as the IPBs are replaced. Moreover, the benefit of the IPB is proximity to underground utilities and the potential to restore paving technologies, thereby minimizing waste materials. The results of the life-cycle cost analysis indicate that for this type of application, when a discount rate of 4% is applied, the interlocking of concrete pavements is more cost-effective than asphalt pavements (Burak, 2002).

Interlocking concrete pavement blocks (ICPB)were first developed in the Netherlands in 1924 replacing paver bricks that were scarce due to the post-war construction boom (Tuffour, 2016). Rollings (1984) claimed that ICPB differs from traditional flexible pavements mainly in the characteristics of superior load distribution and high strength abrasion resistant surface. Typical ICPB has a clean face and a rough face, although some paving blocks can be used on both sides with interchangeable surfaces. Furthermore, ICPB is a versatile paving material with endless possibilities for street cape design due to the different shapes, sizes, and colors

available. Sharma (2009) reported that the ICPB was divided into four categories according to its compressive strength, which are non-traffic (25 – 30 MPa), light traffic (30-35 MPa), medium traffic (35-45 MPa) and heavy to very heavy traffic (45-55 MPa). Moreover, Kasim and Rohim [1] recommended that the IPB strength of 20 MPa is suitable for landscape. However, in the production of the ICPB needs cement as a bonding agent. Where the cement content in the ICPB releases green-house gases which lead to global warming (Kassim & Rohim, 2017). In addition, alkaline compounds such as lime (calcium oxide) are corrosive to human tissue due to the content of cement (Ali et al., 2011). Besides, small quantities of crystalline silica in concrete that is abrasive to the skin and can damage the lung, as well as environmental pollution (Kassim & Rohim, 2017). Apart from that, the production of cement is high value due to production of ICPB. Therefore, this research presents to produce an environmentally friendly construction material through the use of plastic wastes. Besides being used as a potential material for construction applications, the total amount of plastic waste at the landfill site has since been reduced.

Municipal solid waste management (MSW) is becoming a major challenge in global development plans, particularly in fast-growing cities. Malaysia is one of the most successful transition countries. As a result of rising waste generated, Malaysia is experiencing rapid industrialization and urbanization (Samsudin & Don, 2013), which has adverse effects on the environment. SWCorp (2016) reported that plastic wastes is the largest contributor to environmental pollutions. Plastic most of the consumer product used was 3,087,765 ton/year or 8459 ton/day (SWCorp, 2016). The annual use of plastics in the world has risen from about 5 million tons in the 1950s to almost 100 million tons (El-Newehy, 2016). Plastic is as valuable as a hazardous material as it develops every day, since plastic waste is highly non decomposed material (LeBlanc, 2019). Plastic was found to be very useful at the time of need. However, it is thrown away after its use, increasing all kinds of risks to the environment. Plastic waste becomes a serious and long-standing problem because it is non-biodegradable in the natural environment even after a long period. According Ten (2018), Malaysia is the eighth largest plastic waste country in the world and estimated to have created nearly one million tons of mismanaged plastic waste in 2010, but may have washed into the oceans from 0.14 to 0.37 million tons (Abdullah, 2018).

Through reusing and recycling plastic waste to a new green technical know-how specifically for construction applications, it also eliminates the environmental impact of sustainable waste, the ability to remove the waste from the waste stream for an extended period. in additional to overcoming environmental issues caused by plastics bag, low density polyethylene (LDPE) was chosen as a new alternative material for IPB due to its excellent properties such as ductile, lightweight, durable, flexible and economical. LDPE density in the range of 0.910 to 0.940 g/cm^3. There is a balanced temperature range between −50 ° C and 85 ° C, and the melting point is between 105 ° C and 115 ° C (MOL Petrochemicals Co. Ltd., 2017). The specific gravity and density of LDPE are 0.912 g/cm^3 and 0.914, respectively. The use of plastic in IPB production to enhance a sustainable and cost-effective IPB is therefore becoming a new phenomenon. The main purpose of this research is to assess the potential of plastic waste (LDPE) as a new alternative material to replace cement content in a pavement block through compressive strength, water absorption, and density characteristics.

2.0 METHODOLOGY

2.1 Raw Material

Two main materials were used in this research, which are LDPE and sand. Both materials were mixed to produce alternative interlocking paving block for sustainable road pavement construction.

2.1.1 Low Density Polyethylene (LDPE)

LDPE is a thermoplastic made from oil. In this research, plastic bag as shown in Figure 1 was used as a LDPE sources was collected around Pagoh restaurant. A plastic bag was dried to remove the contamination inside the plastic and was washed with water. Then, plastic bag

was cut into square size 10 cm x 10 cm to ensure the process of batching and burning going smoothly.



Figure 1: LDPE (Plastic Bag) Collected

2.1.2 Sand

Sand is naturally occurring granular material which is composed of mineral particles and finely material. Natural river sand was used as fine aggregate is passed through 4.25 mm sieve size. From the specific gravity test using Pycnometer Method and the result show the specific gravity of sand is 2.58.

2.2 Alternative-Interlocking Paving Block (IPB)

Innovative use of LDPE plastic wastes as an alternative-IPB technology is one of a sustainable and environmental friendly solution to the CIPB. By recycling material, it was reduced total amount of plastic waste dump to landfill. The Alternative-IPB was fabricated for sizes 100 mm x 100 mm x 60mm as shown in Figure 2. The alternative-IPB were fabricated into four different LDPE/sand ratios, which are 1:1, 1:2, 1:3 and 1:4 as summarised in Table 1.

Table 1: Table of Sample

Sample code	LDPE/ Sand ratio	Number of samples
S 1	1:1	3
S 2	1:2	3
S 3	1:3	3
S 4	1:4	3
Note: the sample code dimension 100mm x 100 mm x 60m		Total= 12



Figure 2: Alternative IPB using LDPE/sand ratio

2.3 Laboratory Testing

All the testing procedure in this research was conducted in accordance with American Society for Testing and Material (ASTM) standard and British Standard (BS). The physical

properties tests were conducted includes density and water absorption (WA). While, the compressive strength test was conducted as a mechanical property of alternative-IPB.

2.3.1 Weight Measurement

This evaluation of weight of IPB was measured using balancing weight as shown in Figure 3. The weight of IPB was compared with existing paving block. This test was measured 12 samples.



Figure 3: IPB Was Weighted

2.3.2 Density Measurement

The density is calculated based on Equation 1. This test was conducted for 12 samples for size 100 mm x 100 mm x 60 mm.

$$Eq\ 1: Density = \frac{Mass\ (M)}{Volume\ (V)}$$

Where; M is the specimen's weight, whereas V is the block's volume (length x width x height).

2.3.3 Water Absorption (WA) Test

The water absorption check was performed to assess the pore size and porosity in hardened concrete, according to Ganesan et al. (2018). The sample's total water absorption is known as the increase in a sample's weight due to air moisture. The interlocking paving block was weighed in a dry condition for this experiment and allowed for 24 hours to be submerged in freshwater. The samples were immediately removed from the tank after 24 hours, and with a damp cloth, the surface was wiped. Weighed 12 samples and recorded the data within two minutes after removal from the water. The percentage of water absorption is determined by the difference between the significantly saturated weight and the dry weight in Equation 2. According to Kassim & Rohim (2017). The lower the water absorbed by the interlocking block, the higher the quality. This test was following water absorption test in Malaysian Standard (MS76:1972).

$$Eq\ 2: Water\ absorption, \% = \frac{w2 - w1}{w1} x\ 100$$

Where,

W1 = Weight of dry paver (kg)
W2 = Weight of wet paver (kg)

2.3.4 Compression Test

This test was conducted to determine the IPB's compressive strength in 4 different LDPE and sand ratios (1:1, 1:2, 1:3, and 1:4). Compression testing is significant in determining the compressive strength under vertical loading for goods. This is also called crushing strength of the interlocking paving block. About 12 specimens were tested for 60 mm thickness by using Compression testing machine. All specimens were tested with a Semi-Auto 3000kN

Compression Machine. The compression testing machine ranges have been designed to test a wide range of specimens reliably and consistently. The compression test was performed in accordance with the procedure outlined in MS 1933: Part 1: 2007 compression test standards (Patel & Singh, 2017). Equation 3 shows the formula of compressive strength. Compression test was conducted after 28 days to achieve the strength.

$$Eq\ 3: Compressive\ Strength\ (N/mm^2) = \frac{maximum\ load\ (N)}{load\ area}$$

3.0 RESULTS AND DISCUSSIONS

3.1 Density of IPB

Figures 4 shows the density of alternative-IPB at different percentage ratios. The results showed that the density of IPB increase from 1483.33 to 1916.67 kg/cm^3, which is 43.33% with increasing of sand content from 1 to 4 portions. The reduction of LDPE plastic waste (0.912 g/cm^3) in the mixture showed a significant decrease in average weight through sand density of 2.58 g/cm^3.

The weight of a pavement block is crucial in launching an employee's ability to identify the pavement block for the installation process. In this test, the pavement block density was considered to be a comparison between ordinary ICPB and IPB. The density of the IPB shown in the test results is lower than that of the normal ICPB (in the range of 2100 to 2165 kg/cm^3).

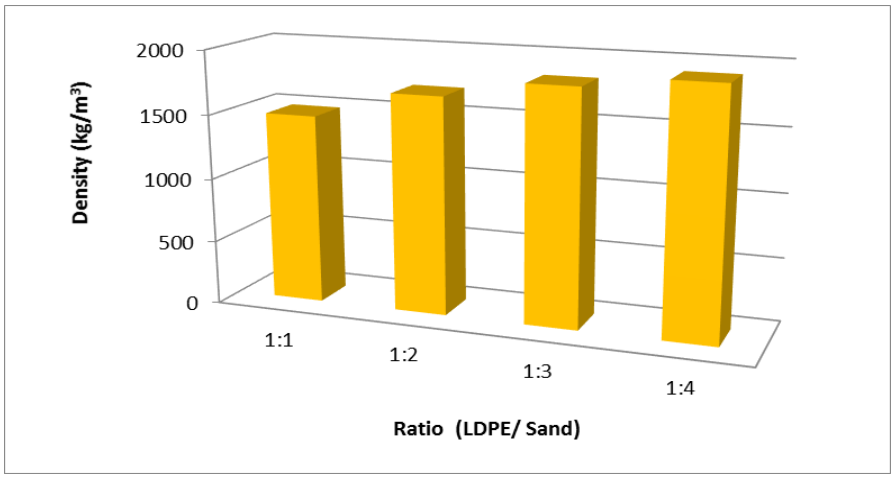


Figure 4: Density of Various LDPE/Sand Ratios

3.2 Water Absorption (WA) Test

Water absorption (WA) was performed to determine minimum and maximum allowable water absorption rates in road construction using interlocking paving blocks. This is because the production of IPB must be resilient to the changing weather conditions in Malaysia, particularly those with frequent monsoon transitions. Figure 5 shows the percentage of WA by the different percentage of LDPE/sand ratios within 24 days. The results showed that the water absorption for 1:1, 1:2, 1:3 and 1:4 of LDPE and sand ratios are 0.226%, 0.663%, 1.060% and 1.799%, respectively. The minimum water absorption is shown to be 0.226% at 1:1, and maximum water absorption is 1.799% at the 1:4 ratio of LDPE and sand. It has been shown that plastic does not absorb water and a similar thing was reported by Kashiyani, Pitroda and Shah (2013). According to Patel & Singh (2017), this is good for the practical application and durability of the paving block and therefore the results of water absorption desirable.

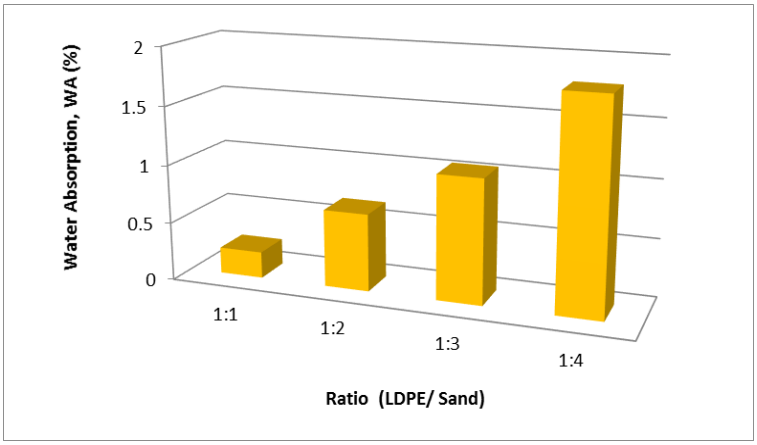


Figure 5: Water Absorption of various IPB Ratios

3.3 Compressive Strength

Figure 6 shows the compressive strength of the alternative IPB at different LDPE/sand ratios (1:1, 1:2, 1:3 and 1:4) are 11.07 MPa, 20.09 MPa, 9.71 MPa and 6.58 MPa. The minimum compressive strength is 6.58 MPa at 1:4 LDPE/sand ratio, while the maximum compressive strength is 20.09 MPa achieved at 1:2 LDPE/sand ratio. It was showed that the compressive strength is decreased by increasing the sand in IPB, but if too much LDPE in IPB also reduce its compressive strength. The IPB compressive strength obtained in this research does not meet the requirement compressive strength for traffic (more than 30 MPa). It is because the production of IPB during moulding process without hydraulic press will affect the compressive strength of IPB. However, it can still be used in non-traffic pavement, but the IPB production method needs to be improved in order to increase IPB's compressive strength according to BS 6717: 1993 standard.

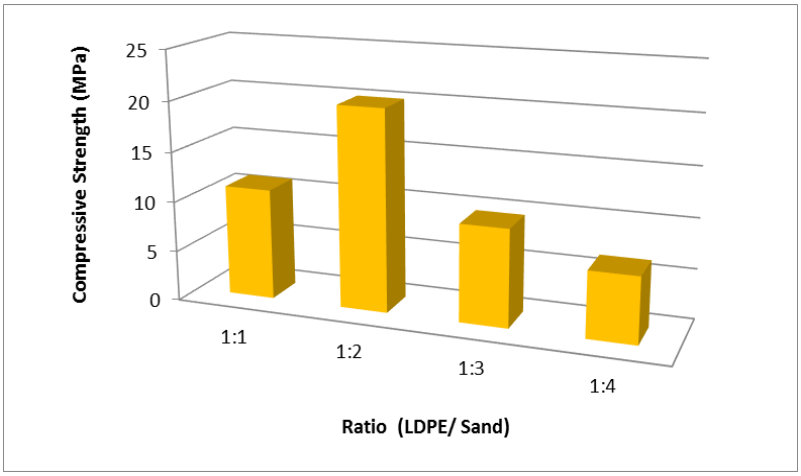


Figure 6: Compressive Strength of IPB with different LDPE/Sand Ratios

4.0 CONCLUSION

In this research, IPB with differences ratio of LDPE and sand (1:1, 1:2, 1:3 and 1:4) were investigated. The results showed that the optimal LDPE / sand ratio of alternative-IPB was reached at 1:2 is based on the optimum compression strength of 20.80 MPa. Moreover, the results also indicate that the LDPE content cannot be too much or too low because it has a direct impact on compressive strength. Although the alternative-IPB compressive strength is low compared to concrete paver block, it can be used in non-traffic such as gardens and landscapes. Besides that, the water absorption of the alternative IPB for all LDPE/sand ratios is much lower than permissible value of 7%, which is suitable for the practical application and durability of paving block.

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DEVELOP, DESIGN AND FABRICATE A KARAKURI PROJECT FOR SMALL INJECTION DEPARTMENT

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Abstrak. Waste of motion has become a considerable concern in manufacturing today, leading to concerns regarding the employee's imitation of activity. In addition, the lifting method does not follow the lifting and necessary method. Karakuri represent an automatic system (equipment or tools) without the use of a dedicated power supply using natural force, such as gravity, momentum, etc. One of the techniques used for the resolution of waste in motion is Karakuri. Karakuri is introduced in order to minimize waste of non-value-it is important to eliminate additional labour in a network that is deemed inefficient, including improper procedures, excessive travel, needless transportation, inventories of all sorts that can contribute to more excessive costs, without the need to invest in more costly structures. Technology from Karakuri maintains the purpose of automating an analytical operation. The purpose of this study is to examine worker activity actions by utilizing the CDIO system to do the job. The outcome of this analysis is focused on rapid whole body assessment (REBA), which uses the REBA worksheet to observe , monitor and evaluate work activity and body posture. The consequence is that the Karakuri model aims to minimize waste in motion, which involves working actions, by using it.

Kata Kunci: Waste of motion, Karakuri ,

1. INTRODUCTION

Motion waste has represented a tremendous issue in the industry nowadays, due to complaints about the repetition of the movement of the worker. Furthermore, the method of lifting does not follow the appropriate lifting method. Karakuri is an automated mechanism (equipment or tools) utilizing natural force such as gravity, momentum, etc. without the use of a dedicated power supply. Karakuri is one of the methods utilized for the resolution of waste in motion. Waste management is one of the most effective ways of rising any business's productivity. Processes attach value or waste to a product or service produce. The seven wastes originated in Japan, are known as "Muda." "The seven wastes" is a method for further categorizing "Muda." To reduce waste, it is necessary to understand precisely what waste is and where it resides. Karakuri is implemented to reduce waste of non-value-added work in a process as wasteful, must be reduced, including inappropriate processes, unnecessary carriage, unnecessary movement, inventories of all kinds that would result in increased costs, without the need to invest in more expensive systems. Karakuri technology carry out the function of automating an objective process. The goal of this paper is to analyze the movement behavior of the worker while the job is completed by utilizing the CDIO framework. The result of this study is based on rapid entire body assessment (REBA), where the working behavior and body posture are observed, record, and analyze using REBA worksheet. The result is that the aid of the Karakuri model helps to reduce in motion waste which includes working behavior.

2. LITERATURE REVIEW

2.1 Advantages of Lean Production System

Lean management facilitates the development of a commodity that, with the least amount of capital, adapts to actual demand and thereby minimizes costs, with the requisite consistency and very high response time. To this end, it is crucial to eliminate all value-adding activities usually dealt with as inefficient, such as inappropriate processes, needless transport, needless travel, inventories of all sorts that will contribute to higher costs (McCutcheon et. al., 1993). Better sustainable sustainability practices are also implemented by companies who have effectively reduced their internal waste by lean manufacturing methods (Womack & Jones, 2013; Abdulmalek & Rajgopal, 2007). In the global automotive industry, lean manufacturing is a development and is gaining ground in other manufacturing sectors (John, 2014; Ohno, 1988) and even in industry (Bicheno & Holweg, 2009) services. This emphasis on the removal of waste has led to practices such as the removal of inventories, the simplification of procedures and the identification and elimination of non-value - adding tasks (Conti et al., 2006), such as delays on the part of consumers waiting for service, distribution, queues, response, and failure to arrive as promised (Sharan & Ajeesh, 2012). One key reason may be that many businesses have simply embraced individual lean approaches, quite short of their core philosophy (Hignett & McAtamney, 2000). That is, maybe some businesses have caused the processes to become ends of themselves by adopting lean, losing sight of the true result, an ultimately efficient and effective manufacturing process.

2.2 Karakuri Reduces Waste of Motion

Karakuri revolves around using imagination to evolve to make operations more convenient and comfortable on these fundamental mechanisms. The force to activate the mechanism is usually achieved in Karakuri's case with a combination of human power, gravity, magnetism, and elasticity. We may use the following elementary phenomena, mechanisms, or components from the perspective of unpowered technologies or technologies based on low-thrust operating energy. Karakuri is implemented to reduce waste of non-value-added work in a process as wasteful, must be reduced, including inappropriate processes, unnecessary carriage, unnecessary movement, inventories of all kinds that would result in increased costs, without the need to invest in more expensive systems. Karakuri technology carry out the function of automating an objective process.

2.3 Rapid Entire Body Assessment

Rapid Entire Body Assessment (REBA) developed by Hignett et. al. in the year 2000. REBA follows a similar idea as RULA regarding the risk factor assessment protocol and the specified body parts for evaluation. The biggest distinction between the two approaches is workplace evaluation. REBA reports determined outcomes in assessing the ergonomics of occupations in the healthcare and service sectors but not in the occupation of the production line. Compared to RULA, which focuses mainly on assessing the upper body, REBA remains a superior method for analyzing the entire body. Table 2 shows the essential steps of the REBA assessment by referring to the REBA Employee Assessment Worksheet (Hignett & McAtamney 2000).

3. RESEARCH METHODOLOGY

3.1 Conceive

Conceive is a technique for Defining customer needs; considering technology, enterprise strategy, and regulations; developing concepts, techniques and business plans. Figure 3.1 shows an operator having to bend 90 degrees to lift the polybox from the pallet to the operation table. Each polybox weighs 5.8kg and 6.8kg depending on the product produced This process is done repeatedly for 62 repetitions per day. Therefore, the total weight lifted each day is 374.6 kg, causing a critical back pain to the operator.



Figure 3.1: Working Behavior on Small Injection Department

3.1.1 Interview

Through an interview with the worker about the activity conducted by the worker during the job period, some of the data rapid whole-body research was carried out. The REBA worksheet consists of two portions of the body segment; A and B are numbered. The spine, trunk, and legs are covered by segment A (left side). Segment B (the right-hand side) covers the arm and leg. This segmentation of the worksheet means that the test involves any painful or limited postures of the spine, torso or legs that may impact the arms and wrist postures. As seen in Figure 3.2, REBA is the method for the measurement of risk factors and specified body components for activity assessment.

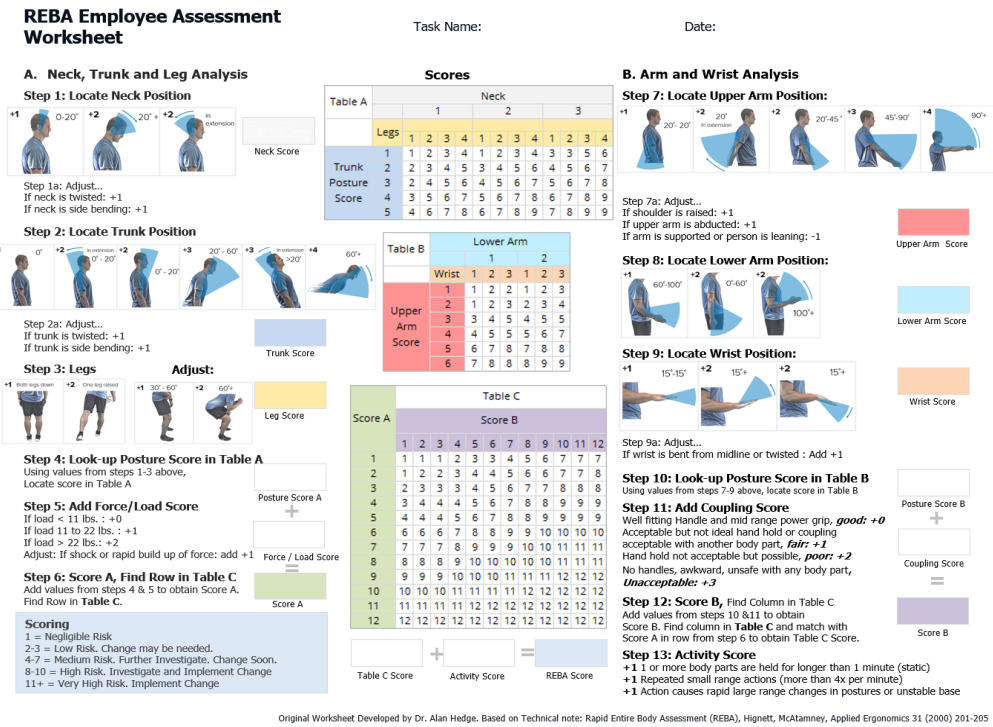


Figure 3.2 : Rapid Entire Body Analysis Worksheet

3.2 Design

Structure in CDIO is about making the structure; the plans, drawings, and calculations that depict what will be executed. Subsequently, CATIA V5 programming is utilized to encourage researches on the project to be executed. The study comes up with selected 2 designs after the brainstorming session that fulfil the necessity to build a Karakuri system to serve the daily role of the operator. The design is going through an improvement the 3D drawing design is created using CATIA software. The Creating the design; the plans, drawings, and algorithms that describe what will be implemented as shown in Figure 3.3 and Figure 3.4.

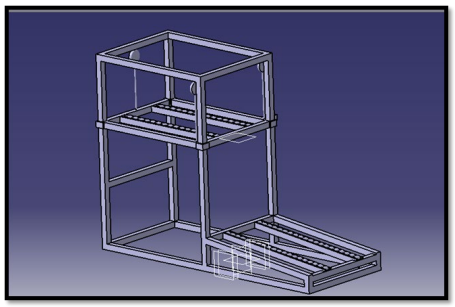


Figure 3.3: Design model A



Figure 3.4: Design model B

3.3 Fabrication

Implementation is the next approach after conceive and design. After finalizing the chosen design, it will undergo the fabricating process which is fabricated by 2 manpower as shown in Figure 3.5, the process involve are grinding, cutting and assembly. The material used is metal joint and plastic coating steel pipe.



Figure 3.5: Fabrication Process

3.4 Implement

The Karakuri will be implemented in small injection department, a SketchUP software is used to determine the location to place the karakuri as shown in Figure 3.6.

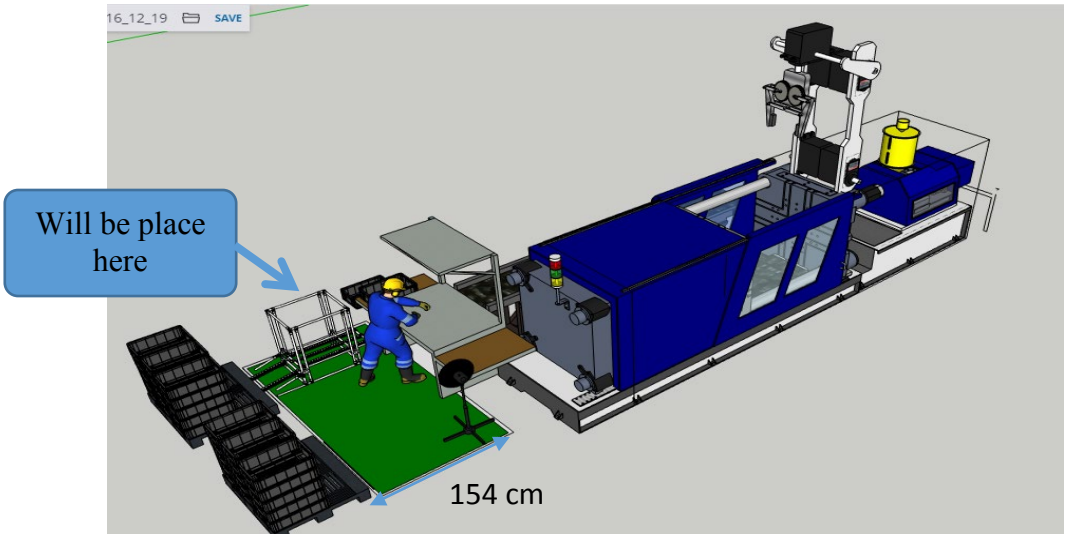


Figure 3.6: Sketch UP 3D Location to Place Karakuri

3.5 Operation

The operation stage is important to determine whether the karakuri is functioning properly or not after it has been fabricated. Every workstation has their own standard operation procedure to operate their task. This standard operation procedure is made for the task after the implementation of Karakuri as shown in Figure 3.8.

Chart no :			Summary		
Subject Charted : Motion	Activity		Present	Proposed	Savings
Activity : Lifting	Operation	O	2		
Method : Manual	Transportation	→	4		
Date : 15/11/19	Delay	D			
	Inspection	□	1		
	Storage distance	▽	2 (173 cm)		
	Time				
Description	Distance in second		Time in second	Symbol	Remarks
				O → D □ ▽	
1. Take empty box from pallet 2. Place empty box on the table 3. Take product from conveyer. 4. Inspect product, identify defect 5. Cut gate A 6. Cut gate B 7. Place product on polybox 8. Put full finish good polybox to karakuri 9. Ejacting karakuri stopper					

Figure 3.8: Standard Operation Procedure

4. RESULTS AND ANALYSIS

4.1 Material Analysis

The analysis is carried out by using Ansys 2020 software, the minimum force load applied is 49.05N which is equivalent to 5 kg of load, and maximum force load applied is 441.81N which is equivalent to 45 kg of load. There are 2 types of material used in this analysis for a different design as shown in Figure 4.1. The design named by design 1 and design 2 which is design 1 uses aluminium alloy as the material and design 2 use structural steel as the material. Both materials came with a different specification structural steel has a better density compared to the aluminium alloy which is 7.85e-06 [kg/mm^2] for structural steel and 2.77e-06 [kg/mm^2] for aluminium alloy. According to the material specification shown below structural steel has a better shear modulus, the high number of shear modulus is for a better shear force distribution in a structure. The structural steel consists of 76923 MPa shear modulus which is higher compare to the aluminium alloy which is 26692 MPa.

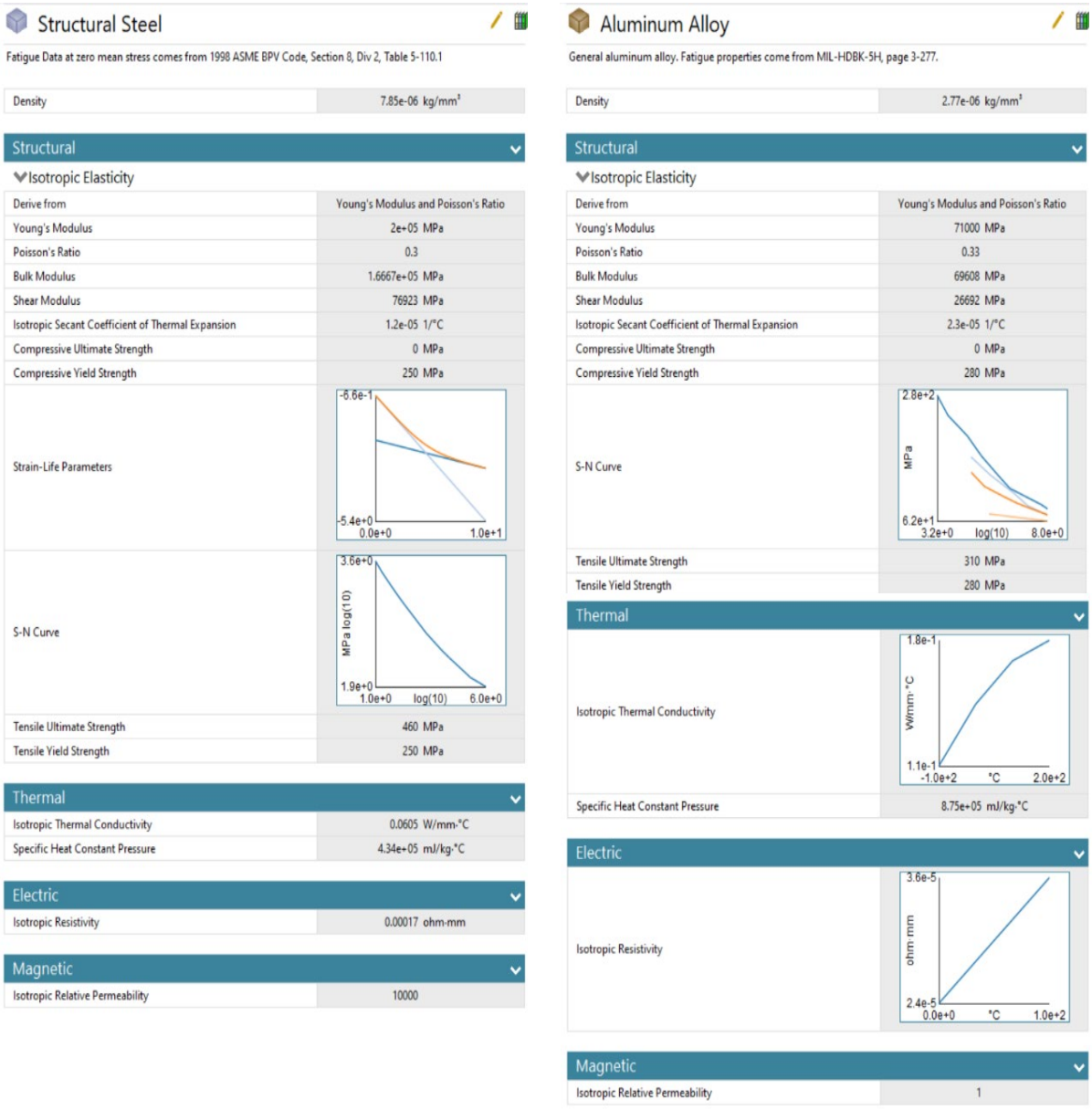


Figure 4.1: Material Specification for Structural Steel and Aluminium Alloy

4.2 esign Analysis

The result of total deformation for design A is 0 mm for minimum and 0.012379 mm for maximum as shown in Figure 4.2. The result of Von-misses stress for design A is 2.4538e-14 MPa for minimum and maximum Von-misses stress is 1.2682 MPa as shown in Figure 4.3. The result of total deformation for design B is 0 mm for minimum and 0.16432 mm for maximum as shown in Figure 4.4. The result of Von-misses stress for design B is 0 MPa for minimum and maximum Von-misses stress is 23.904 MPa as shown in Figure 4.5.

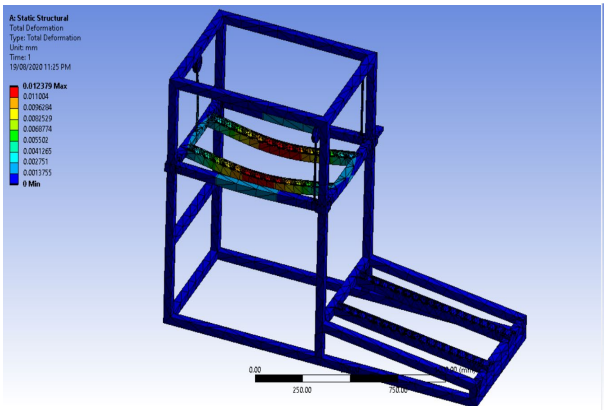


Figure 4.2: Total Deformation for Design A

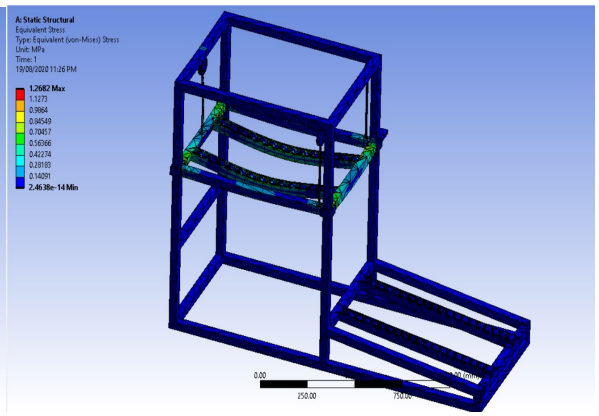


Figure 4.3: Von-misses Stress for Design A

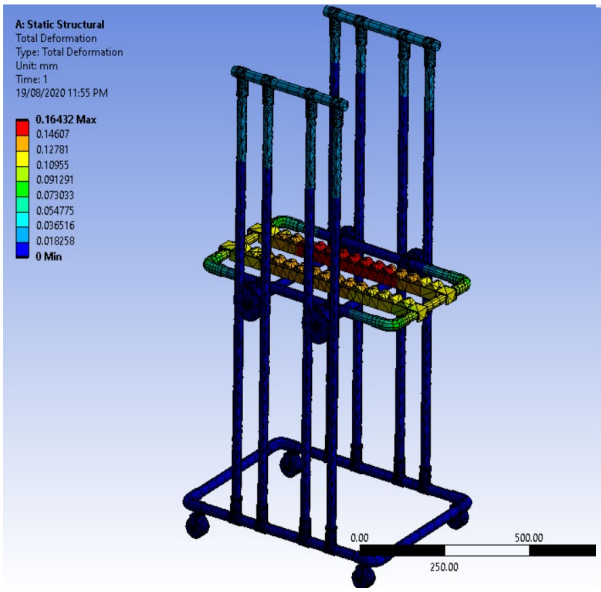


Figure 4.4: Total Deformation for Design B

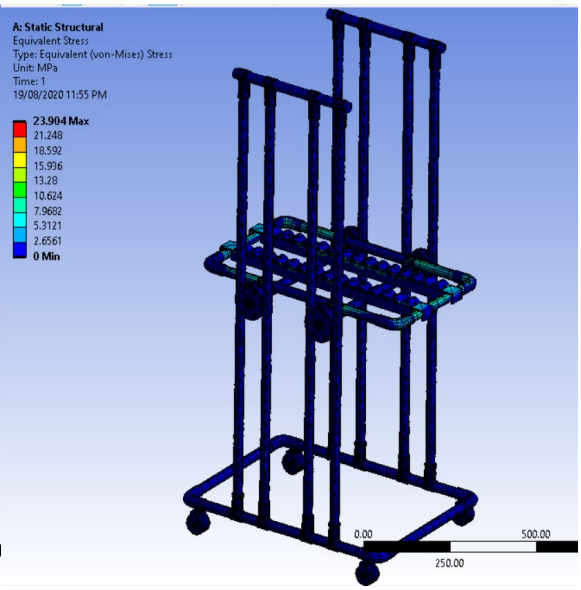
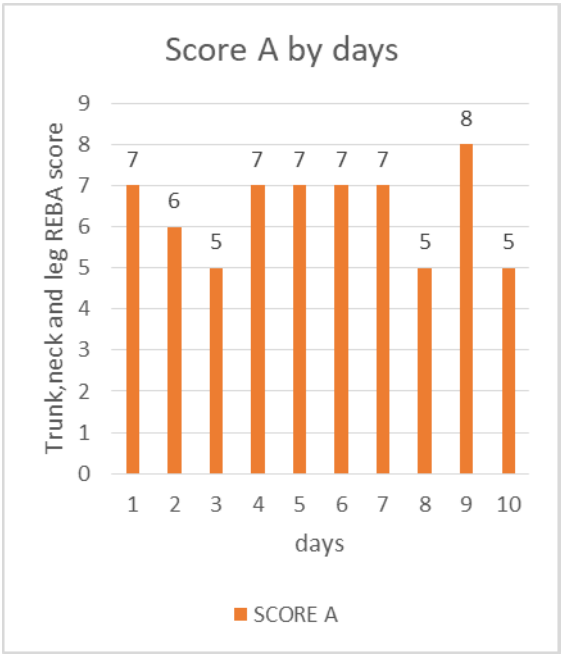


Figure 4.5: Von-misses Stress for Design B

4.3 Rapid entire body analysis (REBA) (Before implementation of karakuri)

After asking the worker about the activity conduct that was conducted by the worker during the job period, rapid whole body research was carried out. The REBA worksheet consists of two portions of the body segment; A and B are numbered. As seen in Figure 4.6, segment A (left side) covers the throat, trunk, and neck. As seen in figure 4.7, segment B (right side) covers the arm and hand. This segmentation of the worksheet means that the test involves any painful or limited postures of the spine, torso or legs that may impact the arms and wrist postures.



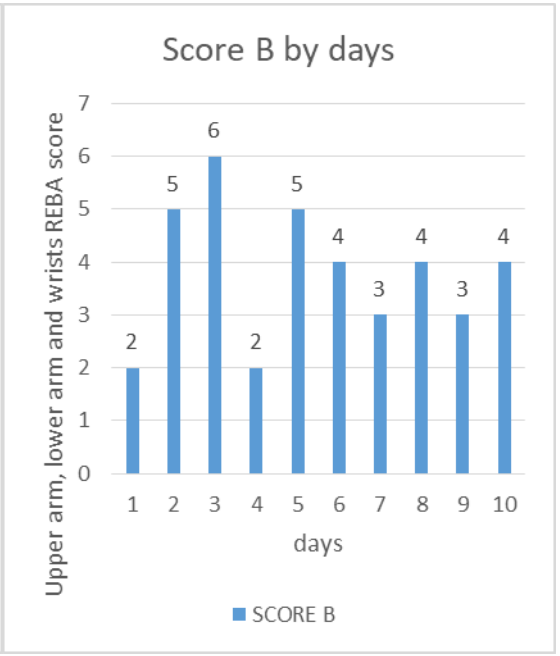


Figure 4.6: REBA score A data **Figure 4.7: REBA score B data**

The result shown the score of all activities including score A for (Trunk, Neck and Legs) postures first, then score Group B (Upper Arms, Lower Arms, and Wrists) postures for left and right, and lastly score C the overall score for REBA assessment as shown in Figure 4.48. The result show that the lowest overall score is 5 and the highest is 9.

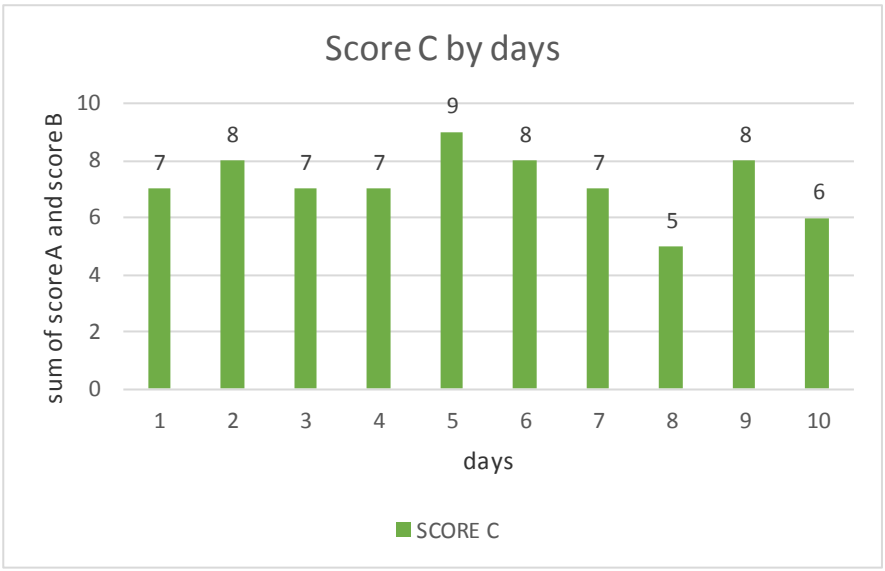


Figure 4.8: REBA Score C Data

4.4 Rapid entire body analysis (REBA) (After implementation of karakuri)

The post data for rapid entire body analysis showed an improvement in body posture behavior where the score for analysis is in the safe score for lifting index analysis. The data has shown a score of 2 for REBA score, this is due to changes in body posture after implementation of Karakuri that acts as a support mechanism for the work in the process. The REBA worksheet is divided into two body segment sections; labelled A and B. Section A (left side) covers the neck, trunk, and leg as shown in Figure 4.9. Section B (right side) covers the arm and wrist as shown in Figure 4.10. This segmenting of the worksheet ensures that any awkward or constrained postures of the neck, trunk or legs which might influence the postures of the arms and wrist are included in the assessment.

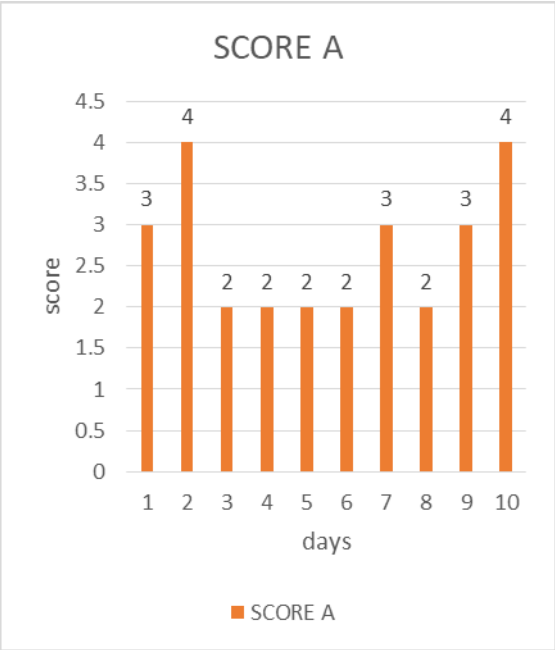


Figure 4.9: REBA Score A Data

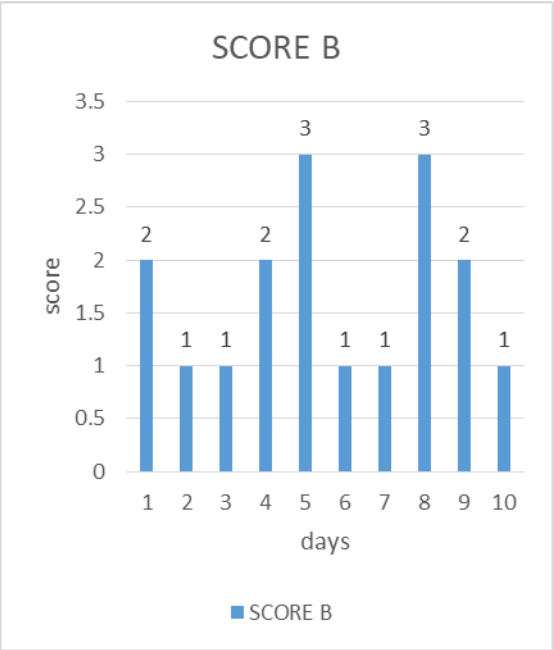


Figure 4.10: REBA Score B Data

The result shown the score of all activities including score A for (Trunk, Neck and Legs) postures first, then score Group B (Upper Arms, Lower Arms, and Wrists) postures for left and right, and lastly score C the overall score for Reba assessment as shown in Figure 4.11. The result show that the lowest overall score is 1 and the highest is 3.

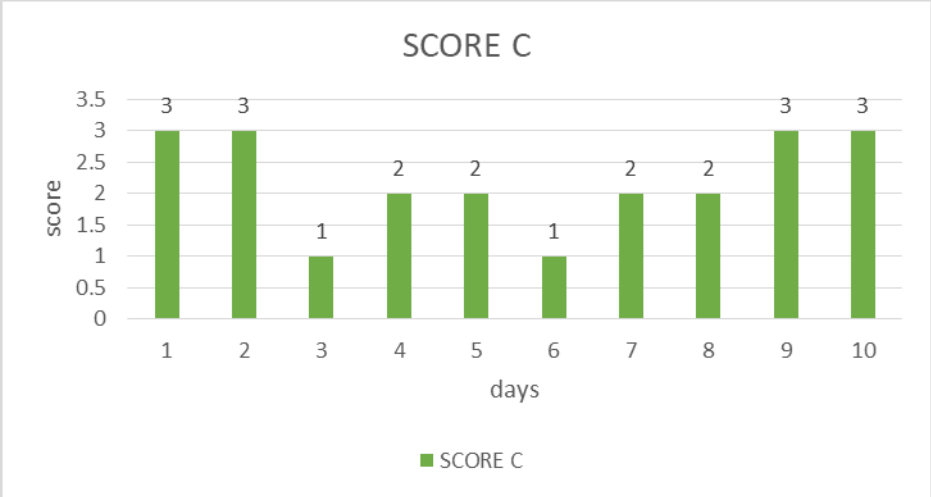


Figure 4.11: REBA Score C Data

4.4.1 Result Analysis

The data result has shown a positive impact of the implementation of Karakuri, the impact is on motion behaviour; improvement in motion behavior with the help of Karakuri which can lead to a reduction in waste of motion as shown in Figure 4.12. Result from rapid entire body assessment (REBA) has shown a tremendous reduction on ergonomic risk from 9 REBA score to 2 REBA score as shown in Figure 4.12. This is due to the aid of Karakuri which help to change the body posture of the worker while their working. The workers are no longer need to bend over their back after the implementation of the Karakuri.

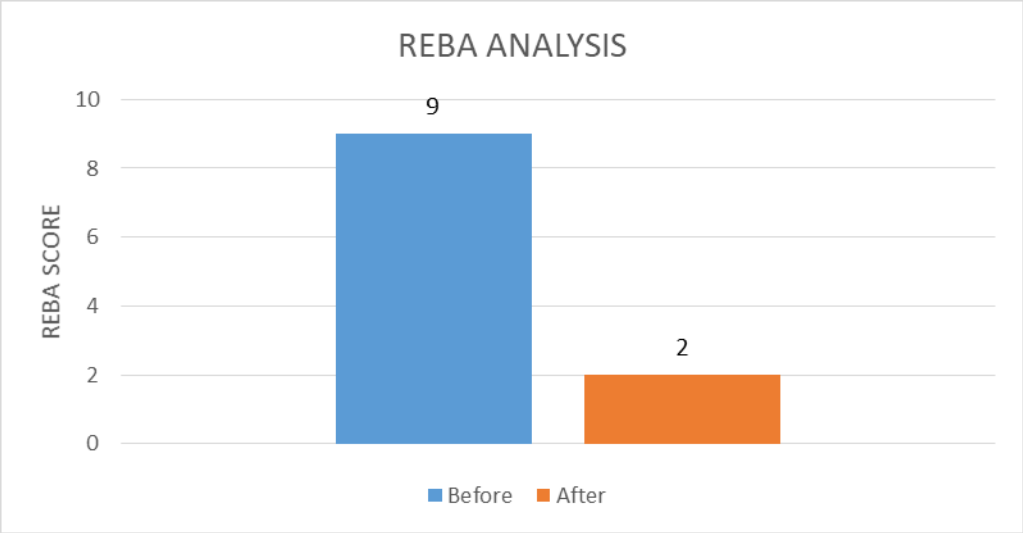


Figure 4.12: REBA Analysis Differences

5. CONCLUSION

The purpose of this study is in conjunction with the success of the project which is to design a Karakuri that can help to improve ergonomic and cycle time along with a support mechanism in the work process. The results of the research that were obtained must be pursued so that further changes can be made to boost the productivity of the industry. Therefore, the use of aid resources should be extended to promote research to reduce ergonomic risk among the staff. However, time management is also at an extreme point in the industry so that the allocated time is not lost and not many workers are hired which consequently leads to cost saving of a company.

The study results are gathered on the data before and after the implementation. The difference in the results proves that the use of Karakuri can help employees run the process more conveniently. The use of Karakuri will increase the ergonomic posture to enhance the current operation and save operation time. The result has shown a reduction on rapid entire body assessment score where the implementation of Karakuri has proven that the score reduce to score of 2 from score of 9.

The conclusion that can be made from this study is that problem solving can be achieved with continuous monitoring as well as data collection and data recording for future analysis of the problem. Objective value is the emphasis on the argument that must be done to solve the problem. In this situation, time-related issues can be solved by continuous research with the aid of karakuri to minimize the process time and improve ergonomic factor. Pre- and post-data should be equivalent to see the outcome or discrepancy acquired.

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A STUDY ON A TOOL GUIDE FOR RUBBER COMPOUND

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Abstract. A local rubber moulding company that produces a huge range of different rubber component for many areas of manufacturing especially automotive product. The operators had a problem due to rubber compound break up during the moulding process. The rubber compound always breaks up due to touch the surface of injection moulding body. To reduce the friction between the rubber compound and the surface body the operator placed a piece of PP sheet on the surface of the machine body. The tool is made to eliminate the friction and replace the existing cover on the surface body. Other than that, the tool is used to reduce the reject that happen that relate to rubber compound break up which is the short mould. The design and construction of this tool is using the design software which is CATIA V5 R21.

Keywords: Injection Moulding, Friction, Rubber Break-up

1. INTRODUCTION

Bush is one of the most important parts in a vehicle that needs to be taken care of for better comfort in driving a vehicle. Bush is very important to absorb most of the vibration that is produced either from the engine or the environment. It is made from rubber that is developed by mixing the rubber with other substances to increase its durability according to the condition encountered. This rubber is transformed into different shapes for the vehicle parts using injection moulding. The injection moulding machine injects the melted rubber into the mould. Different parts different mixture of rubber according to the required hardness

Injection moulding feeder has a shaft with teeth in it that rotates to assist the process of feeding the rubber compound into the moulding chamber as shown in Figure 1.1. In this chamber, the rubber compound will be melted and injected into the mould.

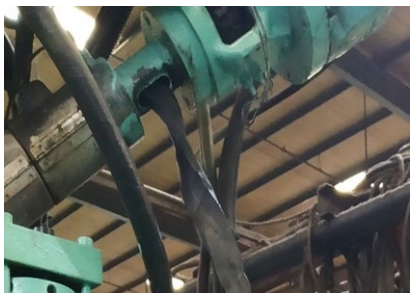


Figure 1.1: Injection Moulding Feeder

1.1 Problem statement

An issue related to the process of injecting the rubber compound into the feeder has been occurring during the production process, where the compound always gets stuck and breaks up at the side of the injection machine surface body. This can cause the operator to have to move from their place to put the compound back into the feeder. Other than that, if the operator did not notice the compound was cut off from the feeder, it can cause the rubber

to not be fully entered into the mould cavity due to not enough compound. Consequently, incomplete parts will be produced. The incomplete parts will then be rejected and may increase cost of production. For purpose of this paper is to investigate the compound break up from the injection machine's feeder.

2. LITERATURE REVIEW

According to Goessling and Heights (1944) this invention relates to machines for injection moulding or die casting of plastics that is, moulding machines of the kind wherein the heat-softened plastic material is forced or injected from a pressure cylinder by a ram, into a mould cavity to form the moulded shape product as shown on Figure 2.1.

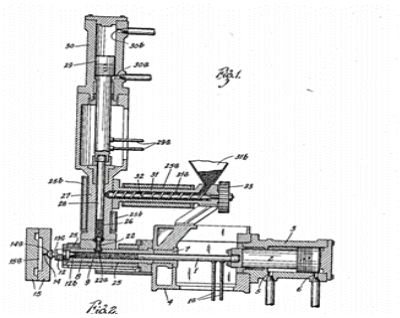


Figure 2.1: Injection Moulding Machine Diagram

2.1 Friction between Two materials

According to Philip Gabriel (2010) the friction between rubber surface in contact with a rigid surface is still not fully understood such as the example in Figure 2.2. Unlike other materials, friction behaviour in rubber is significantly dependent upon a variety of parameters due to its viscoelastic nature. Under certain conditions, it can increase the frictional force significantly above that expected from a consideration of the interfacial coefficient of friction alone.

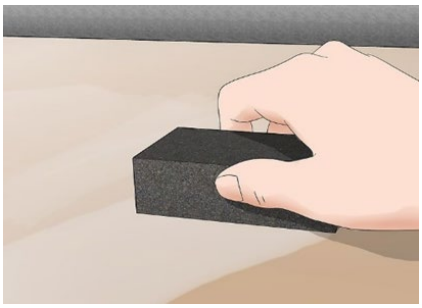


Figure 2.2: Rubber Material On Flat Surface

According to B.N.J Persson (1998) rubber exhibits unusual sliding friction. When rubber is slid on a hard, rough substrate, the surface asperities of the substrate exert oscillating forces on the rubber surface leading to energy "dissipation" via the internal friction of the rubber. Because of its low elastic modulus, the adhesion of the rubber to the substrate is very important. This gives an additional contribution to the friction force, estimated and compared with experimental data.

2.2 Roller Element Bearing

A rolling-element bearing, also known as a rolling bearing that being shown on Figure 2.3 is a bearing which carries a load by placing rolling elements (such as balls or rollers) between two bearing rings called races. The relative motion of the races causes the rolling elements to roll with very little rolling resistance and with little sliding (Luc Houpert, 2008).

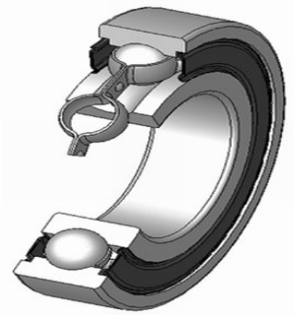


Figure 2.3 Ball Bearing

3. METHODOLOGY

The most important in doing a research is the methodology. In this paper, the method of conducting the current research will be described in detail on how the research was conducted, the research methods used and the reasons for choosing those methods

3.1 Data Collection Method
The analysis that is going to be conducted is due to the rejection problem of short moulds occurring during the moulding operation. Many parts that are being produced faced this problem especially compound break up. Data for this research is taken from the monthly reject schedule that is recorded in one of automotive industry database. The number rejected parts will be recorded in the database every month for monitoring, to see whether it is reducing or increasing.

3.2 Observation
From the observation with the operator handling the machine that has a feeder inside, it was found that it was difficult for them every time the rubber compound breaks up as they have to move from their workstation and place the rubber compound back into the feeder. Example of this compound break up can see on Figure 3.1.



Figure 3.1: Compound Break Up

Other than that, on Figure 3.2 show that the operator also complained that they have to continuously clean the surface body of the machine because of the dirt from the compound. The rubber compound will touch the surface body during the feeding process into the feeder.



Figure 3.2: Dirty Surface Body

3.3 5 Whys Analysis

To find the root cause of the short mould rejection, 5 why analysis was conducted. In this study, the main cause of the problem was found to be the short mould rejection, which is caused by the break-up of rubber compounds when being fed into the feeder. The friction between the compound and the machine's surface body causes this break up to occur. The reason why the friction happens is due to the existence of the feeder inside the moulding machine and the rubber compound is not perfectly positioned as there was no tool to guide the rubber compound into the machine. The 5 Why analysis that being made to find the root cause as shown on Figure 3.3.

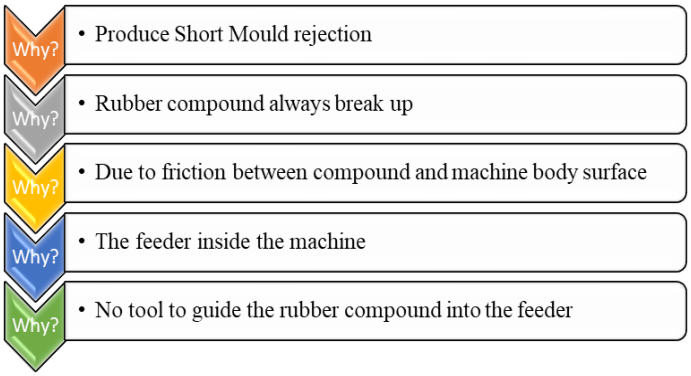


Figure 3.3: 5 Whys Analysis

3.4 Design

In designing the tools to replace the PP sheet, CATIA software was used to design the shape of the tool and to test its functions. The tool will be simulated in this software before the fabrication can be done. After finding the right design, tool fabrication is carried out to test its function.

From the literature review, it was mentioned that two roller bearings can act as a support. For this research, the tool is designed using 2 roller bearings with the diameter of 60 mm and length of 100 mm. The reason why the tool is measured in such a way is because the rubber compound has a width of 50 mm and height of 15mm. The metal plate for the base that is going to be fastened to the machine body has a thickness of 5 mm. Four holes with a diameter of screw size 14 mm were made to fasten the tool.

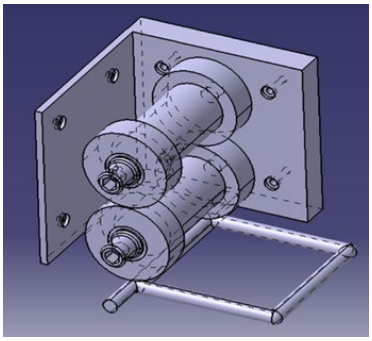


Figure 3.4 Tool Design In CATIA

The tool has a square bar at the bottom of the roller, functioning as the guide for the rubber compound. With the guide placed below the roller, rubber compound will not slip from the roller. This tool will be placed at the top of the machine surface body as shown on Figure 3.4

4. RESULTS AND ANALYSIS

This research is conducted due to the quantity of the increase of rejected products in the production process. This quality issue has been reported by the operators who handled the

machine at the workstation. The rubber compound is used in the moulding process will be stuck at the machine body every time the machine is utilized for the production process. This occurrence will result in rubber compound break up and instead of going into the machine feeder where the rubber compound is being injected into the mould. Due to the breakup, the chamber that stores the rubber compound will not be fully injecting the rubber compound into the mould. The data had been collected for the first three months before installing the tool on the machine's body. The data on the rejection rate for the first three months was collected from the machines that have a feeder inside. The data on the number of rejections caused by the problem with the short mould were collected.

Table 1: Quantity Of Short Mould Reject

Previous Condition	
Month	**Rejection (pcs)**
September	560
October	680
November	655
Total	1895

4.1 Tool Guide for Rubber Compound

The idea in designing this Tool Guide for rubber compound was created using the 5 Why analyses which is also known as the root cause analysis. From the analysis that had been conducted using this method, the reason as to why rubber compound is always broken up is known. The rubber compound always breaks up due to the friction between the rubber and machine body before entering the feeder. This method is one of the solutions that initiates the idea to design this Tool Guide and solve the problem that is being faced by the operators handling the process of inserting the rubber compound into the feeder.

Table 2: 5 Why Analysis For Compound Break Up

Why 1	**Why 2**	**Why 3**	**Why 4**	**Why 5**
Produce Short Mould Reject	Rubber Compound Always Break up	Friction Between Compound and Machine Body	Feeder Inside The Machine	No Tool to Guide the Compound into the Feeder

Meetings and discussions among the staff was conducted in the initial stage for the design development which is considered the main procedure to achieve the goal. Ideas are thrown in a form of a sketch which varied in terms of shape and designs. The main focus of this procedure is to determine the size and position of the Tool guide. This design will be focusing on the suitable angle for the roller of the Tool guide

5. CONCLUSION

For this project it can be concluded that the rubber compound break up can produce many types of defects. From this break up the problem, many issues will happen that can cost lost to the company. It was found that short mould rejection is the highest rejection that was produced due to break up of rubber compound. From the targeted amount of production which is 6,500 pieces per month, 242 pieces of short mould parts were produced due to break up the problem in the month of September 2019. Short mould defect makes up 3.7% from the total 8.6% of all defects that were produced. This short mould problem is the highest defect being recorded in September 2019. Furthermore, the short mould defect showed an increase in October 2019 with a total of 385 pieces being rejected, which is 5.9% from the total 10.4% defects. The data also showed that in November 304 pieces were recorded to be rejected due to short mould defect, which makes up 4.67% from total defect of 10%. This data indicate that the break up the problem is due to friction that occurs between the body

machine and rubber compounds when entering the feeder. From the friction that has been produced, another problem arises where the body of the machine will be dirty. By implementing the tie Tool Guide, the problem of friction has been eliminated and consequently, reducing the rubber compound break up.

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REDUCING THE SHIELD COWL VENT SPLASH PRODUCTION CYCLE TIME USING THE NEW TYPE ASSEMBLY FIXTURE

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Abstract. The rivalry of the manufacturer to satisfy market requests shows that one of a kind procedure and approach is being considered to enhance efficiency. One such technique includes the execution and improvement of an assembly fixture. This particular assembly instrument underpins an assembly work by improving laborer's productivity and produces a steady degree of exactness to the work. The goal of this thesis is to structure and builds an assembly fixture. Furthermore, this study aims, at analyzing establishment time in a shield cowl vent splash assembly from a working proficiency perspective assembly fixture is built by utilizing the CDIO framework to assess the process duration during shield cowl vent splash assembly procedure, particularly clips assembly. The result of this study is based on perception towards a shield cowl vent splash assembly, where the components related to the assembly fixture are estimated and, trailed by documentation on the analyzed work sequence. The result is an assembly fixture has demonstrated to improve profitability by diminishing cycle time. Based on the solid finding, an assembly fixture design is proposed for an operator at the assembly process to increase the company's profitability.

Keywords: Assembly Fixture, Work Efficiency, Productivity, Cycle time, Shield Cowl Vent Splash Assembly.

1. INTRODUCTION

The revival of the manufacturing industry in the world is instantly rapidly changing. This can be identified from the development managed by each manufacturing industry. The better improvement implemented, the higher the buyer demand level. Thus, with such conditions, the consistency of sums, shapes, and sizes for a singular thing or portion should obtain a uniform quality. The quality upgrades can be cultivated by implementing tools for a creation methodology, including jig and fixture, mould, and dies.

The standard improvements can be practiced by utilizing instruments for a more inventive technique. The use of aids will be converted into improved quality, diminished costs, streamlined work forms, less waste, and improved consumer loyalty and benefits. For example, in the welding strategy, there is every now and again a couple of errors both to the extent overseer and to the extent plan and decision of welding instruments used. The most outstanding mistakes during the welding method remain the nonattendance of precision between the two sections that will be welded to make harmed things. This is an immediate aftereffect of the slip up in the arranging and picking of a mechanical assembly that is used as an instrument to assist the work piece which is being welded. Therefore, a device is required to support the executive in welding. According Nagarajan et al. (2015), one of the instruments in welding is jig or fixture. Both jig and fixtures are utilized to produce a tedious sort of work pieces with zero deformities. This research will gain insights about the assembly process of shield cowl vent splash to diminish set-up time, achieve simplicity of work, and build generation process speed.

2. LITERATURE REVIEW

According to Deshpande (2016), Lean manufacturing lessens fabricating lead times and process cycle time by decreasing holding up times between preparation stages, just as procedure establishing times and item, model change times. With the utilization of jig and fixture, it does not merely exclusively improve the process duration. It can additionally improve profitability and help to cause the workers' work to become frequently simpler (Radhwan.et.al., 2019).

According to Raut (2017), it likewise serves to decrease the working time by permitting fast arrangement and by smoothing the change from part to part. Referring to the Giorgio Sudibyo, 2016, satisfied representatives who are steadfast and occupied with the organization can benefit the organization by being beneficial.

3. METHODOLOGY

3.1 Conceive

Conceive is a technique for understanding the ongoing issues in the project. In this project, the problem was detected and observed in the workstations A-1 and A-2 and at the assembly area A (Figure 3.1).

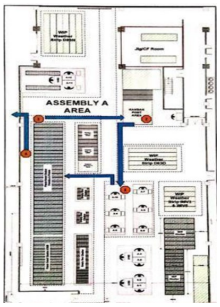


Figure 3.1: Assembly Area A

3.1.1 Interview

The first method used to identify the issue is interviewing the operators (Figure 3.2). The interview session was held during the working time where a couple of questions were asked. Then, the answers will be written down on the interview form. The operator at workstation A-1 will be asked first followed by the worker at workstation A-2. The operator at workstation A-1 assembles shield cowl vent splash left part while another worker assembled the right part. From this interview, it will help to clarify, increase comprehension, and investigate the inquiries about the subjects' feelings, conduct, encounters, wonders and so forth.



Figure 3.2: Interview Session at The Workstation

3.1.2 Observation

The second qualitative method used to identify the problems is an observation (Figure 3,3). The observation method is done in assembly area A at workstation A-1 and A-2 during the morning assembly process. The fixture is used to install the clips of the shield cowl vent splash. With the current tool, there are some issues that affected the installation process. During the observation, the operator is seen using the old type fixture to install the clips. The first step of clips installation is one clip must be inserted in the fixture hole before placing it into the part. Next, repeat the step for the second clip installation. Both of the clips must be installed properly until a tapping sound is heard indicating that it has been tightened. The obvious issue here is the operator needs to take and put the clip from the poly box one by one and it led to the loss of cycle time. So, this will affect the finished part output because the operator cannot achieve the required target output.



Figure 3.3: Part Assembly Process Observation

3.1.3 Fishbone Diagram

The next method is illustrating a cause and effect diagram. It is based on the previous methods which are interview and observation. The first step is begun by naming the fundamental issue or occasion. The problem statement is based on the main objective of the project. This generally goes at the head of the fishbone in the chart. Then, classes are made for causes and make the structure of the fishbone. Normal classes include methods, material, machine, manpower, and environment. The cause of the problems under each class is found through the interview and observation methods. Next, rundown potential causes are made under every class remembering varieties for a procedure or structure. Finally, the finished fishbone outline (Figure 3.4) is put into the research. The main cause has been identified from this fishbone which is from the method class. This is because the method class contributes the most causes than the rest of the classes.

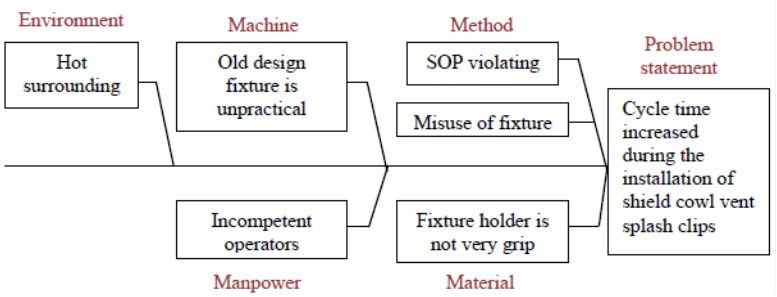


Figure 3.4: Fishbone Diagram

3.1.4 Cycle Time

The fourth method is recording the cycle time. The cycle time (Figure 3.5) is recorded during the working time at workstations A-1 and A-2. The time is measured between the fruition of one part of the shield cowl vent splash until the culmination of the following part. The cycle time of both parts is taken ten times to get the average data.

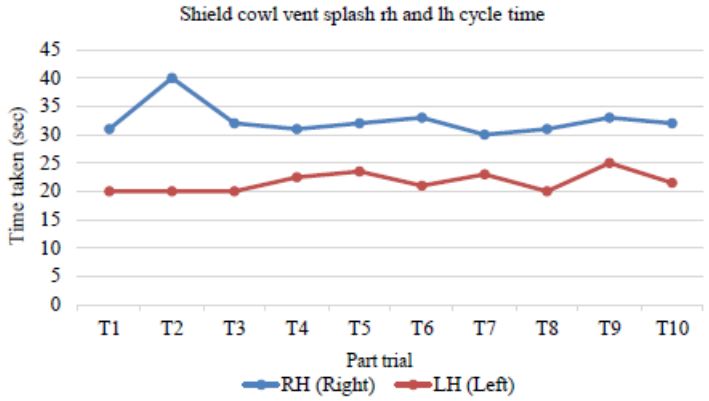


Figure 3.5: Shield Cowl Vent Splash Assembly Cycle Time

3.2 Design

Structure in CDIO is about making the structure; the plans, drawings, and calculations that depict what will be executed. Subsequently, CATIA V5 programming is utilized to encourage researches on the project to be executed. 3 types of designs (table 3.1) have been sketched on paper and will be illustrated in CATIA software. Parts' dimension has been taken and will be used to draw the parts.

Three plans were made based on the discussion with the leader and workers. The decision was made for the sake of the comfort of the workers while conducting the procedure. Taking this factor into account, fixture design 3 was chosen. Next is the drawing of the design steps using CATIA V5 software. The drawing utilizes the mechanical design and part design utilities. Some types of the fixture model are using CATIA V5. In the wake of doing estimations on shield cowl vent splash part, the dimension is taken and consolidated into the plan for fixture model before producing another fixture. Each of the three fixtures has their own strengths and weaknesses. The appropriate model with the best characteristics will be chosen to be executed using 3D printing.

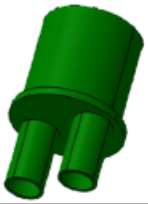
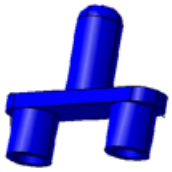
Product	Fixture Type 1	Fixture Type 2	Fixture Type 3
Product Design			

Table 3.1: Fixture Designs Selections

3.3 Implement

Next, Implementation is the next approach after conceiving and design. After finalizing the chosen design, it will undergo the fabricating process which is using 3D printer. The material selected for this process is ABS type material. According T. Minamikawa, 1956, the 3D printer can print various type of items incorporate printing models, parts, and toys. 3D printers are also being developed for medical applications, including printed bone, skin, and even complete organs.

3.3.1 3D Modelling Process

3D modelling is a method in PC illustrations for delivering a 3D computerized portrayal of any article or surface which is created by using CATIA V5 software (Figure 3.6). It can take author through sketching, part modelling and design, drafting, and product design.

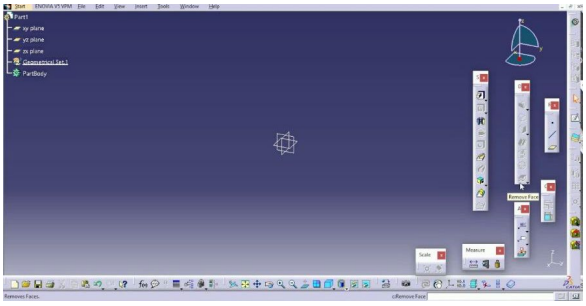


Figure 3.6: CATIA V5 Software

3.3.2 Printing Process

After the designing process has been completed, the design can be directly printed using the 3D printer mechanism (Figure 3.7). The time taken for the printing process depends on the dimension of the design. The printing procedure utilizes the fundamental standards of the additive layer with a progression of procedure machines to peruse the 3D plan and start to mastermind the layers progressively to manufacture virtual models consequently joined to frame a whole structure.

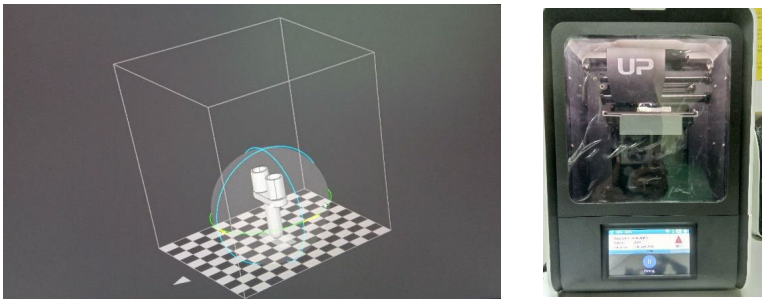


Figure 3.7: 3D Printer Mechanism

3.3.3 Finishing

In this stage, the process that occurs is the process of removing the excess plastic around the fixture with an aim beautifying the fixture. The excess plastic is removed by scraping it with a knife. It must be done with care and caution as it can cause injury. It needs to be done perfectly to reflect the fineness of the fixture.

3.4 Operation

The operation stage is important to determine whether the fixture is functioning properly or not after it has been fabricated using the information taken from the check sheet form. One of the significant steps in gathering the information is the utilization of the check sheet structure (Table 3.2). This assortment date process incorporates perusing the sequential construction system process duration and dismissal rate. This procedure is intended to recognize the process duration perusing and dismissal rate when the apparatus is actualized.

Table 3.2: Check Sheet Form

LIST OF TOOLING, CHECKING FIXTURE/INSPECTION JIGS, EQUIPMENT & FACILITIES								
SUPPLIER NAME							CHANGE LETTER	
PART NAME	MODEL	COLOR/VARIANT PART NO.		PART CHARACTERISTIC		APPROVED (SUPPLIER)		
NO.	TOOLING/EQUIPMENT/C/F/JIG/PRODUCTION JIG/FACILITIES	PURPOSE OF TOOLING/ JIG/EQUIPMENT/ FACILITIES	MATERIAL	CYCLE TIME	USAGE AREA	Drawing Number (if applicable)	New	Existing
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

3.4.1 Installation process

Figure 3.8 comprises all steps in assembling the shield cowl vent splash.

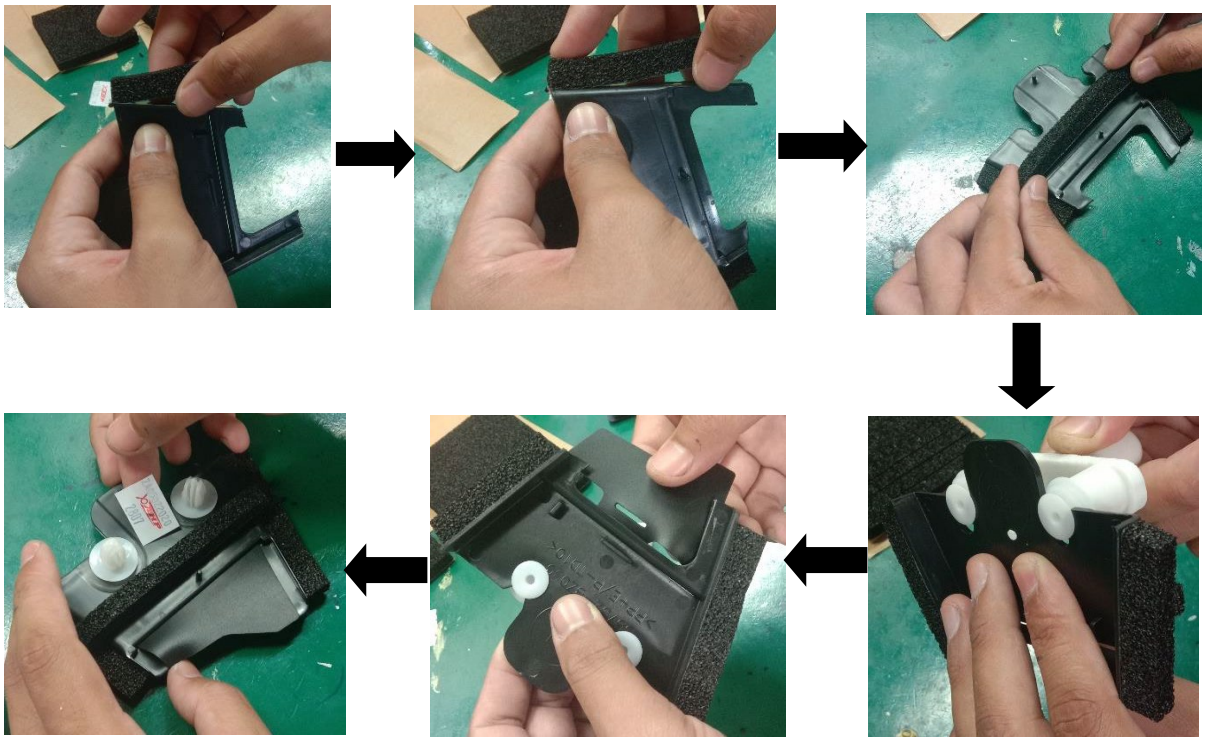


Figure 3.8: Shield cowl vent splash assembly process

4. RESULTS AND ANALYSIS

4.1 New assembly fixture design

The data assembled for this exploratory research are primarily obtained from journals, books, and online websites that help the research. The literature review can be the establishment of the difficult definition, and it might likewise be the data required to actualize the approach into the execution of the research. Data investigated in this procedure are adjusted into the research by adding it to the composing segment or supporting the tools and programming execution.

4.1.1 Child part design

Before the start of the fixture design, the child part needs to be considered. This study focuses on the child part or more specifically called clip (Figure 3.9). This is because it is closely related to the new assembly fixture design which is to know whether it works or not. The related dimension such as the curve of the clip must fit the new assembly fixture design because it is a crucial area.



Figure 3.9: (left) Clip 3D Design. (right) Clip

4.1.2 Assembly fixture design

To improve the process duration during the establishment, the fixture should be actualized. Before the beginning to build it up, the plan procedure is done to confirm that the assembly of the fixture is reasonable to hold the part. The piece of shield cowl vent splash clips has been concentrated to get the correct shape and size of the installation. The structure of the assembly fixture is basic in light of the fact that the clips are uncomplex.

Figure 3.10, illustrates the design of shield cowl vent splash assembly fixture. The design followed the shape and size of the clip and both of the fixture holes will hold the clips during the assembly process to the mother part. By using the new fixture, all clips will be attached to the mother part at one time. Thus, it will automatically ease the operator handling during the installation process. The design is made using the CATIA V5 R21 software.



Figure 3.10: (left) Assembly fixture 3D design. (right) Assembly fixture

4.2 Data Collection

Data collection is the method of collecting and estimating data on factors of enthusiasm, in setting up a deliberate design that empowers one to address expressed research questions, test theories, and assess results.

4.3 Cycle Time Improvement

A process duration study has been done at the assembly production system. Both of the process durations after implementing the new shield cowl vent splash fixture were recorded. All the information including the time taken for completing the part was gathered by utilizing the standard check sheet. The process duration was recorded multiple times. The span for assembly information process takes a few times. This is on the grounds that the creation of shield cowl vent splash is following the conjecture from the client.

4.3.1 Old Design Assembly Fixture Implementation

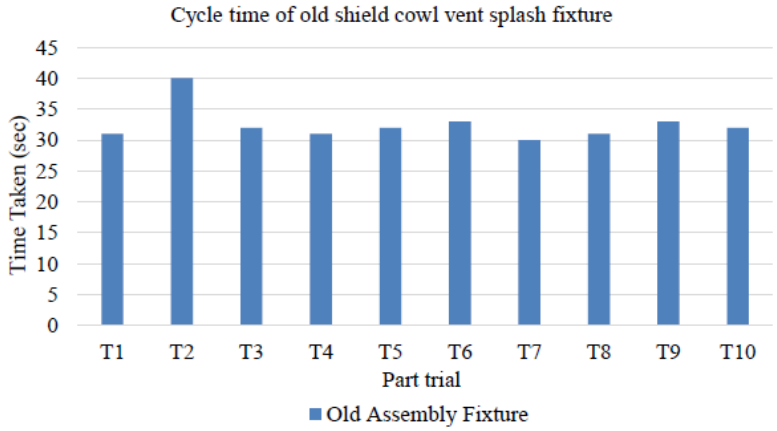


Figure 3.11: Shield cowl vent splash cycle time using old type assembly fixture

Average production per day = 588 pcs

Average cycle time = Total time taken / Total part trial
= 166 sec / 10
= 16.6 sec

Working hour per day = 10 hour
= 600 min
= 36000 sec

Time taken to produce 588 parts = Average cycle time x Average cycle time
= 16.6 x 588
= 9760.8 sec
= 162.68 min
= 2.7 hour

4.3.2 New Design Assembly Fixture Implementation

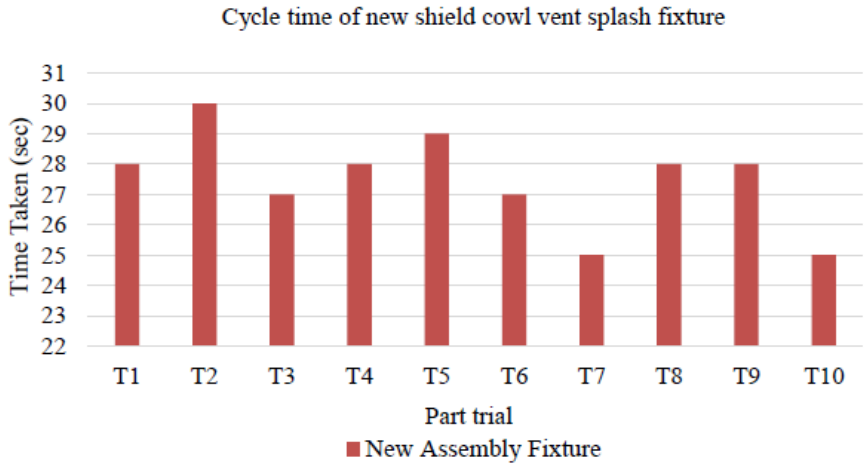


Figure 3.12: Shield cowl vent splash cycle time using new type assembly fixture

Average production per day = 588 pcs

Average cycle time = Total time taken / Total part trial
= 142 sec / 10
= 14.2 sec

Working hour per day	= 10 hour = 600 min = 36000 sec
Time taken to produce 588 parts	= Average cycle time x Average cycle time = 14.2 x 588 = 8349.6 sec = 139.16 min = 2.3 hour
Differences	= 2.7 hour – 2.3 hour = 0.4 hour = 24 min = 1440 sec (additional working time available)
Additional parts	= Additional working hour / cycle time after = 1440 hour / 14.2 sec = 101 parts

After the new fixture was executed, the time expected to gather 588 parts was reduced from 2.7 hours to 2.3 hours. By this way, a total of 101 pieces of parts can be stored as the stock for upcoming ordering.

5. CONCLUSION

Assembly fixture usage in an industrial facility can be viewed as one of the choices to accomplish a more noteworthy efficiency. As an instrument, an assembly fixture lessens the production cycle time. Furthermore, it is additionally proficient to diminish the development required in a work. Assembly fixtures can be adjusted into supporting assembly procedures for almost all types of items. By breaking down the working necessities, an ideal plan of an assembly fixture can be produced. A few conclusions can be derived from the analysis result.

The proposed fixture was sufficiently proven to reduce the cycle time in the assembly process and consequently reduce the cost of production and overcome the quality issues being posed by the customer. Therefore, general expenses could be mercifully spared. From the comprehensive analysis and extensive examination that had been done, the excellent quality of shield cowl vent splash has been typically increased by properly introducing the new fixture in the assembly process. This is due to the fundamental fact that the initial cycle time was longer as the old fixture was no longer suitable to be properly used to properly assemble the clips. Furthermore, the workers typically faced direct challenge in properly handling the old fixture, which leads to a noticeable increase in time.

Moreover, the number of rejected parts was high. The rate of the deformity was around 3.4 % of the total produced parts when using the old fixture. This contributes the and the workers' compensation. The rejection and defects also caused the organization to lose the trust of the clients.

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AUTO-RELEASE TRANSFER CART (GRAVITY FLOW RACK) FOR PRODUCTION LINE EFFICIENCY

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Abstract. The research is regarding the improvement of material handling and ergonomic at Safe Launch Plan workstation. The continues improvement or normally known as Kaizen making the work more efficient and effective by creating a team atmosphere, improving everyday procedures, ensuring employee satisfaction, and making a job more fulfilling, less tiring and safer. Meanwhile, material handling and ergonomic played a major role in the manufacturing industry. Minimum workforce during the process and material handling efficiency help the facility work in a productively. The problem that was facing is the trolley ergonomic is to narrow and not convenience while the trolley also not efficient in term of materials handling. The main goals of this study are to overcome all the problem by collecting data and design a new trolley to more efficient in term of cycle time. Finally, propose the solution.

Keywords: Ergonomic, Kaizen, Material handling efficiency

1. INTRODUCTION

ABC SDN BHD is a well-known company in Malaysia automotive industries by producing Rubber, Polyurethane (PU) and Thermoplastic elastomers (TPE) product with high quality and low cost by using the latest technology. ABC always looking for improvement in every section to become a more profitable company to eliminate waste by maintaining low production cost. The overall focus on this research in on the improving the safe launch plan (SLP) workstation to become more efficient in terms of material handling, production line efficiency and ergonomic design of trolley during the inspection process.

1.2 Research background
Material handling involves short-distance movement within the confines of a building or between a building and a transportation vehicle. It uses a wide range of manual, semi-automated, and automated equipment and includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to create time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which creates form utility by changing the shape, form, and makeup of the material. (RAY, S. 2008)

Investing in ergonomics can help to increase the health and wellbeing of office personnel. Effective ergonomic products and practices can increase productivity by reducing the time taken to complete daily tasks, as well as reducing instances of absenteeism due to work-related injury or illness. As a result of all of these, company productivity can be increased, in turn increasing company profits, (Reicks & Myers, 2004).

Thus, Safe Launch Plan (SLP) Workstation is one of the controls to make sure the quality of new development product is top-notch (Figure 1). SLP is shipment zero defects parts that meet either the defined time or number of lots. Any defects discovered during this period restarts the event to "0" pieces shipped. Hence, action can be taken immediately to improve the weakness to make sure products always in good condition. This study is focused primarily on data collection, and to propose a new design of the trolley.

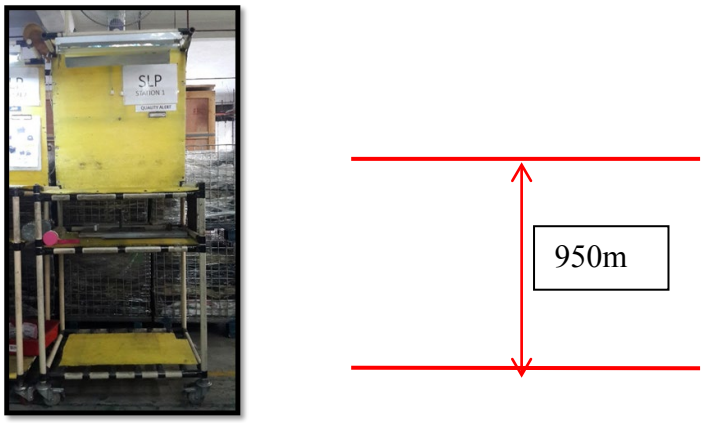


Figure 1: SLP workstation

2. LITERATURE REVIEW

This philosophy of continual improvement emphasizes the importance of involving employees at every level of the organization. This philosophy assumes that our everyday life should focus on constant improvement efforts. This is so natural and obvious to many world-class organizations that they sometimes forget they possess it. Kaizen is intended to be integrated into the normal day-to-day activities with the focus on eliminating waste, creating standards, and having a clean, organized workplace. Improvements made through kaizen are generally small and subtle; however, their results over time can be large and long-lasting (Ortiz, 2006).

2.1 Material Handling

The term 'materials handling' itself requires defining, if only because the phrase usually conjures up visions of fork-lift trucks (FLTs), conveyors and other pieces of expensive hardware, (Belekoukias et al., 2014). Materials handling endeavours to do for the flow of materials through an organization what work study does for the various jobs that make up the production processes. By examining each movement, and considering in detail the requirements for the move, the necessity for it, and the amounts and sizes of material to be moved, we obtain a detailed picture of the handling which is taking place throughout the processes and are thus in a position to consider whether any of these moves can be eliminated, combined with some other movement or processes, or simplified.

2.1.1 The system Concept In Material Handling

There are three types of system typically used in industry:

i) Manual mode - Typified by individuals observing operation, making records and taking corrective actions when needed. Job tickets, move orders and control documents may accompany materials travelling their routes in containers or on pallets.

ii) Mechanical mode - Used of limit switches, photoelectric cells, and other devices to actuate stopping, starting, diverting, accumulating and other functions.

iii) Automatic mode - Integrating of code-reading scanners that either record operating information or cause an action to take place or both.

2.1.2 Safety of material handling

The industrial accidents can be attributed to handling activities, according to an industry study. Such accidents particularly involve lifting and related types of manual effort. Thus, both

mechanized and automated materials handling equipment can play a major key role in saving life and hoists and ramps can go a long way towards providing a safe workplace.

2.2 Ergonomic

The definition for Ergonomics is a work-study, (Deml et al., 2017). In particular, ergonomics is a science that designs work in line with the comfort and safety of workers, rather than forcing the workforce to adjust their daily tasks. By adjusting tasks, workstations, tools, and equipment to meet employees can help reduce physical stress in the workforce and reduce the number of serious problems associated with musculoskeletal disorders (MSD). Ergonomics attracts several scientific disciplines, including physiology, biomechanics, psychology, anthropometrics, industrial hygiene and kinesiology.

3. METHODOLOGY

This methodology is an important element that aims to explain the method and implementation of the project, methodology and project design in more detail. This is also a description related to the equipment, component measurements, rules and techniques used in the manufacture of the project. To produce high-quality projects, manufacturing projects must be carried out according to a systematic and orderly planning schedule provided that the projects produced are of good quality and can meet the required specifications. This also aims to ensure that its implementation does not cause problems and the project runs smoothly.

3.1 Define Problem

In this study, SLP workstation had been defined as problem areas and need to improved. SLP is one of the alternatives to control product quality before going out to the customer. Most of the new development product will go through SLP inspection. Thus, SLP workstation will be flooded with parts, especially during the morning. This problem will interrupt the inspection process (Figure 2). The workstation are conducted by an operator and will be monitored by QA. This study was conducted at the SLP workstation. This is due to many items at this station and it requires efficient work. This is because the items need to be checked 100%. Workers should lift the polybox from the trolley onto the table. This study is more focused on heavy goods such as P2/124 and P2/123. The ergonomic factors become the main element in this study. Problems often happen when stuff is so urgent. Workers need to work faster but limited tools and equipment make work inefficient.



Figure 2: SLP workstation (part need to inspect)

3.2 Collect Relevant Data

Some data collection is required to disclose the desired information. Often information must be developed about the flow of materials through the facility, along with the type of movement that takes place. Observation is carried out during the product manufacturing process. During the survey, there was a problem happening at SLP workstation because bottlenecks occur in SLP workstations.

At the SLP workstation is also a non-ergonomic work process. This non-ergonomic condition occurs when employees want to lift the polybox from the trolley. This adds to the problems that occur during the work process. In addition to the non-ergonomic working environment, it will also make the cycle time for the worker's c to inspect the product increase. A non-ergonomic working environment will make the worker feel sick and will cause musculoskeletal disorders.

3.2.3 Product Description

Bush Lower Arm (MRP CODE: P2/123 & P2/124) according to product description in table 2. This product is supplied to Oriental Summit Industries Sdn Bhd (OSISB). P2/123 and P2/124 are assemblies with the lower arm at OSISB. This lower arm is known as the D20N product for a new Perodua MYVI.

Table 1: product description

MRP CODE	Part weight	Quantity	Total weight	Cycle time
P2/123	197grams/pieces	120pcs/polybox	23.6kg/polybox	15minute/polybox
P2/124	318grams/pieces	60pcs/polybox	19.0kg/polybox	5minute/polybox

3.3 Analyses Data

With all the data collection, the analysis needs to be carried out deeply to find the root cause. Ishikawa (fishbone) diagram is one of the technique widely in the industry used to find any root cause (Figure 3). A Fish bone diagrams are a visual way to see cause and effect. A Fish bone diagrams can help identify possible causes of problems that may not be considered by directing teams to look at categories and think of alternative causes.

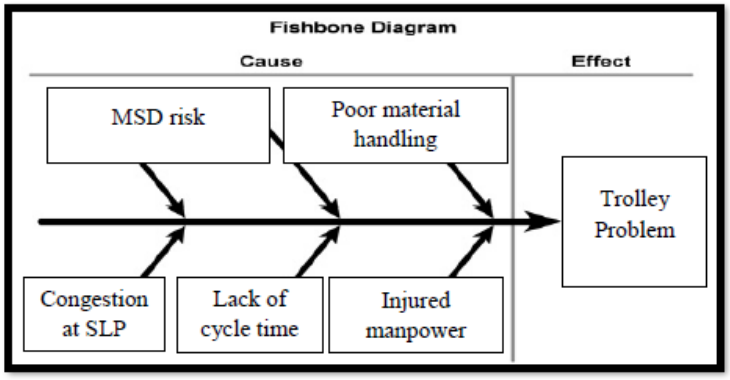


Figure 3: Fishbone diagram

3.4 Develop Plan

Once appropriate data have been assembled and analysed, developing and evaluating alternative solution plan can begin immediately. Brainstorm all the idea by sketching the new racking system and choose the best considering all aspects by reflecting all problem in the fishbone diagram. Hence, the design chosen will draft into CAD using CATIA software.

3.4.1 CATIA V5r21

CATIA an acronym of computer-aided three-dimensional interactive application is a multi-platform software that offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex, innovative shapes from industrial design to Class-A surface with the ICEM surfacing technologies. CATIA supports multiple stages of product design either started from scratch or 2D sketches (blueprints).

3.4.2 Trolley

A trolley is an object with wheels that use to transport heavy goods. Figure 4 shows the existing trolley that used at the production line. This trolley is used to transport the product from one workstation to another. Figure 5 shown the gravity flow rack trolley.



Figure 4: Existing trolley model

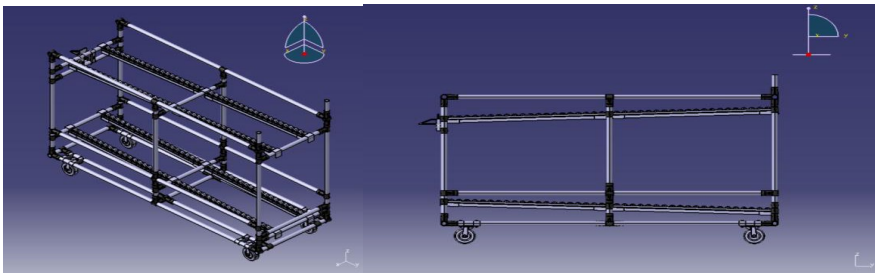


Figure 5: Gravity flow rack trolley

3.4.3 Analysis

This study was led at the SLP workstation. This is due to many items at this station and it requires efficient work. This is because the items need to be inspected 100%. Workers should lift the polybox from the trolley onto the table (Figure 6). This study is more focused on heavy goods items, such as P2/123 and P2/124 where ergonomic factors become the main element in this study. Problems often happen when stuff is so urgent. Employees need to work faster. Limited tools and equipment make work inefficient.



Figure 6: workers lift the polybox to put to the inspection table

i) FEA simulation / ANSYS

ANSYS structural analysis software used to solve the complex structural engineering problems and make better and faster design decisions. Finite element analysis (FEA) tools available in the suite, we are able to customize and automate solutions for your structural mechanic's problems and parameterize them to analyze multiple design scenarios.

ii) CATIA Clash Analysis

CATIA is a complex design tool. One of its core competencies is solid modelling. This allows the user to check for clashes between components in assemblies. CATIA offers clash analysis in many of its workbenches. CATIA has an excellent set of API with documentation that can

be accessed using VBA. With a little effort, CATIA can be customized with a set of tools to significantly increase the productivity of the tool.

iii) Rapid Upper Limb Assessment (RULA) Analysis

RULA was developed to assess the exposure of individual workers to ergonomic risk factors associated with upper extremity MSD. The RULA ergonomic assessment tool considers biomechanical load requirements and posture/work demands on the neck, trunk and upper legs, (Middlesworth, 2015). A single-page worksheet is used to evaluate required body posture, force, and repetition. Based on the evaluations, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk. The score that represents the level of MSD risk as outlined below (Table 2).

Table 2: Level of MSD risk

Score	Level of MSD Risk
1-2	negligible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

By using CATIA V5r21, the level of MSDs risk can be defined by simulation of manikin performed the work (Figure 7 and 8) at Ergonomics design and analysis (human activity analysis).

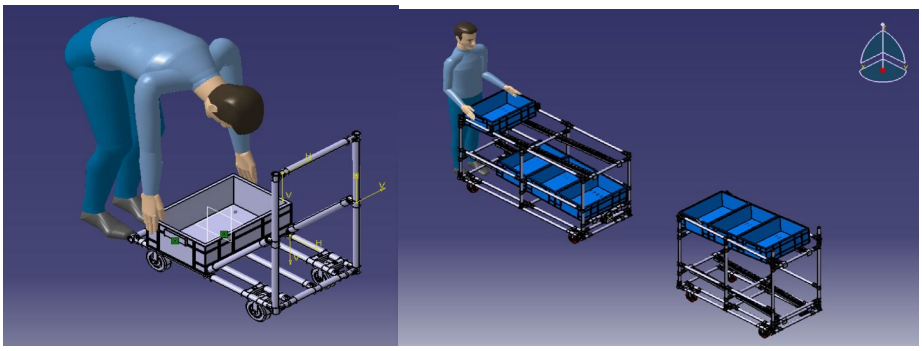


Figure 7: Existing trolley (manikin) and Figure 8: Gravity flow rack (manikin)

3.5 Proposed Solution

Finally, propose the new trolley (Figure 9) for the SLP workstation with all the data collection to the top management. This propose may take time to be approved considering cost, time and willingness of the management to take the risk by changing the layout that may cause the unsatisfied result.

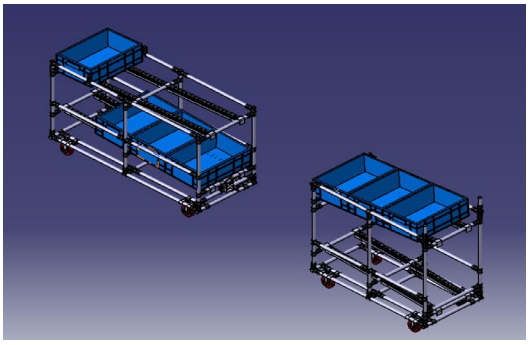


Figure 9: gravity flow rack & storage rack

4. ANALYSIS AND RESULTS

This chapter discusses about the Gravity Flow Rack system that was carried out in this study involving worker. It also discus about workers at SLP and trimming workstations, data analysis of cycle time on the level of every single construct and item. Analysis of Finite element analysis (FEA), clash analysis and ergonomic design and analysis are also presented in this chapter.

4.1 The Gravity Flow Rack System (GFR) Concept
It is a storage rack that uses metal shelves, which are equipped with rollers or wheels to move items on it by using gravitational force. The mains function of this system is to move the parts and components as close as possible to the operators' place of use. Therefore it can be achieved ergonomically by the operator. The GFR allows only small number of parts or components to be replenished at a time; hence it does not require a larger storage area and saves space. At the same time, it also ensures that the right material with the right quantity and orientation supplied into the line.



Figure 10: Operator lift up the Parts

4.1.1 A Series Of Kaizen Activities Have Been Conducted To Optimize The Effectiveness Of The GFR System As Follows:

i) Simplify and re-arrange the assembly processes:
Current assembly processes were simplified and re-arranged by combining the process elements and movements where possible, as well as rearranging the process sequence and simplifying the processes.

ii) Elimination of Non-value aided (NVA) activities:
The NVA activity such as loading the components has been replaced by the GFR system. While transferring of FG poly-boxes onto the line store which was manually done by two operators has been improved by a specially designed trolley.

4.2 Finite Element Analysis (Structural Analysis)
4.2.1 Load Description

Table 3: Load description

No.	Description	Magnitude
1	A pressure load is applied on the base surface of the standard trolley, 10 polybox/trolley	Pressure load = 2319.08 Pa
2	A pressure load is applied on the base surface of the GFR, 3 polybox/trolley	Pressure load = 685.73 Pa

4.2.2 Standard trolley result

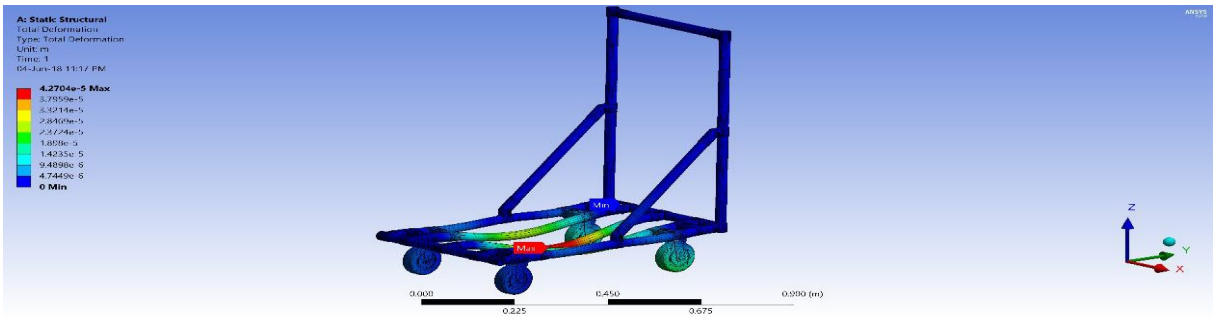


Figure 11: standard trolley (total deformation)

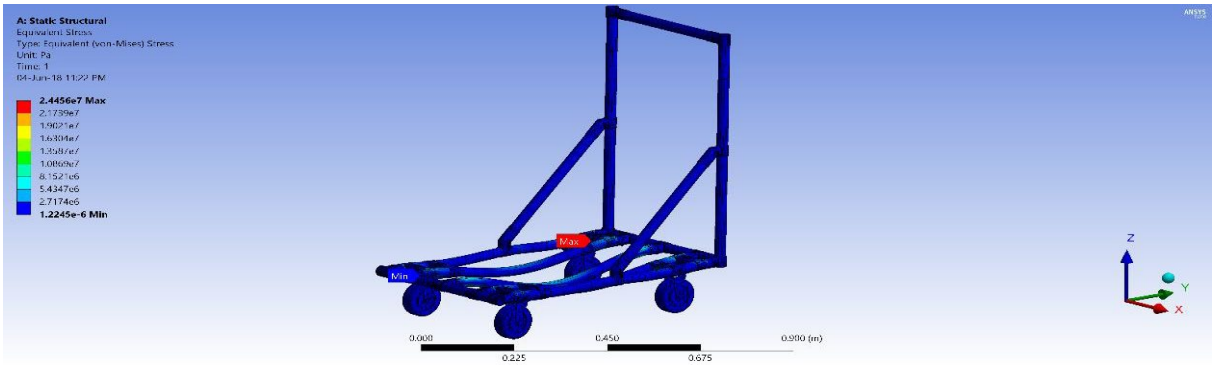


Figure 12: standard trolley (equivalent stress)

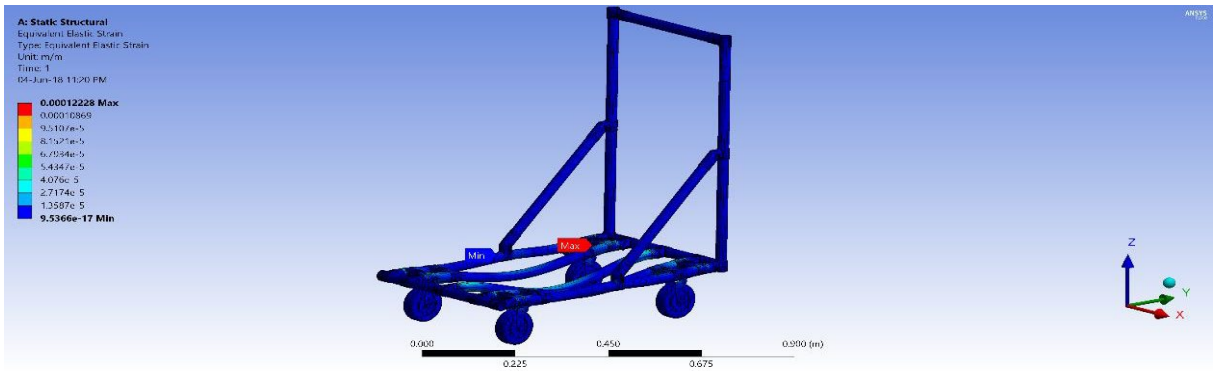


Figure 13: standard trolley (equivalent strain)

4.2.3 Gravity flow rack (GFR) result

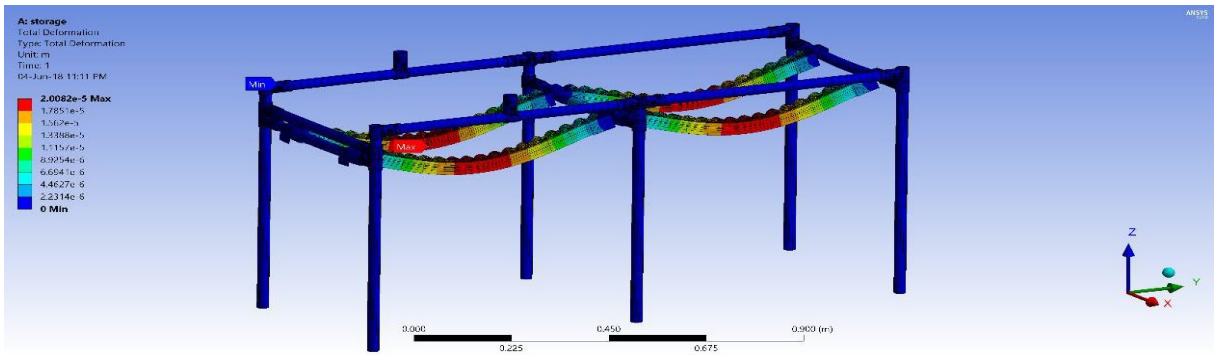


Figure 14: GFR (total deformation)

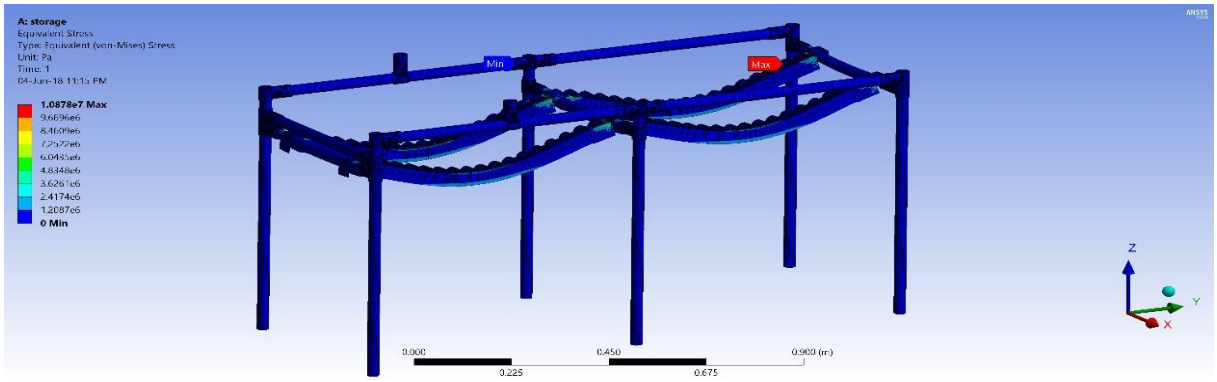


Figure 15: GFR (equivalent stress)

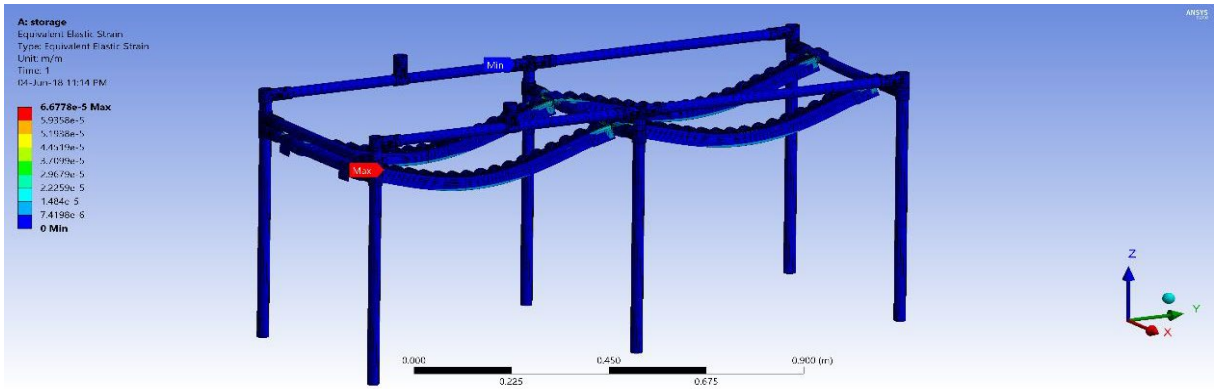


Figure 16: GFR (equivalent strain)

4.2.4 Data comparison,
The important results are summarized in Table 4 (Standard trolley)

Table 4: Standard trolley structural analysis

No.	Description	Magnitude
1	Maximum and minimum of Total Deformation	Max : 4.2704e-5 m Min : 0 m
2	Max and min of Equivalent (von-mises) stress	Max : 2.4456e7 Pa Min : 1.2245e-6 Pa
3	Max and min of Equivalent (von-mises) strain	Max : 1.2228e-4 m/m Min : 9.5366e-7 m/m

The important results are summarized in Table 5 (GFR)

Table 5: GFR structural analysis

No.	Description	Magnitude
1	Maximum and minimum of Total Deformation	Max : 2.0082e-5 m Min : 0 m
2	Max and min of Equivalent (von-mises) stress	Max : 1.0878e7 Pa Min : 0 Pa
3	Max and min of Equivalent (von-mises) strain	Max : 6.6778e-5m/m Min : 0 m/m

4.3 Clash Analysis

Clash analysis is performed to identify the distance between two objects. The picture below shows the distance between the pipe rack and polybox. The distance between pipe rack and polybox is only 1.41mm. The purpose is to stabilize the polybox rather than move.

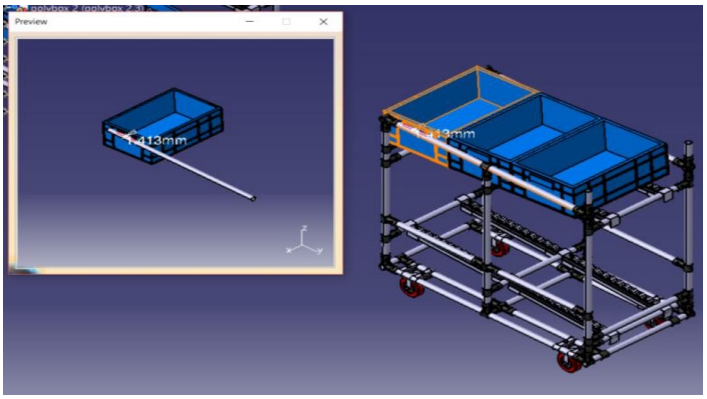


Figure 17: clash analysis (GFR)

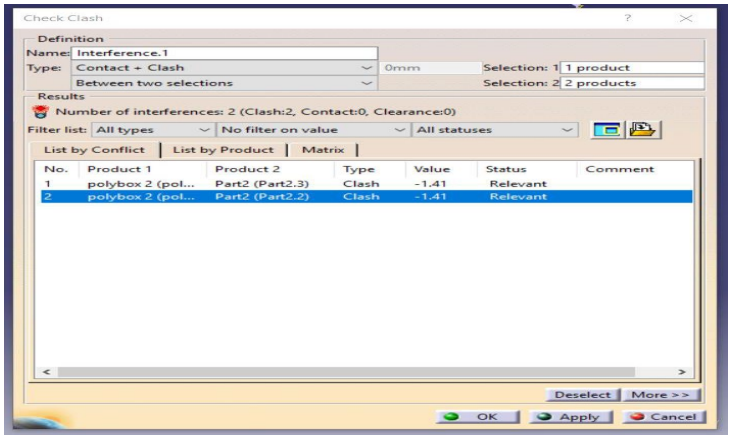


Figure 18: clash analysis data

4.4 Ergonomic Analysis

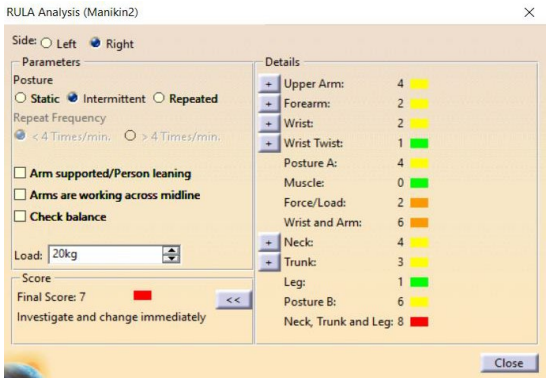


Figure 19: RULA result (standard trolley)

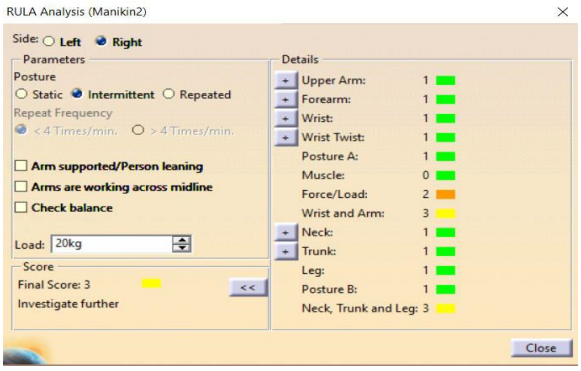


Figure 20: RULA result (GFR)

5. DISCUSSION

5.1 Space Optimization

The GFR is designed to save up space in the trolley and the amount of space needed to store the polybox. The GFR is made of two levels of conveyor system that will retrieve the polybox automatically when placed on the rack by the operators who place the polybox back inside the rack. The GFR is expected to place three to four polybox per conveyor. This will save up the cycle time. The number of polybox that could be placed inside the rack is calculated using CATIA V5 clash analysis. Clash analysis will be able to calculate the amount of polybox that could be placed in a single row of conveyor and it can determine whether the polybox clash with the rack's row space and it can determine the maximum number of polybox that can be placed in a single row.

5.2 Cycle Time

The current GFR used is a common rack which has no system and the polybox are places with no order. This causes a big risk of part damage and polybox loss due to improper storage of polybox. The new racking system is designed to have a First in First Out system to save time on jig arrangement and identification. The current racking system has the polybox placed in it just by stacking the polybox in the inside compartment.

6. CONCLUSION

This research describes the entire study involving material handling and ergonomic design on the Gravity Flow Rack (GFR). The problem statement also describes the problems that occurs and leading to this study. The material handling activities of the SLP workstations can achieve improvement by introducing the GFR systems. Hence, a smooth delivery system for efficient implementation of a Just-in Time (JIT) system can be promised by the production operation. Moreover, it helped to enhance 5S activities, provide systematic and proper resources delivery system. and at the same time can reduce unnecessary activities in the secondary process line. From the analysis simulation shown that this GFR is now more capable than standard trolley because of the strength and stability. It is can improve productivity and efficiency workflow and also ergonomic design meet the requirement of the worker.

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KONSEP *LAILATUL QADR* MENURUT PENTAFSIRAN QURAISH SHIHAB DI DALAM TAFSIR AL-MISBAH

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Abstrak. *Al-Qadr* merupakan surah ke 97 dalam senarai surah di dalam al-Quran. Surah ini mempunyai lima ayat yang menceritakan berkaitan malam *lailatul qadr*. Terdapat banyak konsep pentafsiran yang dikemukakan oleh para ulama *mufassirin* terhadap malam *lailatul qadr* yang terkandung di dalam surah tersebut. Pelbagai tafsiran telah diberikan mengenai konsep *lailatul al-Qadr* oleh ulama *mufassirin* sama ada yang terdahulu mahu pun *mufassirin* kontemporari. Kertas penyelidikan ini adalah satu kajian penyelidikan *maktabi* terhadap konsep *lailatul qadr* yang ditafsirkan oleh Dr. Muhammad Quraish Shihab di dalam kitab tafsirnya yang terkenal iaitu Tafsir al-Misbah. Beliau merupakan *mufassir* kontemporari yang agak terkehadapan dalam memberi tafsiran. Penelitian terhadap menuskrip tafsir al-Misbah dan huraian surah *al-Qadr* karangan Dr. Muhammad Quraish Shibab dianalisa dan dimurnikan dengan pandangan dan tafsiran ulama *mufassirin* terdahulu dan sezaman dengannya agar tidak menjadi kekeliruan kepada orang awam.

Kata Kunci: *lailatul qadr, tafsir, quraish shihab, al-misbah*.

1. PENDAHULUAN

Di dalam senarai turutan *mushaf* al-Quran al-Karim, surah *al-Qadr* adalah surah yang ke 97 selepas surah *al-Alaq*. Para ulama tafsir bersepakat mengatakan bahawa surah *al-Qadr* diturunkan setelah Nabi Muhammad s.a.w berhijrah ke Madinah (al-Qurtubi, 1997). Terdapat banyak tafsiran berkaitan konsep *lailatul qadr* berdasarkan tafsiran para ulama *mufassirin* sama ada yang terdahulu mahu pun ulama *mufassirin* yang kontemporari. Prof. Dr. Quraish Shihab merupakan seorang ulama tafsir kontemporari nusantara kelahiran Indonesia seperti Abuya Hamka yang mempunyai pemikiran yang menarik berkaitan konsep *lailatul qadr* seperti yang dibahaskan di dalam kitab tafsirnya yang masyhur iaitu al-Misbah, satu kitab tafsir yang lengkap 30 juzuk sebanyak 15 jilid. Kewujudan tafsir al-Misbah di tengah-tengah masyarakat telah memberikan sumbangan keilmuan yang amat berharga bagi meningkatkan kefahaman umat Islam, khususnya dalam merungkai dan menyelesaikan isu-isu semasa (Abur Hamdi et. al., 2017). Tidak menghairankan jika kitab tafsir al-Misbah telah menarik minat sebahagian sarjana untuk dijadikan sebagai objek kajian. Namun begitu, banyak kajian sarjana mendapati beberapa pentafsiran beliau perlu dimurnikan kerana mengandungi unsur-unsur pentafsiran yang menyeleweng (Wardani, 2009). Keluasan pandangan Dr. Muhammad Quraish Shihab dalam mentafsirkan konsep *laitatul Qadr* menimbulkan kebimbangan kepada orang awam dalam memahaminya.

2. METHODOLOGI KAJIAN

Kertas penyelidikan ini merupakan kajian berbentuk *maktabi* terhadap menuskrip tafsir *al-Misbah* karangan Dr. Muhammad Quraish Shihab (Quraish Shihab) terhadap surah *al-Qadr*. Setiap konsep yang diketengahkan terhadap makna *lailatul al-Qadr* mengikut pandangan beliau dianalisa dan dimurnikan serta dibandingkan dengan pandangan dan tafsiran *mufassirin* yang lain sama ada sezaman dengannya seperti Abuya Hamka dan ulama *mufassirin* yang terdahulu seperti *Ibn Kathir* dan *al-Qurtubi*. Penelitian ini dibuat dengan

menganalisa terhadap methodologi pentafsiran yang dilakukan oleh Quraish Shihab terhadap konsep *lailatul qadr* dalam surah *al-Qadr* tersebut.

2.1 Biodata Mufassir Quraish Shihab

Muhammad Quraish Shihab dilahirkan pada 16 Februari 1944 di Rappang, Kabupaten Sidenrang Rappang, Sulawesi Selatan, Indonesia. Beliau telah mendapat pendidikan awal daripada ayahnya Abdurrahman Shihab yang merupakan seorang ulama dan guru besar bidang tafsir al-Quran (Abudin, 2005). Pendidikan formal beliau bermula di Makassar sehingga Kelas Dua Sekolah Menengah. Pada tahun 1956, beliau menyambung pengajian ke Pondok Pasentren *Darul al-Hadith al-Faqihiyyih* di Kota Malang (Quraish Shihab, 1992). Setelah itu beliau meneruskan pelajaran ke Universiti al-Azhar, Mesir bermula dengan *I'dadi al-azhari* dan *thanawi al-azhari*. Beliau memperoleh ijazah sarjana muda, sarjana dan doktor falsafah (PhD) dalam bidang Tafsir dan Hadith dari Fakulti Usuluddin, Universiti al-Azhar. Tajuk tesis sarjana beliau ialah *al-i'jaz al-tasyri' li al-quran al-karim* dan tajuk tesis peringkat Doktor Falsafah pula ialah *nazhm al-durar li al-biqa'iy tahqiq wa dirasah* dan memperolehi keputusan lulus cemerlang (Quraish Shihab, 2011).

Beliau merupakan pelajar pertama dari Asia Tenggara yang berjaya meraih gelaran Doktor Falsafah dalam bidang *ulum al-Quran* di Universiti al-Azhar (Arief Subhan, 1993). Penulisan disertasi beliau diseliakan oleh Dr. Abdul Basit Ibrahim Bulbul (Wardani, 2009). Beliau bertugas sebagai pensyarah di IAIN Jakarta dalam bidang tafsir dan *ulum quran*. Selain itu, beliau juga dilantik untuk tempoh dua tempoh masa sebagai Rektor IAIN Jakarta iaitu 1992 – 1996 dan 1997 – 1998. Beliau juga pernah dilantik menjawat jawatan Menteri Agama Republik Indonesia dan Duta Besar Luar Biasa & Berkuasa Penuh Republik Indonesia untuk Negara Republik Arab Mesir dan Republik Djibouti yang ditempatkan di Mesir (M. Quraish Shihab, 2011).

Quraish Shihab telah mengabdikan dirinya kepada agama dan mencurahkan ilmunya dalam banyak buku penulisannya (Muhd Khafidhoh, 2013). Lebih 80 buah buku ditulis oleh beliau dan antara yang masyhur ialah Tafsir al-Manar: Keistimewaan dan Kelemahannya, Menyingkap Tabir Ilahi: Asma al-Husna dalam Perpspektif al-Quran, Hidangan Ilahi, Tafsir Ayat-ayat Tahlili dan Tafsir al-Misbah sebanyak 15 jilid.

2.2 Method Pentafsiran Quraish Shihab

Quraish Shihab merupakan seorang pakar al-Quran yang berkemampuan menterjemah dan menyampaikan tafsiran kandungan al-Quran dalam konteks kontemporari dan era modern (Ahmad Atabik, 2014). Ini menjadikannya lebih dikenali dan lebih menonjol daripada pakar al-Quran selainnya (M. Mawangir, 2018). Dalam perkara berkaitan pentafsiran ayat, beliau sangat menekankan kepada penggunaan method tafsir *maudu'i* (tematik), iaitu suatu method pentafsiran yang mengumpulkan ayat-ayat al-Quran yang mempunyai maksud atau tujuan yang satu yang bersama-sama membahas tajuk tertentu dan menyusunnya sebaik mungkin bersesuaian dengan masa turunnya dan selari dengan *asbab al-nuzul* (sebab penurunan ayat) serta memperhatikan ayat-ayat tersebut dengan penjelasan, huraian, hubungan dengan ayat-ayat yang lain dan mengeluarkan hukumnya (al-Farmawi, 1971).

Quraish Shihab mentafsirkan al-Quran dengan cara menghimpunkan sejumlah ayat al-Quran dari pelbagai surah yang membahaskan perkara atau masalah yang sama, kemudian beliau menjelaskan pengertian menyeluruh daripada ayat-ayat tersebut dan seterusnya membuat kesimpulan sebagai jawapan terhadap perkara atau masalah yang menjadi titik perbahasan (Safinun, 2007). Quraish Shihab juga lebih memperincikan keterangan lafaz, ayat bahkan munasabah ayat dan surah yang ditafsirkannya sehingga pembaca akan merasa puas dan memahami kandungan ayat-ayat yang dibacanya. Beliau beranggapan bahawa method ini akan dapat menterjemahkan pendapat-pendapat al-Quran dalam pelbagai masalah kehidupan manusia dan seterusnya dapat membuktikan bahawa al-Quran itu selari dengan perkembangan teknologi dan kemajuan peradaban manusia (M. Danial, 2017).

Terdapat banyak kitab tafsir yang diterbitkan di zaman era modern hari ini dan fafsir al-Misbah adalah salah satu daripadanya. Ia merupakan tafsiran dan huraian kandungan-kandungan daripada ayat-ayat suci al-Quran (Nur Lubis, 2002). Tafsir al-Misbah dikarang oleh Quraish Shihab sekitar tahun 1999 sehingga 2001 iaitu ketika beliau bertugas sebagai duta besar Republik Indonesia di Mesir. Ia mula ditulis pada malam Jumaat 4 Rabiul Awal 1420H bersamaan dengan 18 Jun 1999 dan selesai pada 8 Rejab 1423H bersamaan 5 September 2003 (Quraish Shihab, 2004).

Quraish Shihab juga menekankan kepada perlunya memahami ayat-ayat al-Quran secara kontekstual dan bukan semata-mata terikat pada makna tekstual supaya isi-isi pengajaran yang terkandung di dalam al-Quran dapat diadaptasikan dalam kehidupan seharian (Zakiar, 2003). Oleh kerana itu, beliau sentiasa memberikan motivasi kepada pelajar-pelajarnya, khususnya pelajar-pelajar di peringkat sarjana dan doktor falsafah supaya mereka berani menafsirkan al-Quran, tetapi tetap berpegang dengan kaedah-kaedah tafsir yang betul (Iqbal, 2010). Menurut Quraish Shihab lagi, pentafsiran terhadap al-Quran tidak akan berhenti dan sentiasa berkembang dari semasa ke semasa sehingga ada saja kemunculan pentafsiran baru sehingga sekarang kini selari dengan perkembangan ilmu dan kemajuan tamadun manusia (Choli, 2015). Namun, beliau tetap mengingatkan bahawa sikap berhati-hati dan teliti dalam menafsirkan al-Quran lebih diutamakan supaya seseorang tidak mudah mengatakan pendapatnya sebagai pendapat al-Quran. Menurut Quraish Shihab perbuatan seperti itu adalah satu dosa besar (Iffaty Zamimah, 2018).

2.3 Surah *al-Qadr* Dalam Tafsir al-Misbah

Quraish Shibab mengatakan bahawa isi kandungan surah *al-Qadr* menjelaskan mengenai masa penurunan al-Quran (Quraish, 2010). Permulaan ayat (إِنَّا أَنْزَلْنَاهُ فِي لَيْلَةِ الْقَدْرِ) bermaksud "*sesungguhnya Kami yang menurunkannya pada malam lailatul al-Qadr*". Beliau mengatakan kalimah (إِنَّا) itu selain menunjukkan bahawa keagungan Allah s.w.t, ia juga menunjukkan bahawa ada keterlibatan yang lain dalam penurunan al-Quran iaitu keterlibatan Malaikat Jibril a.s dalam menyampaikan wahyu kepada Nabi Muhammad s.a.w. Beliau berpandangan bahawa tidak ada wahyu atau ayat al-Quran yang tidak dibawa oleh Malaikat Jibril a.s bahkan semuanya diturunkan melalui perantaraannya (Quraish, 2010).

Ibnu Abbas r.a berpendapat bahawa Allah s.w.t telah menurunkan al-Quran secara sekali gus dari *Luh Mahfuz* ke *Baitul 'Izzah* di langit dunia yang paling hampir dengan bumi (Ibn Kathir, 2004). Kemudian diturunkan secara beransur-ansur mengikut kesesuaian dengan kejadian-kejadian dalam masa 23 tahun kepada Nabi Muhammad s.a.w.

Quraish Shihab mengatakan bahawa kalimah (أَنْزَلْنَاهُ) yang bermaksud "*kami telah menurunkannya*" adalah diambil daripada perkataan (*nazala*) yang menunjukkan perpindahan dari suatu tempat yang tinggi turun ke suatu tempat yang rendah. Beliau mengatakan bahawa penurunan al-Quran di sini adalah dalam bentuk sekali gus. Menurut beliau, ia berbeza dengan penggunaan kalimah (*nazzala*) yang memberi maksud turun beransur-ansur atau sedikit demi sedikit (Quraish, 2010).

Quraish Shihab mengatakan bahawa penurunan al-Quran yang dimaksudkan dalam ayat ini ialah turun sekali gus dari *Luh al-Mahfuz* ke Langgit Dunia. Beliau juga berpendapat bahawa (*anjalna*) itu menunjukkan penurunan al-Quran buat kali pertama di malam *lailatul qadr*. Beliau berpendapat bahawa apa yang dimaksudkan dengan "al-Quran diturunkan" ialah al-Quran itu dinampakkan kepada Nabi Muhammad s.a.w. (Quraish, 2010). Menurutnya lagi al-Quran (kalam Allah) itu bersifat *qadim* (sudah sedia ada) dan dinampakkan kepada Nabi Muhammad s.a.w pada malam *lailatul qadr* sehingga Baginda s.a.w mengetahuinya.

Beliau juga mengatakan bahawa maksud "penurunan al-Quran" itu ialah perpindahan al-Quran dari suatu tempat yang tinggi ke suatu tempat yang rendah. Iaitu dari sisi Allah s.w.t Yang Maha Mulia ke tempat yang rendah di sisi manusia iaitu Nabi Muhammad s.a.w. (Atik Wartini, 2014).

Dhomir (هُ) di dalam kalimah (أَنْزَلْنَاهُ) merujuk kepada al-Quran namun tidak disebut atau dinyatakan di dalam ayat tersebut. Menurut Quraish Shihab bahawa sesuatu yang sangat mulia kebiasaannya tidak disebut namanya. Ia juga untuk mengisyaratkan bahawa al-Quran itu sangat dekat di hati manusia. Sesuatu yang mulia dan dekat di hati tidak perlu disebut kerana ia sudah diketahui umum (Quraish, 2010). Tiada penjelasan bahawa waktu diturunkan al-Quran sama ada pada awal malam, pertengahan malam atau akhir malam.

Menurut Quraish Shihab, *al-qadr* bererti malam yang mulia. Al-Quran diturunkan pada malam yang mulia. *Al-Qadr* juga menurut beliau bermakna 'sempit' kerana ramainya malaikat yang turun ke bumi pada malam tersebut seolah-olah menjadikan bumi ini sempit dipenuhi dengan para malaikat (Quraish, 2010). *Al-Qadr* juga bererti 'ketentuan' iaitu malam Allah s.w.t menentukan apa yang akan terjadi sepanjang tahun tersebut. Beliau juga menyamakan seperti firman Allah s.w.t (إِنَّا أَنْزَلْنَاهُ فِي لَيْلَةٍ مُبَارَكَةٍ إِنَّا كُنَّا مُنْذِرِينَ ۝ فِيهَا يُفْرَقُ كُلُّ أَمْرٍ حَكِيمٍ ۝) yang bermaksud "*sesungguhnya Kami telah menurunkan al-Quran itu pada malam yang berkat, (Kami berbuat demikian) kerana sesungguhnya Kami sentiasa memberi peringatan dan amaran. Pada malam yang berkat itu dijelaskan (kepada Malaikat) setiap perkara yang berlaku mengandungi hikmah*". Allah s.w.t menentukan *khitbah*Nya bagi perjalanan umat manusia pada malam *lailatul al-Qadr*.

Firman Allah s.w.t (وَمَا أَدْرَاكَ مَا لَيْلَةُ الْقَدْرِ) bermaksud "*dan apakah kamu mengetahui apa itu malam lailatul al-Qadr*?" Menurut Quraish Shihab penggunaan (أَدْرَاكَ) dalam ayat tersebut adalah untuk perkara-perkara yang tidak boleh terfikir dengan fikiran manusia atau sangat susah untuk difikirkan oleh pemikiran manusia kerana kemuliaannya dan penuh kerahsiaan malam tersebut (Quraish, 2010). Namun sekelumit atau sedikit rahsia malam tersebut dijelaskan dalam ayat berikutnya iaitu (لَيْلَةُ الْقَدْرِ خَيْرٌ مِنْ أَلْفِ شَهْرٍ) bermaksud "*malam lailatul-Qadr itu lebih baik daripada seribu bulan*". Ia dinilai satu malam itu diberi ganjarannya dengan seribu bulan.

Menurut Quraish Shihab, terdapat 13 kali lafaz kalimah (مَآ أَدۡرَىٰكَ) di dalam Al-Quran. Sepuluh daripadanya adalah pertanyaan tentang kehebatan dan dahsyatnya hari kiamat, seperti (وَمَآ أَدۡرَىٰكَ مَا يَوۡمُ ٱلۡفَصۡلِ) [Surah al-Mursalat: 14], (وَمَآ أَدۡرَىٰكَ مَا ٱلۡحَآقَّةُ) [Surah Al-Haqqah: 3] dan (وَمَآ أَدۡرَىٰكَ مَا عِلِّيُّونَ) [Surah al-Mutaffifin: 19]. Kesemua ayat ini merupakan pertanyaan kepada suatu perkara yang tidak boleh ditanggapi oleh akal dan mustahil dapat ditanggapi oleh akal manusia. Daripada ketiga belas kali (مَآ أَدۡرَىٰكَ) itu terdapat tiga kali yang mengatakan: (وَمَآ أَدۡرَىٰكَ مَا ٱلطَّارِقُ) [Surah at-Tariq: 2], (وَمَآ أَدۡرَىٰكَ مَا ٱلۡعَقَبَةُ) [Surah al-Balad: 12] dan (وَمَآ أَدۡرَىٰكَ مَا لَيۡلَةُ ٱلۡقَدۡرِ) [Surah Al-Qadr: 2]. Menurut Quraish Shihab juga sekiranya dilihat dari segi penggunaan kata-kata al-Quran yang berkaitan dengan perkara-perkara yang menjadi objek pertanyaan, maka kesemuanya adalah perkara-perkara yang sangat hebat dan susah untuk ditanggapi oleh akal fikiran manusia. Perkara ini termasuklah konsep dan makna *lailatul qadr* (Quraish, 2010).

Quraish Shihab menghuraikan lagi dengan memberi perbezaan makna dan maksud dalam penggunaan kata (أَدۡرَىٰكَ) dan (يُدۡرِيكَ). Beliau menegaskan bahawa terdapat tiga ayat menggunakan lafaz (يُدۡرِيكَ) di dalam al-quran iaitu (وَمَا يُدۡرِيكَ لَعَلَّ ٱلسَّاعَةَ تَكُونُ قَرِيبًا) [Surah al-Ahzab: 63], (وَمَا يُدۡرِيكَ لَعَلَّ ٱلسَّاعَةَ قَرِيبٞ) [Surah al-Syura: 17] dan (وَمَا يُدۡرِيكَ لَعَلَّهُۥ يَزَّكَّىٰٓ) [Surah 'Abasa: 3]. Lafaz (يُدۡرِيكَ) di dalam ayat 63 surah *al-Ahzab* dan di dalam ayat 17 surah *al-Syura* itu adalah pertanyaan yang berkaitan dengan kedatangan hari kiamat. Manakala lafaz (يُدۡرِيكَ) di dalam ayat 3 surah '*Abasa* adalah pertanyaan berkaitan dengan kesucian jiwa manusia (Quraish, 2010). Penggunaan kedua-dua lafaz ini memberikan perbezaan dari sudut makna dan maksud kedua-duanya. Lafaz (يُدۡرِيكَ) menunjukkan bahawa Nabi Muhammad s.a.w tidak mengetahui bila kedatangan hari kiamat dan tidak mengetahui perkara-perkara ghaib. Manakala lafaz (أَدۡرَىٰكَ) menunjukkan pertanyaan yang awalnya Nabi s.a.w tidak mengetahui tetapi akhirnya Allah s.w.t memberitahu kepada Baginda s.a.w sehingga Baginda s.a.w mengetahuinya dan pengetahuan itu dapat disampaikan kepada umat. Oleh kerana itu persoalan berkaitan malam *lailatul qadr* mesti dirujuk kepada al-Quran dan *al-Hadith* untuk memahaminya (Ahmad Zain, 2009).

Firman Allah s.w.t (لَيْلَةُ الْقَدْرِ خَيْرٌ مِنْ أَلْفِ شَهْرٍ) bermaksud "*malam lailatul qadr lebih baik daripada seribu bulan*". Mujahid r.a menyatakan bahawa malam kemuliaan itu lebih baik daripada seribu bulan yang di dalam bulan-bulannya tidak terdapat malam *lailatul qadr*. Makakala Amr Qais al-Mala'i mengatakan bahawa dengan melakukan amalan di malam kemuliaan itu lebih baik daripada melakukan amalan selama seribu bulan (Ibn Kathir, 2004). Ibn Jarir al-Tobari pula mengatakan bahawa malam *lailatul qadr* itu lebih *afdhal* daripada melakukan ibadah selama seribu bulan yang di dalamnya tidak terdapat *lailatul qadr*. Pendapat al-Tobari ini diterima oleh sebahagian besar ulama *mufassir* (al-Tobari, 2001).

Firman Allah s.w.t (تَنَزَّلُ الْمَلَائِكَةُ وَالرُّوحُ فِيهَا بِإِذْنِ رَبِّهِمْ مِنْ كُلِّ أَمْرٍ) bermaksud "*pada malam itu turunnya malaikat-malaikat dan Jibril a.s dengan izin Tuhan mereka, untuk mengatur segala urusan*". Quraish Shihab berpendapat bahawa ini banyak Malaikat a.s yang turun di malam *lailatul qadr* ini kerana berkat malamnya. Para Malaikat a.s turun bersama berkat dan rahmat Allah s.w.t sebagaimana mereka turun ketika al-Quran dibaca dan mengililingi *halaqah-halaqah* zikir serta meletakkan sayap mereka bagi menaungi penuntut-penuntut ilmu dan menghormati mereka. Adapun yang dimaksudkan dengan *al-Ruh* dalam ayat ini merujuk kepada malaikat Jibril a.s. Namun ada *mufassirin* berpendapat *al-Ruh* adalah sejenis malaikat tertentu (Quraish, 2010).

Ibn Kathir (2004) telah menukilkan kata-kata Mujahid r.a yang berpendapat bahawa *lailatul qadr* adalah malam yang penuh dengan keselamatan sehingga syaitan pun tidak boleh berbuat apa-apa keburukan atau gangguan padanya. Qatadah r.a mengatakan makna yang dimaksudkan dalam ayat tersebut ialah segala urusan ditetapkan di dalamnya serta semua ajal dan rezeki ditakdirkan seperti mana yang disebut dalam ayat (فِيهَا يُفْرَقُ كُلُّ أَمْرٍ حَكِيمٍ) [surah al-Dukhan: 4] yang bermaksud "*pada malam itu dijelaskan segala urusan yang penuh hikmah*".

2.4 Kesimpulan daripada surah al-Qadr

Allah s.w.t menjelaskan bahawa al-Quran itu maha mulia dan bertambah kemuliaannya itu kerana ia diturunkan di malam yang mulia. Walaupun *lailatul al-qadr* itu terjadi hanya sekali di sudut permulaan penurunan al-Quran tetapi ia berkali-kali terjadi setiap tahun di mana minimanya sekali dalam bulan Ramadhan setiap tahun. Nabi Muhammad s.a.w bersabda (تحروا ليلة القدر في الوتر من العشر الأواخر من رمضان) yang bermaksud "*carilah lailatul al-qadr pada malam-malam ganjil sepuluh terakhir Ramadhan*". *Lailatul al-qadr* tidak boleh diketahui secara hakikatnya kerana akal manusia tidak mampu untuk memikirkannya. Kita hanya boleh mengetahuinya daripada penjelasan ayat-ayat quran dan *hadith-hadith* Nabi s.a.w yang menjelaskan tentangnya. *Lailatul al-qadr* itu bukan sesuatu benda yang datang tetapi ia adalah situasi kejiwaan yang dialami oleh seseorang yang menyiapkan diri untuk menerima kehadirannya.

2.5 Konsep Lailatul al-Qadr Menurut Quraish Shihab

Dalam penyelidikan ini, hasil analisa terhadap pentafsiran Quraish Shihab terhadap surah *al-Qadr* di dalam Kitab Tafsir al-Misbah dapatlah ditegaskan bahawa konsep *al-qadr* terbahagi kepada tiga:

(a) *Lailatul qadr* difahami sebagai malam penetapan Allah s.w.t bagi perjalanan hidup manusia. Pendapat ini berdalilkan firman Allah s.w.t dalam surah *al-Dukhan* ayat 3 (إِنَّا أَنزَلْنَـٰهُ فِى لَيْلَةٍ مُّبَـٰرَكَةٍ إِنَّا كُنَّا مُنذِرِينَ) yang bermaksud "*sesungguhnya kami yang menurunkan al-Quran itu pada malam yang berkat, kerana Kami sentiasa memberi peringtan dan amaran*". Sebahagian ulama berpendapat bahawa penetapan itu dalam tempoh setahun. Maksud *lailatul qadr* itu bahawa Allah s.w.t mengatur dan menetapkan *khinthah* dan strategi kepada NabiNya, Muhammad s.a.w untuk menyeru manusia kepada jalan yang benar serta menetapkan *takdir* kepada seluruh alam.

(b) *Lailatul qadr* juga diertikan kepada kemuliaan. Malam tersebut adalah malam mulia yang tidak ada bandingan. Malam itu menjadi mulia kerana terpilih sebagai malam

turunnya al-Quran yang menjadi permulaan kepada segala kemuliaan. Perkataan *al-Qadr* bererti mulia seperti di dalam surah al-An'am ayat 91 iaitu (وَمَا قَدَرُوا اللَّهَ حَقَّ قَدْرِهِ إِذْ قَالُوا مَا أَنزَلَ اللَّهُ عَلَىٰ بَشَرٍ مِّن شَيْءٍ) yang bermaksud "*mereka itu tidak memuliakan Allah dengan kemuliaan yang sebenar tatkala mereka berkata Allah tidak menurunkan sesuatu pun kepada manusia*".

(c) *Lailatul qadr* juga dimaksudkan dengan sempit. Malam tersebut dikatakan malam yang sempit kerana ramainya Malaikat turun ke bumi dengan izin Allah s.w.t untuk mengatur segala urusan. Kata *qadr* yang bererti sempit digunakan dalam surah al-Ra'd ayat 26 iaitu (ٱللَّهُ يَبْسُطُ ٱلرِّزْقَ لِمَن يَشَآءُ وَيَقْدِرُ) yang bermaksud "*Allah melapangkan rezeki bagi mereka yang dikehendaki dan menyempitkannya bagi mereka yang dikehendaki*".

Menurut Quraih Shihab (2010) bahawa ketiga-tiga pengertian *lailatul qadr* yang dikemukakan boleh menjadi betul dan benar kerana malam tersebut adalah malam mulia dengan turunnya ramai malaikat, dapat dinikmati pahala yang dijanjikan dan diraih serta menetapkan masa depan serta *takdir* manusia.

Quraish Shibab melanjutkan perbahasan dengan kejadian malam *lailatul qadr* itu adakah berlaku setiap tahun atau hanya sekali ketika turunnya al-Quran pada kali pertama dahulu. Beliau mengemukakan pendapat sebahagian ulama yang berpendapat bahawa malam mulia *lailatul qadr* itu tidak akan hadir lagi dan mengemukakan penjelasan yang logik akal kerana wahyu sudah terhenti dengan kewafatan Nabi Muhammad s.a.w. dan kemuliaan malam tersebut adalah kerana ia menjadi waktu turunnya al-Quran.

Pendapat tersebut ditolak oleh sebahagian besar ulama yang berpendapat bahawa *lailatul qadr* terjadi pada setiap bulan Ramadhan kerana Nabi Muhammad s.a.w sendiri menganjurkan untuk mempersiapkan diri dan jiwa serta mencarinya secara khusus pada malam-malam ganjil di sepuluh yang terakhir Ramadhan (Ibn Kathir, 2004). Sabda Nabi s.a.w (تحروا ليلة القدر في العشر الأواخر من رمضان) bermaksud "*Carilah lailatul qadr pada sepuluh terakhir daripada Ramadhan*". Mereka menolak pendapat pertama dengan hujah bahawa penggunaan kata *fe'el mudhori'* pada lafaz (تَنَزَّلُ) dalam ayat (تَنَزَّلُ ٱلْمَلَٰٓئِكَةُ وَٱلرُّوحُ فِيهَا بِإِذْنِ رَبِّهِم مِّن كُلِّ أَمْرٍ) [Surah al-Qadr: 4] memberi makna kesinambungan dan berterusan, maka *lailatul qadr* itu terjadi pada masa kini dan masa akan datang (Mohd Najib et. al., 2009). Pendapat ini juga tidak menafikan bahawa turunnya al-Quran pada 15 abad yang lalu pada malam *lailatul qadr* dan bukan bermakna ia hadir pada masa itu sahaja. Kemuliaan *lailatul qadr* bukan hanya disebabkan penurunan al-Quran ketika itu sahaja malah ia sendiri adalah perkara yang sangat mulia.

3. KESIMPULAN

Pentafsiran al-Quran berdasarkan hadith yang sahih amat dititikberatkan oleh *mufassirin* yang *muktabar* dan perlu diutamakan bukan semata-mata pentafsiran *bil ra'yi (pandangan akal)*. Quraish Shihab adalah seorang *mufassir* al-Quran kontemporari yang sangat bijak dan pandai menafsirkan al-Quran berpandukan ayat-ayat Quran dan *hadith-hadith* Nabi s.a.w. Namun penyelidik berpendapat bahawa pandangan dan hujahan beliau lebih mengutamakan tafsiran *bil ra'yi* (akal) dalam menafsirkan ayat-ayat Quran daripada tafsiran *bil ma'thur* (quran dan hadith). Apabila dianalisa dan dibandingkan dengan tafsiran *mufassirin* terdahulu maka pemahaman terhadap konsep *lailatul qadr* di dalam ayat tersebut dapat dimurnikan dan dapat mengelakkan salah faham dan kekeliruan kepada orang awam.

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DRAIN RUBBISH COLLECTOR

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Abstract. Flash flood is a common occurrence in Malaysia during heavy rain. Usually, flash flood occurs in area with poor drainage system. Apart from that, human's habit to litter is a major factor that contributed to flash flood. Plastic bottles, tissue paper and drinking straws are some of the many type of rubbish that people litter everywhere. This, in time will cause drain blockage and stagnant drain. Water flow rate is reduced and most of the times, the water flow in these drains are almost non-existent. The "Drain Rubbish Collector" were created as an instrument to collect rubbish or trash in a drain." Drain Rubbish Collector" main function is to collect rubbish that is thrown into drains. Rubbish is collected as it flows through the drain, therefore, no blockage will occur. This prototype machine is operated automatically using a DC motor and a 12V battery. Mild Steel is used to fabricate the machine's body frame, while, the driver components was constructed using sprocket and chains. "Drain Rubbish Collector" was tested and operated successfully achieving its main objective. After several test-runs, it is better if some improvement and enhancement is done to the mechanism used to snare the rubbish is necessary, especially if it were to be used at a larger scale. The fabricated If this machine is installed in affected areas or better, nationwide, flash floods can be reduced significantly.

Keyword: flash flood, drain blockage, rubbish collector, drainage, flood

1. INTRODUCTION

Flash floods is a common occurrence in Malaysia. Heavy rain accompanied by severe thunderstorm caused rapid flooding in geomorphic low areas and concentrated city areas. Poor drainage system is the main reason behind this natural disaster. Garbage, like tin cans, plastic bags and all kinds of litter blocks the drain when it rains. These garbage or debris that accumulated in stagnant area in the end caused drain blockage when it flows into larger drains during a rainstorm. Most roads and highway system in Malaysia adopts gullies, piped sewer or drainage and soak away to discharge water from it surfaces. Gullies are used to collect and drain water off the road or pavement into a piped system or roadside ditch. Despite all of the drainage system available, flash floods is inevitable when heavy thunderstorm occurs especially in high density areas.

Blocked drains caused by garbage not only resulted with flash floods, it also become a breeding ground for bacteria and virus which ultimately leads to several type of disease. When water goes down a drain, it is usually dirty to begin with. Even initially uncontaminated water can encourage bacteria like 'Legionella' when it stands idle. That, and it then sits within a blocked drain for a prolonged time will only be the cause of many disease.

A blocked drain will usually smell, and this itself create a few health concerns. Even if the odor is not innately toxic, being exposed to bad odors stresses us, makes us more anxious, causes symptoms like headaches or poor moods, and can even make us feel more tired. Bad odors might not be life-threatening, but that does not mean it is not a problem.

In order to address the cause of all this problem, which is blocked drainage due to accumulated rubbish, a simple mechanical machine known as Drain Rubbish Collector was created. Drain Rubbish Collector is a type of machine that can collect floating rubbish in a drain. This machine needs to be placed strategically in a drain so that it traps the rubbish before it reaches stagnant area. Besides that, it can also be placed before any ends of the drain to prevent rubbish from blocking any drains entrances or exits. Perhaps this kind of machines will help to reduce the drainage blockage in Malaysia. It might not be the ultimate solution to the problem, but slightly will help toward healthier and cleaner Malaysia.

2. LITERATURE REVIEW

2.1 Flash floods

Floods occurs when the water flow in natural or artificial irrigation system is higher than usual. Higher water flow will cause the irrigation system, whether it's a river or drainage to overflow and floods the surrounding area. When this happen, it becomes an imminent danger to the nearby society *(Yatim et al., 2013)*. Apart from being a hazard, floods also will affect everybody's daily activities and the disruption caused by flood can last for weeks. Plus, if the flood happens during climate change, its impact is more trying (Gasim et. al., 2014).

According to the Malaysian Drainage and Irrigation Department (DID, 2012), the occurrence of floods in Malaysia can be divided into two types:

i. Flash flood
ii. Monsoon flood

Both, flash floods and monsoon floods, can be differentiate based on the hydrological perspectives is the time taken for the increased water level to recede to its normal state. Usually flash floods recedes faster than monsoon floods because it only take hours for it to return to normal water level. Meanwhile, the duration of monsoon flood is longer, as it can takes up to a month to recede to normal water level (Noorazuan, 2006).

Chan (1996) in his study stated that in the urban area or town, there are more impenetrable surfaces which increases the chances for flash flood to happen. This surfaces includes roads, buildings and parking spaces. As for its impact on the society, low income urban residents in the flood-plain area (Chan, 2000) faces more challenges due to flash flood then their higher income counterpart.

Kong et al. (2010) in their research on urban flooding concluded the results obtained in the following figure:

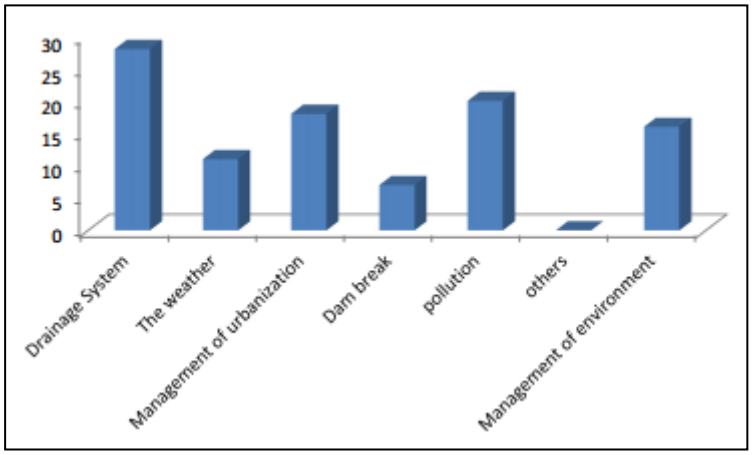


Figure 1: Causes of flash floods *(Kong et al., 2010)*

Based on Figure 1, it is found from the people's opinion that causes of flash floods is stated as follows:

(i) 28% says that flood is due to improper drainage system,
(ii) 20% said the cause is pollution,
(iii) 18% thinks is the management of urbanization,
(iv) 16% believe environment factor,
(v) 11% said weather is the causative agent, and
(vi) 7% thinks dam break.

Results from Kong et. al. research was verified by another study conducted by Thorndah et al. in 2008. In Thorndah's research, it was concluded that flooding occurs due to improper drainage system. In that study, Thorndah concluded seven causes of urban flooding, whereby three of the concluded causes can be linked to drainage system. There was another related study prior Kong et. al. carried out by Oguntala et al. *in 1982* also shows that causes of flood can be linked to the improper management of environment. Another similar study done by Vinet (2008) finds that poor drainage system and management as the main result of flash floods.

Based from all these studies, it is safe to conclude that blockage in the drainage system is the main reason that cause flash flood. Therefore, the fabrication of this 'Drain Rubbish Collector" is a means to address this problem.

2.2 Current Rubbish Collecting Equipment in Watery Area

There have been many equipment and machineries designed around the world, to tackle rubbish collecting problem in watery areas. Here, some of the available machineries and equipment is compared to identify features or specification that will be suitable when used in Malaysian drainage system.

2.2.1 River Darwen Litter Trap

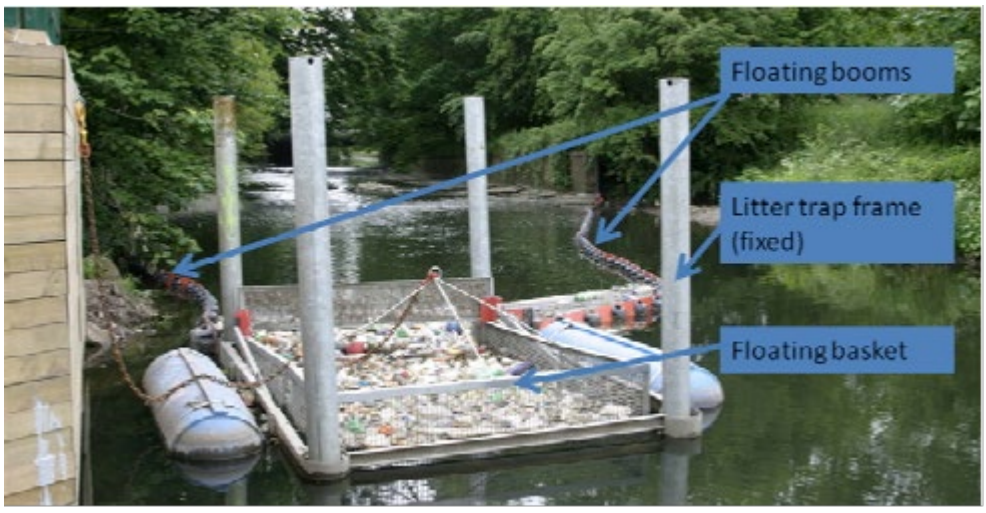


Figure 2 : The River Darwen Litter Trap

The River Darwen Litter Trap is a device used to collect and trap litter in rivers areas such as Blackburn and Darwen rivers in the United Kingdom. The objective for creating this device is to invent, plant, and manage litter trap on Darwen rivers. This device helps to prevent litter dropped in Blackburn and Darwen being washed downstream reaching towards Darwen River and the Irish Sea. This trap helps to collect litters by locating the trap in the prominent position at Witton Country Park (*Mersey Basin Campaign, 2010*).

For design, it consists of floating booms, litter trap frame and also floating basket. All device or machine had to be managed and maintain as well as this litter trap. It required a suitable machine to lift up the cage of the rubbish. In this trap, there is a bracket known as the skip. The skip had been install by the side of the trap to store the collected waste. As a result, it was estimated about 40m³ litter had been removed for the first two years operation. The rubbish consists of domestic waste, toys, fast food packages and also syringes.

2.2.2 Seabin



Figure 3 : The Seabin

The Seabin project was inspired by two Australian surfers, Andrew Turton and Pete Ceglinski. They came up with the idea of Seabin after observing pollution in the ocean when both goes surfing. Initially, Andrew was the one who came up with the idea of an ocean cleaning device after coming across many polluted and poor ocean conditions marinas. Since, he has an idea on the concept of a cleaning device, he asked Pete, who is a product engineer, to make his idea into a functioning product. Pete uses his experience and skills in injection molding to design and produce the Seabin's molded plastic components. Finally, they came up with the Seabin, which can be described as a bucket that sifts and filtrates water in marinas (*www.seabinproject.com, 2015*).

They started by installing the Seabin in marinas and yacht clubs, as both locations are situated in controlled environments. Marinas and yacht club usually are situated in areas where debris from the ocean tends to collect. These debris drifted from the ocean to these area by wind and currents that resulted from when the ocean swells and storms. Prior to the Seabin, large boat with nets are commonly used to collect garbage in marinas and other similar locations, but it was not cost effective as the boats are expensive to keep up and not completely efficient in collecting these debris. Seabin cost lower, easily fits in the polluted areas of harbors and needs minimal maintenance, making it the better alternative to deal with the aforementioned problems.

The Seabin bucket is implanted to a wall or dock and water pump constantly pulls the water into the bucket, sifting whatever pollutants might be present in the water. The device runs on 110 or 220 volts and uses a 1.5 horsepower pump. Apart from solid debris, the Seabin device can also be used to remove oil and other chemicals by installing a filtering system for the pump. Despite looking very simple, the Seabin system is complex and requires work to create, produce and install.

2.2.3 The Ocean Cleanup Array



Figure 4 : The Ocean Cleanup Array

Boyan Slat came up with the idea for The Ocean Cleanup Array in 2012. Singh (2013) in his article on The Ocean Cleanup Array based on interview with Boyan Slat, described the design concept and operating methods of this device. The Ocean Cleanup Array has long floating barriers installed at an angle that will capture and concentrate the plastic, making mechanical extraction possible. The system's uses the natural circulation period of the North Pacific Subtropical Gyre, which passively cleans up the ocean. Another plus side of this system is that it is scalable. It is estimated that the cleanup process duration could be reduced to a minimum of just 5 years using this device. Since a passive collection approach is used, operational expenses will be low. The Ocean Cleanup Array converts the extracted plastic into either energy, oil or new materials making the system more viable and cost effective. Its design without any nets involved, makes it harmless to the marine ecosystem and could potentially catch particles that are much smaller than what nets could provide.

3. METHODOLOGY

During the planning phase, material selection was crucial as the "Drain Rubbish Collector" needs to be placed in a drain. It will not only be exposed to water in the drain but also, to unpredictable weather. Heavy water flow during rainstorm was also put into consideration during this process.

The body frame of this fabrication was made using mild steel, where all joints and any welding process involved was done using MIG. Next, 4 U-clamps is welded to the corner of the upper and lower section of the body frame. The function of the U-clamp is to hold the shaft for the connecting chain.

The driver system for this fabrication uses a Proton Wira power window motor. This motor runs on a maximum of 80 rpm and needs low current supply of 15 ampere. It is a Direct Current (DC) motor type and powered by 12V car battery.

The fabrication process of "Drain Rubbish Collector" took about 6 months to complete. Initial design and improvements were drafted using AutoCAD as shown in the following diagram:

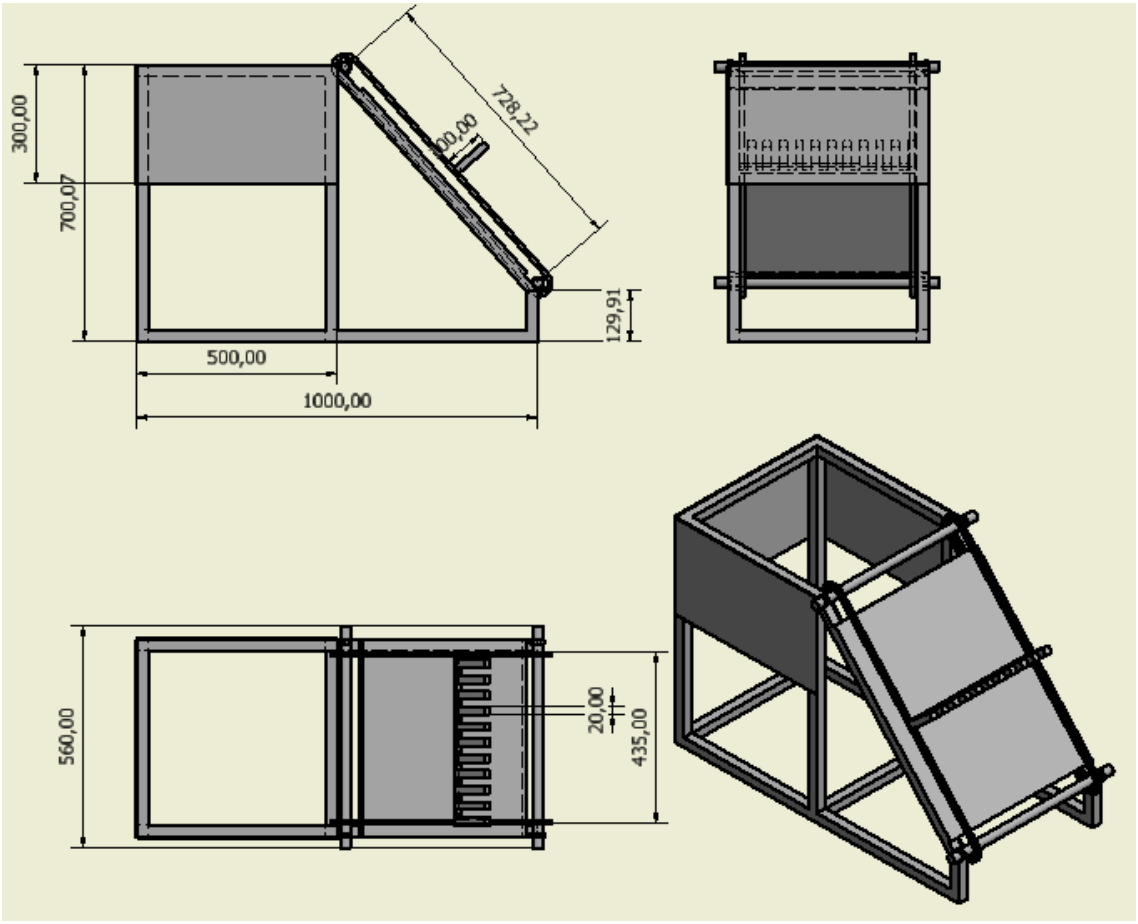


Figure 5 : "Drain Rubbish Collector" final design using AutoCAD

As for the transmission, a threaded rod was used as the connecting the shaft to rotate the rack that catches any garbage in water flow. Sprocket are attached at both shafts ends. There are two shafts which consists of threaded rod and bearings. The sprockets are then connected using a chain.

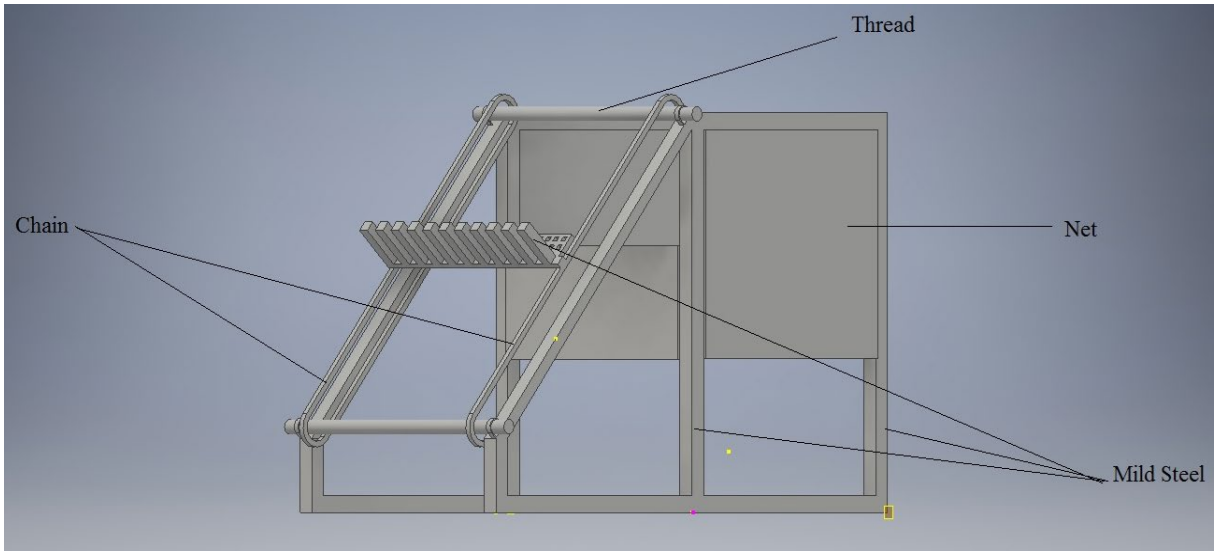


Figure 6 : Parts installed in this fabrication

Every rack attached, has a metal frame. A plastic mesh net is attached to every rack. It catches garbage as it flows through water into the net. After all the other parts are attached (refer Figure 7), a cover is installed at the back of the machine. This is to protect the collection net, battery and motor from being exposed.



(a)



(b)

Figure 7: (a) Mechanical components of this fabrication
(b) Mesh net installed to trap garbage

4. ANALYSIS AND RESULTS

After conducting several test runs, using different type of garbage usually found littered in a drain, the following results were obtained:

Table 1: Type of rubbish collected

No	Types of rubbish	Yes	No
1	Plastic bottle	√	
2	Plastic bag	√	
3	Water weeds		X
4	Leaves	√	
5	Polystyrene container	√	
6	Aluminum can	√	
7	Glass bottle	√	
8	Plastic container	√	
9	Debris/dirt		X
10	Small wood branches	√	

Based on Table 1, it is shown that a few types of rubbish cannot be collected using this device, basically due to its sizes. Small and micro size rubbish floats through the wire mesh net that covers the rack. In order to prevent this, wire net with smaller mesh can be used. Besides that, the rack used can only support lightweight rubbish such as plastic bottle, since the rack is made using hollow mild steel.

Based from the conducted test runs, there are still a lot of room for improvement. The material used for the body frame can be upgraded from mild steel to stainless steel. This is because stainless steel has higher corrosion resistant. In this fabrication mild steel was used because of budget restriction and also, since it is a prototype, this project concentrates more on its functionality. If to be produced and used widely, stainless steel is more suitable as the device would be submerge in drain water for long period of time. Alternately, if budget is a concern, mild steel can still be used as the body frame but the material must be coated with chrome. This is to make sure that mild steel will not rust easily.

Apart from that, the power supply for this device can be switched from lead-acid battery (as this type of battery needs to be recharged) to dry battery with a higher capacity (the battery should be 12V with capacity above 3Ah). Using battery with higher capacity makes it last longer before due for replacement.

Lastly, the design for this fabrication was done according to average drain size around Politeknik Ibrahim Sultan. Therefore, in order to build and installed in any other size of drain the size can be increased or reduced accordingly.

5. CONCLUSION

Drain rubbish collector was a device fabricated to trapped rubbish in drains. Indirectly, it is hoped with such devices, flash flood can be reduced in Malaysia. This device can reduce the need for manual labor. Another perk of using this device is it also ensure the safety of this workers, as there is no need for them to enter drains frequently to collect rubbish. The basket or container that collects the rubbish that floats through this is machine is easily located and also, easy to remove/install. Less time is needed as rubbish collection from this device can be scheduled accordingly. Ultimately, this device will help waste management company to reduce its operational costs. This device is not expensive because the material use is affordable and strong. Apart from that, since this machine uses rechargeable battery, it can be easily recharged to continue usage. The fabrication of this machine was successful as it runs smoothly and achieved its objective to collect and trap everyday kind of litter that flows through it.

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BONDING PERFORMANCE OF BONDED WOOD JOINT USING NATURAL RUBBER LATEX AND TAPIOCA STARCH MIXTURE

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Abstract. The aim of this study is to determine the performance of bonded wood joints using mixtures of natural rubber latex and tapioca starch through mechanical strength and delamination tests. It is conducted to see the potential of both natural adhesive as an alternative to synthetic adhesive, particularly formaldehyde-based adhesives, which have many side effects on human health and the environment. Three ratios of rubber latex-tapioca starch (L: T) mixture were used, which are 60:40, 50:50 and 40:60 as well as 100% urea formaldehyde (UF) as control sample. The internal bonding (IB) strength performance of the bonded wood joints reveals that all of the three mixtures ratio (latex and tapioca) recorded lower IB of 0.27 N/mm^2, 0.07N/mm^2 and 0.16 N/mm^2 respectively, compared to 100% UF which is 0.87 N/mm^2. The shear test also shows similar results which is 1.4 N/mm^2, 5.8N/mm^2 and 6.02 N/mm^2, compared to 84.37 N/mm^2 of 100% UF. Nevertheless, the delamination performance of bonded wood joints shows the mixture of 60:40 rubber latex-tapioca starch has indistinguishable result with 100% UF bonded wood joints, with 85.23% and 80.80% respectively. Although the strength performance was not on par with the control sample, the delamination performance shows much positive result. The delamination test demonstrates that it is possible to promote natural adhesive rubber latex-tapioca starch to be used for indoor products that does not require heavy loading particularly non-structural purposes. For future study, the temperature and assembly time must be focused on as it plays a significant role in the bonded-joint wood adhesion process, thus affecting the properties of the bonded lines.

Keywords: glue line, natural adhesive, formaldehyde

1. INTRODUCTION

The aim of this study is to study the glue-line properties of bonded-joint wood using a mixture of rubber latex-tapioca starch as a natural adhesive to replace synthetic adhesives, particularly formaldehyde-based adhesives such as urea formaldehyde.

Synthetic adhesive is widely used in the wood composite industry. Recent developments have shown more concerns of the use of synthetic adhesives, especially formaldehyde-based adhesives, due to its adverse impacts on the environment and consumers' health. Most of the adhesives used in wood bonding have formaldehyde as a co-monomer, generating concern about formaldehyde emissions. Therefore, the use of natural adhesives as alternatives specifically in wood industry, has gaining more interests among researchers. It is very well anticipated because the use of natural adhesives goes back a long way since the history of composite wood technology and has recently made a comeback.

This research needs to be done to study the potential of rubberwood (*Hevea brasilliensis)* latex and tapioca starch mixtures to be used as a green alternative in the wood composite industry, particularly glulam. Through this research, the potential of both natural resources can be optimized in the production of green adhesives, which will benefit the wood-based composites.

2. LITERATURE REVIEW

2.1 Wood Adhesion and Adhesive Bonding

Adhesion is an attraction between dissimilar molecules or surfaces to cling or bond to one another (Von Fraunhofer, 2012). Adhesion science focuses on understanding the materials properties associated with formation of the interfaces, changes in the interfaces with time, and events associated with failure of the interfaces (Sally, et. al. 2009). In wood adhesion whereby bonding interactions of wood surfaces is essential, relates deeply on the adhesive strength performance. Adhesive strength is defined mechanically as the force necessary to pull apart two substrates that are bonded together, and because it is a measurement of failure, both chemical and mechanical aspects of bond strength, and the interrelation of the two factors are very important to consider (Frihart, 2012).

Adhesive bonding performance between wood elements is very much influenced by the degree of penetration of the adhesive into the porous network of interconnected cells (Onur Ülker, 2016). The process of adhesive bonding involves three steps which are surface preparation, wetting of wood surfaces by the adhesive and setting of adhesives.

2.2 Formaldehyde-based adhesive

Formaldehyde-based adhesive such as urea formaldehyde (UF) is a widely used synthetic adhesive in the downstream timber industry, particularly in the manufacturing of chipboard, plywood and glulam board. Formaldehyde copolymer adhesives are used for the production of most laminates, finger joints, and composite products (Frihart, 2012).

It is a common adhesive used in the industry whereby it involves a reaction of formaldehyde with phenol, rescorcinol, urea, melamine or mixtures thereof. The reaction between the substances basically involving water to react hence characterized as water-borne resins. It is known that formaldehyde adhesives are a fast-setting with high degree of curing time, thus makes it popular in the industry. A better adhesive basically needs extra formaldehyde, but it raises concerns about the problem of significant formaldehyde emissions from the bonded product.

The emission of formaldehyde gas is associated with the reduction of adhesive property which caused by its susceptibility towards high temperature and humidity (Onur Ülker, 2016) It became a concern since most forest industry products are made for indoor use.

2.3 Natural Rubber Latex

Natural rubber latex is a bio-based product which is processed mostly for manufacturing of extruded rubber products, moulded goods or pneumatic tires, while small percentage in the manufacturing of rubber gloves and other dipped products such as balloons and condoms. It can also be used as a water-based contact adhesive. However, it is known to be unstable and is brittle when left for a period of time. Thus, it is necessary to add an antioxidant and stabilizer into the natural rubber latex adhesive (Pranee Chumsamrong & Oukrit Monprasit, 2007).

2.4 Tapioca Starch

Tapioca starch is an unflavored whitish starch which is processed from the roots of tapioca tree. Tapioca is one of the staple foods in most populations and sometimes used as thickening material in food. Tapioca starch does not contain gluten and almost protein free. It is also known to be potentially used as natural adhesive (Celikci, 2017).

2.5 Application of adhesive

The largest wood market is the manufacturing of panel products, including plywood, oriented strand board (OSB), fiberboard, and particleboard. Except for plywood, the adhesive in these applications bonds' small pieces of wood together to form a wood-adhesive matrix. The strength of the product depends on efficient distribution of applied forces between the adhesive and wood phases (Frihart, 2012).

For laminating lumber and bonding finger joints, the adhesive can either be heat or room temperature cured. The cost of the adhesive has become more critical as the thickness of the wood decreases from glulam to laminated veneer lumber and parallel strand lumber (Stark *et al*. 2010).

2.6 Performance of bonded products

Since an adhesive is used under normal use conditions to hold two surfaces together, it is important to understand the properties of an adhesive that allow it to perform this function. The concept of adhesion is to create mechanical interlocking between the substrate and the adhesive, making it important to understand the internal and external forces on the bondline and the distribution of those forces across the bonded assembly. Mechanical properties are dependent upon the chemical structure, thus knowing the structure of the adhesive and interphase helps to understand the adhesive performance (Frihart, 2012). In order to understand the performance of the bonded product, it is necessary to understand the force the bondline can withstand under normal use conditions. The effect of external forces on the bondline can be analyse through a variety of standard test such as shear and internal bonding test.

Durability of wood adhesive bonds exposed to moisture is an important topic in the wood products industry. Not all adhesives create durable bonds with wood, especially when exposed to wet conditions (Yelle & Strigus, 2016).

2.7 Shear strength test

The shear strength test is designed to put pressure on the test sample so that it does not slide parallel to the applied force. Shear forces generally cause both material surfaces to move in opposite directions until the material is pressed in shear motion. As the force applied is parallel to both surface touches, the shear strength test differs from the tension test and the compression test, while the tension test and compression test are one surface touch that only pulls and presses (Ylinen, 1963).

2.8 Internal bonding test (IB)

The internal bonding force is intended to measure the strength between the adhesives and the substrate (Jaafar & Shakri, 2009). The internal bonding test of the glueline adhesion to the wood was carried out by the samples held on both surfaces of the width of the wood and drawn in two directions, giving a measure of the glueline internal bond strength between the adhesive and the wood. Sample measurements were recorded to determine the best ratio for the internal bonding of the adhesive.

2.9 Delamination test

Delamination is a failure of the laminate material due to forces or moisture. There are several types of delamination failures, adhesive failure, either in the adhesive or at the interface between adhesive and wood and debonding that is adhesives detached from the substrate on the laminate layer (Ebnesajjad & Landrock, 2015). Delamination is caused by a weak bond. Delamination is therefore a type of hazardous failure as it results in a material not being visible on the surface.

3. METHODOLOGY

3.1 Materials

This project utilized *seraya timbau* wood blocks, natural rubber-latex, tapioca starch and Urea Formaldehyde (UF) adhesive. Three ratios of natural rubber latex-tapioca starch (L:T) mixture were used which are 60:40, 50:50, and 40:60. The adhesive ratio mix obtained from 500g for both adhesive types. The wood block samples were cut into rectangular shape to the sizes of 5cm x 5cm x 1cm and 5cm x 5cm x 2cm, respectively.

3.2 Glulam samples making
Two wood blocks of each sizes were bundled and glued together. The sample adhesion process was performed by using brushing method on the surface of the sample block before and then pressed together. Samples were left for 24 hours for the curing process.

3.3 Evaluation of glue line performance.
Testing was done using the IMAL test machine located at the Wood Composite Laboratory, Faculty of Science and Natural Resources University Malaysia Sabah (UMS).

Internal bonding (IB) was done according to JIS A5908, 1995 standard with the size of 5cm x 5cm x 2cm. The test was performed to measure the strength of the internal bond strength of each sample according to the specified ratio. The IB performance were calculated based on the formula below:

Eq 1: IB (N/mm^3) = P/bL
Where, P = maximum load (N) at failure
b= width (mm) sample
L= length (mm) sample

Shear sample size was following the ASTM D905-08 2013 standard with the samples size of 5cm x 5cm x 4cm. The test was performed to measure the shear strength of each sample according to the specified ratio. The shear was calculated according to the formula below:

Eq 2: Shear = max load/ [Length x glue line x Width]

Delamination test was done using drying chamber method (Vella *et al.* 2019) with slight modification. Delamination was assessed as part of the individual glue line as well as the total glue line of total element. All standards involve a procedure that fully impregnates test sample with water followed by a drying cycle.

Eq 3: Ratio of delamination (%) = LD/LG x 100
Where, LD= Total length of delamination on both ends
LG= Total length of glue line on both ends

3.4 Data analysis.
Data analysis was performed by comparing the mean and standard deviation of adhesion performance between samples using the different ratio of natural adhesive mixtures, with a sample using UF adhesive.

4. RESULTS AND ANALYSIS

4.1 Adhesive Characteristics Tests.
Referring to Table 1, the mixture ratio of 50:50 (L: T) adhesive has the highest solid content (36.7%) and the lowest is the mixture ratio of 40:60 adhesive (19.6%) compared to 100% UF with 23.6% solid contents. The highest solid content in the 50:50 adhesive is due to the equality of starch contents from both latex and tapioca starch.

From Table 2, the mixture ratio of 60:40 (L: T) adhesive has the highest viscosity and the lowest is 40:60 ratio adhesive. This is co-related to the solid content of the adhesive, whereby the highest the solid content the highest is the viscosity too hence the results.

Table 1: Adhesive's solid content results

Adhesive	Solid content %
UF	23.6
40:60 (latex : tapioca)	19.6
50:50 (latex : tapioca)	36.7
60:40 (latex : tapioca)	30.9

Table 2: Adhesive's viscosity results

Adhesive (L:T)	*Needle/spindle*					
	6/62	**12/62**	**6/63**	**12/63**	**6/64**	**12/64**
40:60	16	2.5	20	10	100	50
50:50	8	6.5	20	26	100	50
60:40	170	116	100	104	100	50

4.2 Glue line Properties Tests.

4.2.1 Internal Bonding

Figure 1 shows that all of the internal bonding test results of the three adhesive mixture ratios are below the JIS requirement. Nevertheless, the 40:60 (L: T) adhesive slightly or insignificantly recorded the highest performance compared to the others. Solid content of adhesive materials plays a crucial role in mechanical properties of adhesion.

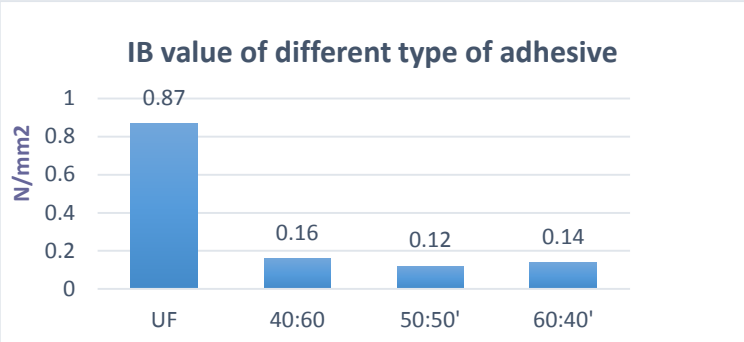


Figure 1: Internal bonding results

According to Carvalho *et al.* (2003), the presence of protein and lipid at the surface region of the rubber particle in the latex, played the role of the compatibilizer between starches which is a polar matrix while the rubber is non- polar material hence the insignificant result.

The increment of the starch concentration in the bio-adhesive increase the chances for agglomeration which leads to the region of stress concentrations on the board structure. Thus, less energy is needed to elongate the crack propagation; hence internal bonding gets weaken easily (Jayshree Thuraisingam *et al.* 2016).

4.2.2 Shear strength

Figure 2 shows that all shear strength test of the three adhesive mixture ratios are below the ASTM requirement. However, the 60:40 (L: T) adhesive recorded the highest performance compared to the others. It is due to the characteristic of latex which has higher adhesion ability in its natural states compare to tapioca starch hence the result obtained.

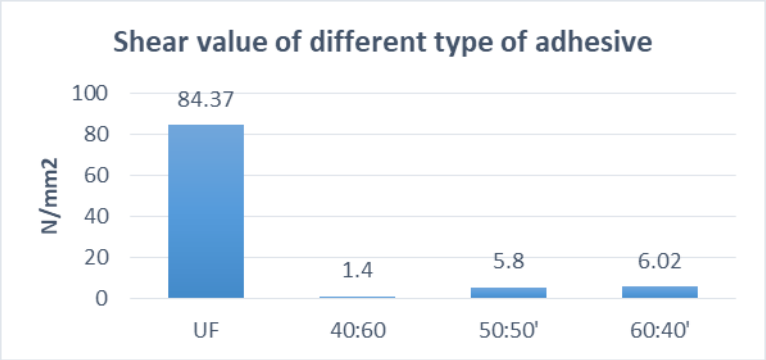


Figure 2: Shear test results

4.2.3 Shear strength

The delamination test shows a positive result of the three adhesive mixtures compare to UF adhesives as shown in Figure 3. The mixture of 60:40 (L: T) adhesives has the lowest delamination with 1.84%. This is due to higher moisture resistant nature of latex, hence low moisture absorption to affect the adhesion strength between the glue lines.

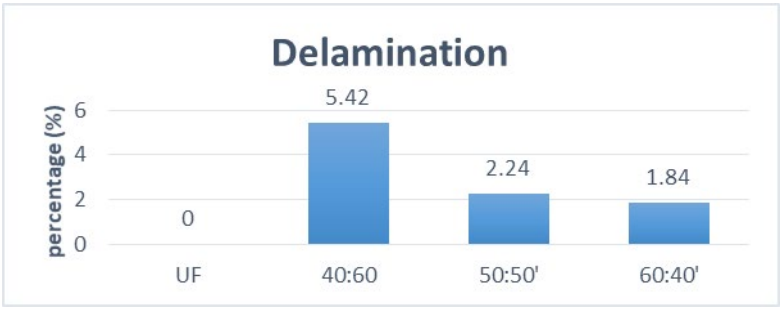


Figure 3: Delamination test results

5. CONCLUSION

In conclusion, this research needs further study with a thorough experimental design to have a more significant impact on the use of natural adhesives in the wood composite industry. There are a few factors that should be taken into account that could have an impact on the results achieved. Temperature and assembly time play a significant role in the bonded-joint wood adhesion process, thus affecting the properties between the bonded lines. For future consideration, these factors need to be focused on the achievement of satisfactory results.

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Abstrak. Kajian menerangkan ciri ciri fizikal buluh serta untuk mengkaji ketegangan buluh sebagai tetulang keluli dalam rasuk konkrit bertetulang. Beberapa sampel buluh yang tidak dirawat telah disediakan untuk kajian ini. Ciri-ciri fizikal buluh termasuk ketumpatan, penyerapan air, dan tegangan turut dikaji. Kajian terhadap sifat fizikal buluh dari segi ketumpatan mendapati bahawa buluh mempunyai ketumptan yang rendah diantara (0.05 – 0.07) (g/cm^3). Ini menunjukkan bahawa buluh merupakan bahan ganti yang sesuai dalam pembinaan. Sebanyak 9 sampel buluh daripada 3 bahagian buluh iaitu bahagian dasar, hujung dan tengah dikaji sifat fizikal buluh dari segi resapan air. Hasil dari ujian resapan air menunjukkan buluh dari bahagian hujung menunjukkan peratusan paling tinggi berbanding bahagian lain dalam masa 24jam, 15 hari dan 30 hari iaitu (41.05%) (62,97%) dan (63.54%) . Hal ini demikian kerana bahagian dasar buluh berada di bahagian paling bawah di mana bahagian yang sememangnya mengandungi air. Oleh sebab itu kadar resapan akan menjadi kurang berbanding pada bahagian hujung buluh. Manakala bagi ujian ketegangan buluh pula keputusan yang didapati bagi 9 sampel buluh mendapati purata ujian ketegangan maksimum buluh dari 3 bahagian buluh itu menunjukkan buluh pada bahagian dasar adalah paling tinggi purata ketegangan maksimum iaitu sebanyak 703.011 (MPa). Laporan kajian makmal menunjukkan buluh mencatatkan keputusan yang luar biasa untuk tegangan di mana ia memperolehi nilai purata ketegangan paling tinggi adalah 824.475 (MPa). Kajian ini dapat menyediakan satu data serta maklumat dimana dapat dijadikan sebagai rujukan. Penggunaan buluh dapat menjimatkan kos kerana harga buluh lebih murah berbanding besi kerana bahan ini mudah untuk diperolehi. Buluh juga dikatakan mempunyai kekuatan yang sama seperti tetulang besi menjadikan ia bahan yang sesuai untuk menggantikan tetulang besi.

Kata Kunci: Buluh, tetulang, rasuk konkrit, ketumpatan, resapan air.

1. PENGENALAN

Buluh adalah contoh sumber semula jadi yang berpotensi untuk menggantikan keluli dalam konkrit bertetulang. Kekuatannya yang lebih besar daripada kayu dan kekuatan tegangannya kira-kira setengah berbanding dengan keluli menjadikannya sesuai untuk menggantikan bar pengukuhan keluli dalam konkrit (Khare, 2005). Sifat fizikal buluh dari segi kepadatan, kandungan lembapan awal, air penyerapan, mampatan dan ketegangan yang menjadikannya sesuai untuk konkrit kerana ciri-ciri buluh mampu untuk menandingi keluli, dalam beberapa tahun kebelakangan ini, kajian telah dibuat pada buluh sebagai bahan struktur dan pengukuhan dalam konkrit (Fikremariam et al,2010) telah menjalankan ujian ketegangan dan ujian mampatan pada spesimen buluh. Beliau menyimpulkan bahawa kekuatan mampatan buluh kurang daripada kekuatan tegangan buluh. Populariti konkrit sebagai bahan binaan dalam industri pembinaan terkenal dan ia dihasilkan lebih daripada 10 bilion tan setahun sumber (Meyer, 2009). Ini kerana ia mempunyai sifat kekuatan mampatan yang agak tinggi. Walau bagaimanapun, ia tidak boleh digunakan semata-mata tanpa sebarang tetulang kerana ia mempunyai kekuatan tegangan yang rendah. Biasanya, konkrit akan diperkuat dengan keluli untuk memberikan kekuatan

tegangan yang kuat. Walau bagaimanapun, keluli adalah terdedah kepada kehakisan apabila konkrit bertetulang keluli terdedah kepada keadaan buruk. Selain itu, keluli diperbuat daripada besi yang terdapat di dalam kerak bumi. Walau bagaimanapun, ia akan mengalami kekurangan jika eksploitasi berterusan dijalankan. Disebabkan ini, banyak penyelidik mula mencari bahan yang ada dan boleh diperbaharui serta mempunyai ciri eko-cekap untuk menggantikan keluli. Dalam kajian ini, buluh akan digunakan sebagai gantian mengukuhkan bar dalam konkrit bagi mengkaji prestasi tetulang buluh dalam konkrit dari segi ketegangan kekuantan dan menilai sifat fizikal buluh serta penyerapan air. Matlamat utama kajian ini adalah untuk menilai sifat fizikal buluh dari segi ketumpatan dan resapan air dan mengkaji ketegangan buluh sebagai tetulang dalam rasuk konkrit.

2. KAJIAN LITERATUR

2.1Sifat Fizikal

Kajian terhadap sifat fizikal buluh boleh dilakukan dari segi ketumpatan, kandungan lembapan awal, penyerapan air, dan mampatan serta ciri-ciri ketegangan. Sifat-sifat ini penting untuk dipelajari kerana ia akan membantu dalam penyiasatan kelayakan untuk menggantikan tetulang keluli dengan buluh dalam konkrit bertetulang. Secara amnya, buluh mempunyai ketumpatan yang sangat rendah. Oleh itu, ia sesuai untuk menjadi bahan binaan terutama untuk pembinaan ringan. Berdasarkan kajian daripada Gupta dan (Ganguly 2015), didapati bahawa kandungan lembapan awal buluh meningkat di sepanjang batang buluh dari atas ke bawah. Buluh mempunyai keupayaan menyerap air yang tinggi. Ini adalah salah satu faktor yang perlu dipertimbangkan dengan teliti apabila ia digunakan sebagai pengganti tetulang keluli dalam konkrit. Sifat pembengkakan dan pengecutan buluh apabila menyerap air telah menjadi batasan untuk menggantikan tetulang keluli. Oleh itu, rawatan berkesan menggunakan penahan air adalah penting untuk meningkatkan ikatan antara segmen buluh dan konkrit. (Sabnabi et al., 2013)

2.2 Rasuk Konkrit Bertetulang Buluh

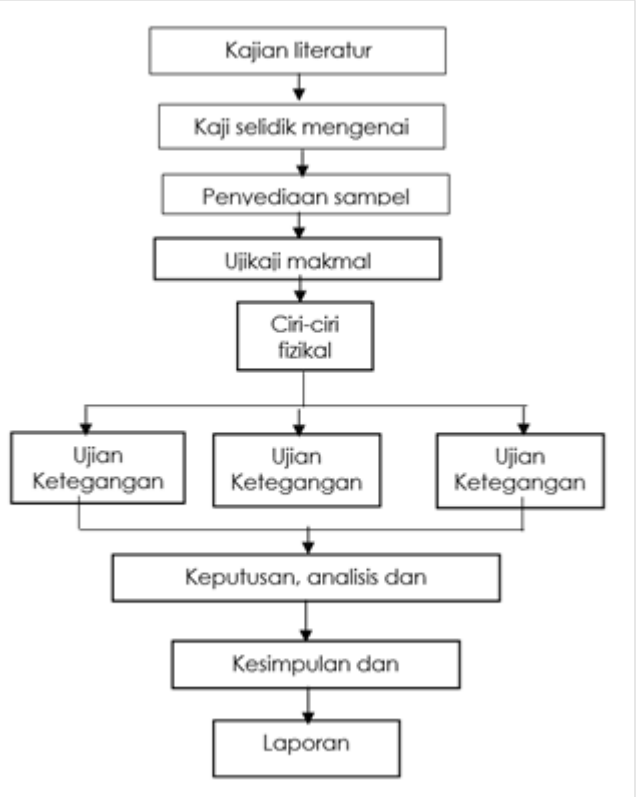
Penggunakan tetulang buluh adalah kaedah yang berfaedah untuk mengantikan rasuk sedia ada yang memerlukan pengukuhan. Buluh adalah bahan binaan yang sesuai digunakan untuk menguatkan rasuk konkrit bertetulang yang terbeban atau salah rekaan. Kapasiti galas beban meningkat sebanyak 84% dengan penggunaan buluh di bahagian bawah dan kedua-dua belah rasuk (Nahar et al., 2015). Buluh tidak dapat mencegah konkrit daripada retak ketika beban maksimum. Walau bagaimanapun, penguatan buluh meningkatkan daya tampungan beban rasuk (Rahman et al., 2011). Bagi konkrit bertetulang yang mempunyai dimensi yang sama, dapat dilihat bahawa kapasiti galas beban meningkat kira-kira tiga kali untuk rasuk konkrit bertetulang buluh berbanding dengan konkrit biasa. Rasuk konkrit bertetulang buluh mempunyai pesongan maksimum sebanyak 1.5 kali berbanding dengan konkrit biasa (Sethia et al., 2014).

3. METADOLOGI

Carta aliran kerja bermula dari kajian literatur sehingga keputusan analisis data diperolehi dapat dilihat melalui carta aliran kajian di Rajah 1.

3.1 Sumber Buluh

Sumber buluh yang diperolehi adalah daripada Sungai Lembing, Kuantan. Buluh yang digunakan adalah jenis vulgaris bamboo atau lebih dikenali sebagai buluh minyak, buluh gading dan buluh temalang.



Rajah 1: Carta Alir Kajian

3.2 Penyediaan Bahan untuk Ujikaji Makmal

Buluh yang diperolehi perlu dipotong mengikut dimensi ukuran yang telah ditetapkan. Rajah 2 menunjukkan ukuran buluh yang digunakan pada dalam ujian ketegangan ialah 200 mm panjang dan 8mm diameter. Rajah 3 menunjukkan ukuran buluh yang digunakan pada ujian ketumpatan iaitu 50mm panjang x 50mm lebar sumber (Tan Khye Fang, 2016). Rajah 4 menunjukkan ukuran bagi ujian kandungan air dimana panjang 400mm.



Rajah 2: Ukuran Buluh untuk Ujian Ketegangan



Rajah 3: Ukuran buluh untuk Ujian Ketumpatan



Rajah 4: Ukuran Buluh untuk Ujian Kandungan Air

3.3 Ujikaji Makmal

Bilangan sampel ujikaji dan ujian-ujian yang dijalankan ditunjukkan dalam Jadual 1.

Jadual 1: Bilangan sampel ujikaji

Bil	Ujian	Bahagian dasar	Bahagian tengah	Bahagian hujung	Bilangan ujian
1	Ujian ketegangan buluh	3	3	3	9
2	Ujian ketumpatan	3	3	3	9
3	Resapan air	3	3	3	9

3.3.1 Ujian Ketegangan Ke Atas Buluh

Ujian dijalankan untuk mengenal pasti kekuatan tegangan maksimum buluh dan besi yang akan menjadi data asas yang digunakan untuk mengira tegangan maksimum yang dibenarkan dalam buluh. Dalam ujian ketegangan buluh, panjang buluh yang digunakan untuk ujian ini adalah 200 mm panjang dan 8mm diameter ujian ini dilakukan sebanyak 3 kali diletakkan pada tiga bahagian buluh yang berbeza. Jadual 2 menunjukkan spesimen dimensi buluh yang digunakan dalam ujian ketegangan.

Jadual 2: Spesimen Dimensi Buluh

Spesimen	**Dimensi**		**Luas keratan rentas (mm)**
	Panjang (mm)	**Diameter (mm)**	
Bahagian dasar	200	8	50.29
Bahagian tengah	200	8	50.29
Bahagian atas	200	8	50.29

3.3.2 Ujian Resapan Air

Dengan perubahan suhu dan kelembapan ralatif, buluh menjadi bahan *hygroscopic*, Kandungan lembapannya juga berubah. Apabila buluh mula hilang kandungan kelembapan, ia mula mengecut. Pengecutan buluh adalah berkadar terus dengan jumlah air yang hilang. Oleh itu, aspek ini perlu dipertimbangkan apabila menggunakan buluh sebagai tetulang dalam konkrit. Pengecutan pada batang buluh dalam konkrit, akan menyebabkan wujudnya tekanan tambahan dan ruang antara. Ini akhirnya akan menyumbang kepada penurunan ikatan antara dua elemen tersebut iaitu antara buluh dan konkrit. Ujian kadar resapan air dilakukan bagi mendapatkan kadar keupayaan buluh untuk menyerap air. Ujian kadar resapan air akan dibuat pada 3 bahagian, iaitu bahagian dasar, bahagian tengah dan bahagian hujung.

3.3.3 Ujian Ketumpatan

Prinsip asas menjalankan ujian ketumpatan buluh adalah dengan menimbang dan mengambil pengukuran dimensi sampel untuk mendapatkan jisim dan dimensi buluh masing-masing. Oleh kerana ujian ini hanya berlaku bergantung kepada jisim buluh yang dikeringkan dan saiz dimensi buluh, ujian ketumpatan boleh digunakan sebagai parameter yang sesuai untuk mengklasifikasikan buluh. Dalam erti kata lain, ujian ketumpatan ialah jisim bagi setiap unit isi padu. Rajah 5 menggambarkan sampel disediakan untuk ujian ketumpatan sumber. Rajah 6 menunjukkan ketebalan sampel diukur menggunakan alat angkup vernier sumber. Jumlah sampel diukur menggunakan kaedah anjakan air seperti yang ditunjukkan dalam Rajah 7 menunjukkan isipadu sampel yang diukur menggunakan kaedah anjakan air sumber (Tan Khye Fang, 2016).



Rajah 5: Sampel yang Disediakan untuk Ujian Ketumpatan



Rajah 6: Ketebalan Sampel Diukur Menggunakan Angkup vernier



Rajah 7: Isipadu Sampel Diukur Menggunakan Kaedah Anjakan Air vernier

4. DAPATAN DAN ANALISIS

4.1 Ciri Fizikal Buluh

Dalam kajian ini, sampel buluh disediakan mengikut ujian ciri fizikal yang telah ditetapkan. Kesemua ujian yang dilakukan adalah tiga, iaitu ujian ketegangan, resapan air dan ketumpatan.

4.1.1 Ujian Ketegangan

Ujian tegangan untuk buluh telah dijalankan menggunakan Mesin Ujian Universal (UTM) yang terdapat di makmal UMP. Dalam kajian ini, sampel buluh terdiri daripada buluh yang merupakan bahagian hujung, tengah, dan dasar dari batang buluh. Buluh yang diuji adalah dalam bentuk tulang anjing yang ditunjukkan dalam Rajah 8.



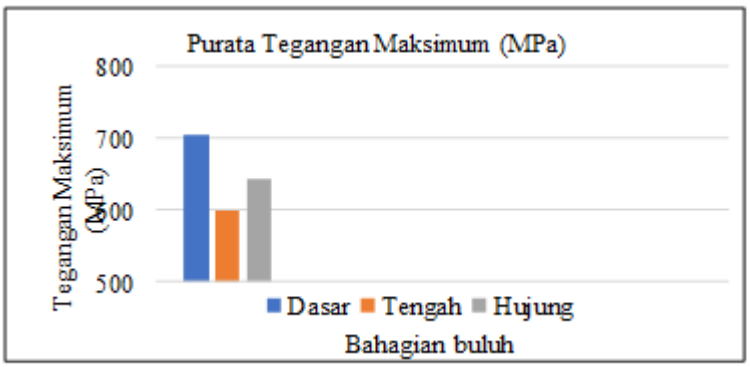
Rajah 8: Sampel Buluh yang Berbentuk Tulang Anjing

Ujian tegangan dilakukan pada 9 sampel buluh yang terdiri daripada tiga bahagian iaitu dasar, tengah, hujung. Buluh adalah bahan semulajadi. Oleh itu, semua sampel yang disediakan tidak mempunyai ketebalan dan lebar yang sama. Keputusan ujian tegangan untuk sembilan sampel diringkaskan dalam Jadual 3.

Jadual 3: Keputusan Ujian Ketegangan

Sampel (MPa)	Ketebalan (mm)	Lebar (mm)	Panjang (mm)	Keputusan tegangan maksimum (MPa)	Purata tegangan maksimum (MPa)
H1	3.22	8	200	658.273	643.916
H2	3.48	8	200	613.952	
H3	3.10	8	200	659.523	
T1	3.44	8	200	618.085	598.673
T2	3.34	8	200	569.108	
T3	3.54	8	200	608.826	
D1	5.22	8	200	824.572	703.011
D2	5.30	8	200	745.566	
D3	4.96	8	200	538.895	

Berdasarkan nilai tegangan maksimum yang diperoleh dalam ujian bahagian tengah buluh merupakan bahagian yang paling lemah kerana mempunyai nilai purata tegangan maksimum yang paling sedikit berbanding setiap bahagian. Manakala, bahagian buluh yang paling tinggi mengalami tegangan maksimum adalah bahagian dasar iaitu sebanyak 703.011 MPa. Perbandingan ini dapat dilihat pada Rajah 9.

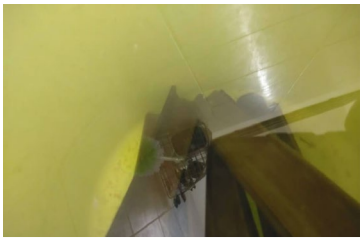


Rajah 9: Perbandingan Purata Tegangan Maksimum pada Setiap Bahagian Buluh

Berdasarkan kajian terdahulu daripada Zhuo Ping Shao et al, (2008) purata tegangan maksimum buluh yang paling tinggi diperolehi adalah 482.2 MPa dengan panjang yang sama iaitu 200mm dalam ujian ini. Manakala, tegangan maksimum yang diperolehi dari kajian ini adalah 824.475 MPa iaitu dari bahagian dasar buluh.

4.1.2 Ujian Resapan Air

Buluh memerlukan air yang mencukupi untuk mendapatkan kekuatan muktamad. Pengecutan akan berlaku apabila konkrit kehilangan air sama ada semasa berada dalam plastik atau keras. Buluh, ialah bahan semula jadi yang mempunyai keupayaan untuk menyerap air di persekitarannya. Dalam kajian ini, 9 sampel buluh dari 3 bahagian buluh iaitu bahagian dasar, tengah,dan hujung diambil bagi mendapatkan keputusan yang tepat. Rajah 10 menunjukkan sampel buluh yang direndam di dalam air. Perubahan warna hijau bertukar kepada warna koko gelap setelah direndam selama sebulan seperti Rajah 11.



Rajah 10: Sampel Buluh yang Direndam di Dalam Air



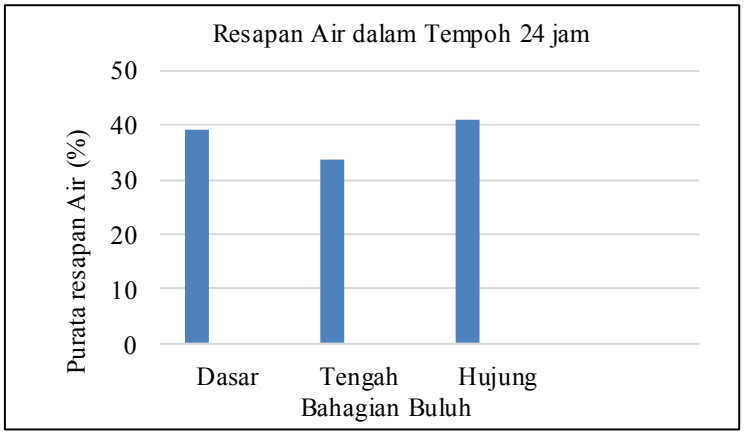
Rajah 11: Sampel Buluh yang Telah Direndam Selama Sebulan

a) Keputusan ujian resapan air selama 24 jam

b) Jadual 4 menunjukkan jumlah resapan air bagi buluh yang direndam dalam air selama 24 jam. Jumlah resapan air yang tertinggi bagi buluh pada bahagian dasar adalah pada sampel A1 iaitu sebanyak 43.75%. Bagi bahagian tengah adalah pada sampel B2 iaitu sebanyak 35.36%. Bahagian hujung buluh pula adalah pada sampel C3 iaitu sebanya 47.10%.

Jadual 4: Jumlah Resapan Air Bagi Rendaman Buluh Selama 24 Jam

Bahagian buluh	Sampel	Ketebalan (cm)	Berat awal (g)	Berat kering oven (g)	Jumlah resapan air (%)	Purata resapan air (%)
Dasar	A 1	0.5	72	40.5	43.75	39.15
	A 2	0.8	67	41.9	37.46	
	A 3	0.6	69	44.0	36.23	
Tengah	B 1	0.6	57	37.8	33.68	33.71
	B 2	0.7	56	36.2	35.36	
	B 3	0.6	53	36.0	32.08	
Hujung	C 1	0.6	44	27.8	36.82	41.05
	C 2	0.5	39	23.7	39.23	
	C 3	0.3	31	16.7	47.10	



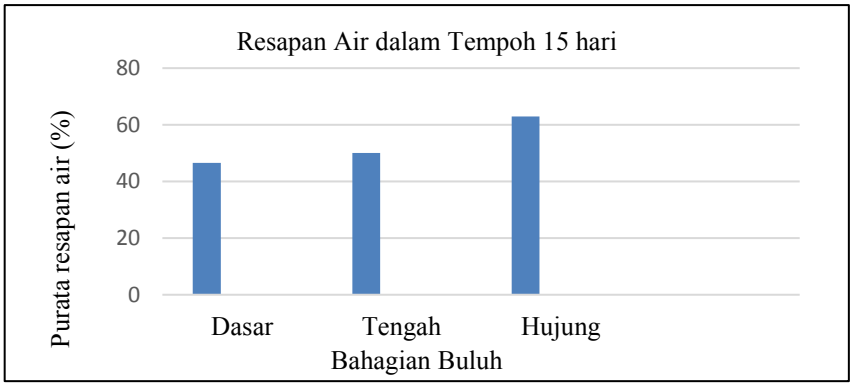
Rajah 14: Purata Resapan Air Selama 24 Jam

Berdasarkan data yang diperolehi selepas buluh direndam di dalam air selama 24 jam, purata peratusan resapan air yang diperolehi buluh bagi bahagian dasar adalah 39.15%. Purata bagi bahagian tengah buluh adalah 33.71%, manakala bagi bahagian hujung buluh adalah 41.05%. Bahagian buluh yang paling banyak menyerap air adalah pada bahagian hujung. Bahagian buluh yang paling kurang menyerap air adalah bahagian tengah. Perbandingan bagi jumlah purata resapan air ini dapat dilihat berdasarkan Rajah 14 dibawah.

c) Keputusan ujian resapan air selama 15 hari
Jadual 5 merupakan data yang diperolehi selepas buluh direndam di dalam air selama 15 hari, purata peratusan resapan air yang diperolehi buluh bagi bahagian dasar adalah 46.61%. Purata bagi bahagian tengah buluh adalah 50.11%, manakala bagi bahagian hujung buluh adalah 62.97%. Bahagian buluh yang paling banyak menyerap air adalah pada bahagian hujung. Bahagian buluh yang paling kurang menyerap air adalah bahagian dasar.

Jadual 5: Jumlah Resapan Air Bagi Rendaman Buluh Selama 15 Hari

Bahagian buluh	Sampel	Ketebalan (cm)	Berat awal (g)	Berat kering oven (g)	Jumlah resapan air (%)	Purata resapan air (%)
Dasar	D 1	0.4	86	40.0	53.49	46.61
	D 2	0.5	74	43.1	41.76	
	D 3	0.5	74	41.0	44.59	
Tengah	T 1	0.6	75	35.8	52.27	50.11
	T 2	0.4	65	36.2	44.31	
	T 3	0.4	80	37.0	53.75	
Hujung	H 1	0.4	57	26.2	54.04	62.97
	H 2	0.3	67	22.6	66.27	
	H 3	0.3	64	20.1	68.59	



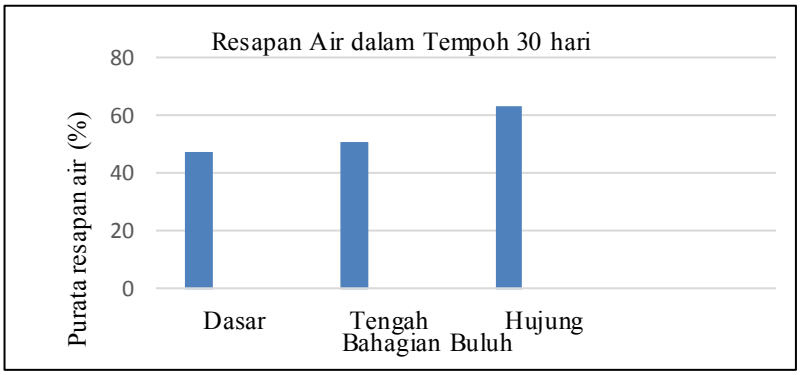
Rajah 15: Purata Resapan Air Selama 15 Hari

Perbandingan bagi jumlah purata resapan air ini dapat dilihat berdasarkan Rajah 15. Bahagian dasar buluh mampu meresap hingga 46.61%, bahagian tengah sebanyak 50.11% dan bahagian hujung pula menyerap hingga 62.97%. Hal ini, menujukkan bahawa bahagian buluh yang paling banyak meresap adalah bahagian hujung. Di ikuti bahagian tengah, manakala bahagian yang paling sedikit adalah bahagian dasar buluh.

d) Keputusan ujian resapan air selama 30 hari
Jadual 6 menunjukkan data yang diperolehi selepas buluh direndam di dalam air selama 30 hari, purata peratusan resapan air yang diperolehi buluh bagi bahagian dasar adalah 47.21%. Purata bagi bahagian tengah buluh adalah 50.79%, manakala bagi bahagian hujung buluh adalah 63.54%. Bahagian buluh yang paling banyak menyerap air adalah pada bahagian hujung. Bahagian buluh yang paling kurang menyerap air adalah bahagian dasar. Perbandingan bagi jumlah purata resapan air ini dapat dilihat berdasarkan Rajah 16.

Jadual 6: Jumlah Resapan Air Bagi Rendaman Buluh Selama 30 Hari

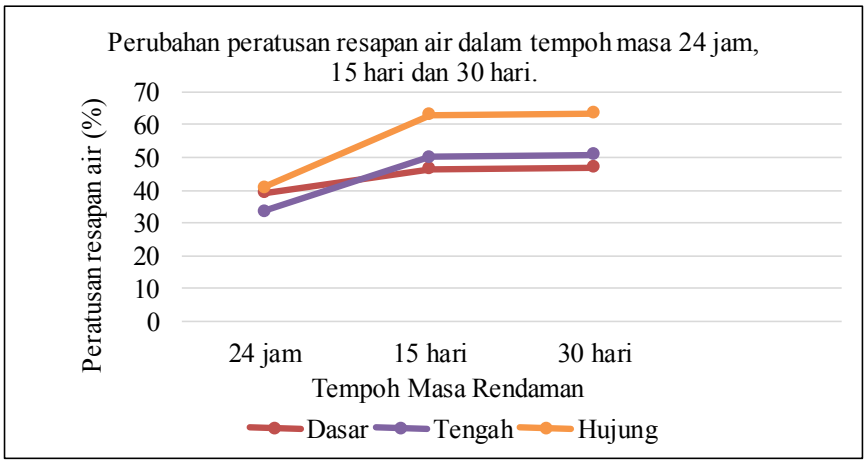
Bahagian buluh	Sampel	Ketebalan (cm)	Berat awal (g)	Berat kering oven (g)	Jumlah resapan air (%)	Purata resapan air (%)
Dasar	D 1	0.5	86	40.0	53.49	47.12
	D 2	0.4	76	43.1	43.29	
	D 3	0.4	74	41.0	44.59	
Tengah	T 1	0.4	76	35.8	52.89	50.79
	T 2	0.5	66	36.2	45.15	
	T 3	0.4	81	37.0	54.32	
Hujung	H 1	0.3	58	26.2	54.31	63.54
	H 2	0.4	68	22.6	66.76	
	H 3	0.3	66	20.1	69.55	



Rajah 16: Purata Resapan Air Selama 30 Hari

Keputusan percubaan untuk 15 hari pertama menunjukkan terdapat perubahan yang jelas kepada 3 bahagian buluh yang direndam selama 15 hari pertama. Pada hari ke 15 buluh menunjukkan bahagian dasar buluh paling sedikit peratusan serapan air berbanding bahagian tengah dan hujung iaitu 46.61 %. Peratusan air yang diserap pada bahagian tengah ialah 50.11 % dan peratusan serapan air pada bahagian hujung paling banyak iaitu sebanyak 62.97%. Keputusan selepas 30 hari peratusan berat air yang diserap oleh bahagian paling hujung adalah paling banyak iaitu sebanyak 63.54%. Manakala sebanyak 50.79% air yang diserap pada bahagian tengah dan pada bahagian dasar pula sebanyak 47.12% air yang diserap. Buluh adalah bahan semulajadi. Oleh itu, keupayaan untuk menyerap air untuk setiap sampel bergantung kepada luas keratan rentas, ketebalan dan kedudukan sampel buluh yang diambil.

Merujuk Rajah 17, perbandingan mengikut tempoh masa rendaman pada setiap bahagian ditunjukkan. Bahagian hujung buluh menunjukkan bahagian yang paling banyak menyerap air, dimana bahagian tersebut mendapat peratusan yang tertinggi dalam setiap tempoh rendaman. Manakala bahagian dasar merupakan bahagian yang paling kurang menyerap air. Ianya disebabkan peratusan yang diperolehi adalah yang paling terendah pada tempoh 15 hari dan 30 hari berbanding bahagian buluh yang lain. Hal ini adalah kerana bahagian dasar. Hal ini adalah kerana bahagian dasar berada di bahagian paling bawah di mana bahagian yang sememangnya mengandungi air. Oleh itu kadar resapan akan menjadi kurang berbanding pada bahagian hujung buluh.



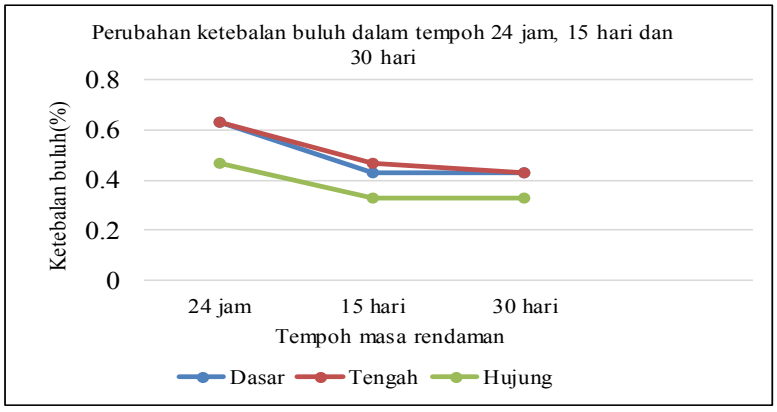
Rajah 17: Perbandingan Mengikut Tempoh Masa Rendaman

e) Keputusan ketebalan selepas ujian resapan air

Keputusan ketebalan pada tiga bahagian buluh berubah selepas 24jam, 15 hari dan 30 hari dicatat dalam Jadual 7. Sama seperti eksperimen terdahulu, hasil yang diperoleh berdasarkan perubahan ketebalan buluh, pada bahagian hujung menunjukkan perubahan ketebalan yang paling banyak iaitu 56.67% pada 24 jam, manakala pada hari ke 15 pula sebanyak 63.33% dan pada hari ke 30 sebanyak 60%. Graf perubahan ketebalan buluh selepas 24jam ,15 hari dan 30 hari terhadap tiga bahagian buluh diplot dalam **Rajah 18**

Jadual 7: Perubahan Ketebalan Buluh

Bahagian sampel buluh	Ketebalan buluh selama 24 jam rendaman (%)	Ketebalan buluh selama 15 hari rendaman (%)	Ketebalan buluh selama 30 hari rendaman (%)
Dasar	12.5	30	57.5
Tengah	2.17	15.22	36.95
Hujung	56.67	63,33	60



Rajah 18: Perubahan Ketebalan Buluh

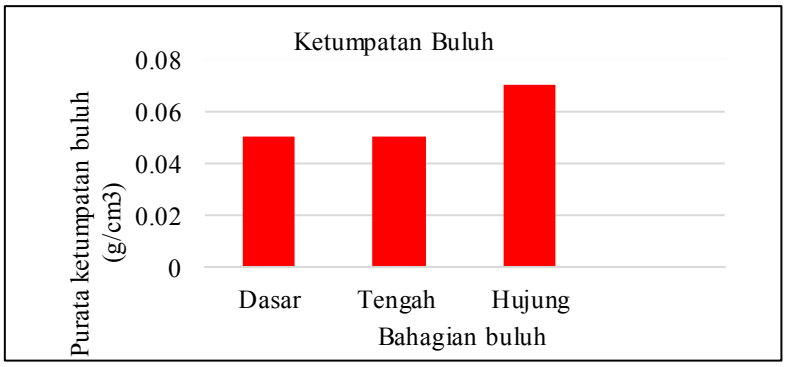
4.1.3 Ujian Ketumpatan

Berdasarkan hasilnya, ketumpatan sampel buluh daripad 3 bahagian tersebut adalah antara 0.05- 0.07 g/ cm^3 seperti yang disenaraikan dalam Jadual 8. Ini menunjukkan bahawa buluh adalah ringan dan mempunyai ketumpatan rendah. Dengan ciri-ciri ini, buluh sesuai untuk digunakan sebagai bahan binaan dalam industri pembinaan kerana ia sangat ringan, oleh itu ia boleh digunakan dan diangkut dengan mudah yang seterusnya mengurangkan penggunaan jentera yang tidak diperlukan dalam industri pembinaan.

Jadual 8: Keputusan Ujian Ketumpatan Buluh

Bahagian buluh	Sampel	Ketebalan (cm)	Berat kering oven (g)	Isipadu sampel (cm^3)	Ketumpatan (g/cm^3)	Purata ketumpatan (g/cm^3)
Dasar	A 1	0.5	4.3	61.25	0.07	0.05
	A 2	0.8	4.1	98.00	0.04	
	A 3	0.6	3.5	73.50	0.05	
Tengah	B 1	0.6	4.4	73.50	0.06	0.05
	B 2	0.7	4.0	85.75	0.05	
	B 3	0.6	3.2	73.50	0.04	
Hujung	C 1	0.6	4.3	73.50	0.06	0.07
	C 2	0.5	4.0	61.25	0.07	
	C 3	0.3	3.1	36.75	0.08	

Berdasarkan data yang diperoleh selepas sampel buluh dikeringkan dalam ketuhar, purata ketumpatan yang diperolehi dari ujian ketumpatan ini adalah bahagian dasar dan tengah memperolehi nilai yang sama iaitu 0.05 g/cm^3, manakala bagi bahagian hujung adalah 0.07g/cm^3. Bahagian buluh yang paling paling ringan dan mempunyai ketumpatan rendah adalah bahagian dasar dan tengah, bahagian dasar dan tengah lebih ringan dan mempunyai ketumpatan rendah berbanding bahagian hujung buluh. Perbandingan bagi jumlah purata ketumpatan buluh bagi bahagian dasar, tengah, dan hujung dapat dilihat berdasarkan Rajah 20 dibawah.



Rajah 20: Perbandingan Ketumpatan Buluh Mengikut Bahagian.

Merujuk, perbandingan ketumpatan mengikut bahagian buluh dapat dilihat. Bahagian hujung buluh merupakan bahagian yang paling banyak mengalami ketumpatan iaitu sebanyak 0.07%. Manakala bahagian dasar dan tengah buluh mengalami ketumpatan yang sama iaitu 0.05%. Keputusan ini adalah sama dengan kajian terdahulu iaitu daripada (Tan Khye Fang, 2016) di mana ketumpatan yang paling tinggi adalah pada bahagian hujung buluh. Di ikuti bahagian buluh pada bahagian tengah dan dasar.

5. KESIMPULAN DAN CADANGAN

Berdasarkan keputusan percubaan yang diperolehi, beberapa kesimpulan boleh diambil. Dari segi resapan air pada buluh didapati bahagian dasar buluh kurang menyerap air jika dibandingkan buluh di bahagian hujung. Ini menunjukkan buluh mempunyai keupayaan menyerap air bergantung pada kedudukan bahagian buluh tersebut. Di samping itu, perubahan terhadap ketebalan buluh yang menyerap air turut berlaku diamana semakin banyak air diserap oleh buluh semakin meningkat ketebalan buluh tersebut. Dari segi ketumpatan buluh mempunyai ketumpatan yang sangat rendah dan sangat sesuai untuk digunakan sebagai bahan binaan iaitu diantara (0.05 - 0.07) (g/cm^3). Keputusan ini didapati daripada 3 sampel bahagian buluh tersebut iaitu dasar, tengah dan hujung. Buluh untuk ujian ketegangan yang dilakukan pada tiga bahagian buluh mempunyai ketegangan yang berbeza pada setiap bahagian. Pada bahagian dasar ketegangan maksimum yang

dicapai ialah 824.572 (MPA) manakala pada bahagian tengah pula ketegangan maksimum yang diperolehi ialah 618.085 (MPA) dan ketegangan pada bahagian hujung ialah 659.532 (MPA). Ketegangan maksimum yang dicapai untuk ujian ketegangan ini ialah 824.572 (MPA) iaitu pada bahagian dasar dan melalui kajian terdahulu oleh (Zhuo Ping Shau et al 2008) keputusan ujian yang dicapai ialah 482.2 (MPA). Secara amnya spesis buluh *Vulgaris* menunujukkan kekuatan tegangan yang lebih tinggi berbanding dengan *Phyllostachys pubescenes.*

Secara keseluruhan, dapat disimpulkan bahawa buluh adalah bahan bangunan yang potensi digunakan selain daripada keluli sebagai tetulang dalam konkrit. Penggunaan buluh sebagai tetulang mampu mengurangkan penggunaan keluli dalam industri pembinaan. Motivasi penyelidikan ini adalah untuk mewujudkan bangunan hijau yang mampan dalam industri pembinaan. Walau bagaimanapun, kajian kemungkinan dalam kajian ini hanya dilakukan dalam skala makmal sahaja. Kaedah tertentu atau teknik pengeluaran mungkin tidak praktikal jika besar pengeluaran diperlukan untuk keperluan masa depan. Oleh itu, penyelidikan masa depan diperlukan untuk dijalankan. Berikut adalah beberapa cadangan mengenai kajian masa depan yang sepatutnya dijalankan.

i. Menurut pengenalpastian spesies buluh oleh Penyelidikan Hutan Institut Malaysia (FRIM), telah dikenal pasti bahawa spesies yang digunakan untuk penyelidikan ini dikenali sebagai Bambusa Vulgaris. Kajian lanjut boleh dijalankan untuk mengenalpasti keberkesanan penggunaan spesies buluh lain. seperti spesis buluh *Gigantochloa scortechinii* atau biasa dikenali sebagai "buluh semantan" yang dicadangkan (FRIM*)* yang juga merupakan buluh yang sesuai digunakan dalam pembinaan.
ii. Model rumah yang diperbuat oleh buluh boleh direka bentuk dan dibina dalam realiti untuk memastikan daya maju penerapan penyelidikan ini dalam industri bangunan sebenar.
iii. Analisis elemen boleh dilakukan dengan menggunakan perisian untuk menyediakan satu simulasi kegagalan model rumah buluh.

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FAKTOR-FAKTOR YANG MEMPENGARUHI KECENDERUNGAN PELAJAR POLITEKNIK MENCEBURI DIRI DALAM E-SUKAN: KAJIAN DI POLITEKNIK BESUT TERENGGANU

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Abstrak. E-sukan (sukan elektronik) atau *e-sport (Electronic-Sports)* adalah permainan video komputer yang dilihat berpotensi memangkin masa depan cerah seiring perkembangan pesat ekonomi digital negara. Acara e-sukan yang buat pertama kalinya dianjurkan di Sukan Sea 2019 mencetuskan persepsi baru kepada hala tuju permainan video komputer. Konsep permainan yang interaktif serta berdaya saing mencetuskan interaksi sosial secara maya ini memberikan keseronokan dan menarik minat golongan muda menceburi bidang e-sukan. Antara faktor-faktor yang dikaji ialah minat, peluang kerjaya di masa depan, reka bentuk grafik permainan digital, hadiah lumayan dan keseronokan bersama rakan. Sampel kajian melibatkan 50 orang pelajar daripada Jabatan Teknologi Maklumat dan Komunikasi, Politeknik Besut Terengganu. Pendekatan kuantitatif menggunakan instrumen soal selidik secara *Google Form* telah diguna pakai untuk mendapatkan data. Data ini dianalisis dengan menggunakan perisian *Statistical Package for Social Science* (SPSS) dan dianalisis menggunakan statistik deskriptif. Hasil kajian menunjukkan skor min bagi faktor keseronokan bersama rakan berada pada tahap sangat tinggi iaitu 4.3 dan skor min bagi faktor minat berada pada tahap tinggi iaitu 4.1. Secara kesimpulannya, Institusi pendidikan perlu mengambil peranan penting bersama dengan pihak kementerian untuk memperkasakan e-sukan di Malaysia. Selain memberi galakan dan tunjuk ajar, institusi pendidikan juga dicadangkan menyediakan kemudahan peralatan dan talian internet yang dapat menampung keperluan latihan e-sukan. Manakala golongan muda perlu menyahut seruan kerajaan untuk melihat e-sukan sebagai satu industri yang serius. Potensi diri dalam permainan video perlu digilap di peringkat awal usia, supaya keupayaan serta kebolehan bermain sesuatu permainan video itu dapat diasah secara profesional untuk melahirkan nama-nama besar dalam industri e-sukan.

Kata kunci: e-sukan, permainan digital, minat dan keseronokan.

1. PENGENALAN

E-sukan (sukan elektronik) merupakan cabang baru dalam institusi kesukanan. Permainan video komputer ini menjadi fenomena yang luar biasa dan telah diiktiraf di serata dunia (Wagner, 2006). Melalui pertandingan, pemain dapat menguji keupayaan minda individu sepenuhnya untuk memenangi pertandingan selain pergerakan tangan atau jari yang pantas serta kecekapan mata menangkap imej di skrin.

Permainan video komputer yang kompetitif ini mendapat perhatian dari sejumlah besar golongan muda. Terdapat pengkaji yang mengkaji mengenai e-sukan berpendapat fenomena permainan ini telah menjadi budaya kepada golongan muda era digital atau *today's digital youth culture* (Wagner, 2006). Di Malaysia, usaha dalam bentuk kajian penyelidikan berkaitan e-sukan agak kurang berbanding dengan penyelidikan di luar negara. Artikel ini cuba untuk memberikan pendedahan awal kepada institusi pendidikan

berkenaan fenomena yang melibatkan golongan muda iaitu generasi Y dan Z. Jika beberapa tahun dahulu seseorang yang bermain permainan video komputer dilihat sebagai orang yang malas tanpa masa hadapan, namun masa telah berubah, sekarang golongan muda mula mengorak langkah mencari peluang menceburi e-sukan melalui liga profesional untuk menunjukkan apa yang mereka boleh lakukan (euroweeklynews, 2018).

Generasi Y atau 'generasi Millenium' ialah istilah yang digunakan untuk merujuk kepada kelompok generasi manusia yang lahir sekitar tahun 1980 hingga 2000. Terdapat pakar demografi seperti William Strauss dan Neil Howe's (2000) yang meletakkan tarikh permulaan bagi generasi ini yang lahir pada 1982 hingga penghujung tahun '90-an. Menurut Tapscott (2008), generasi Z adalah golongan yang dilahirkan tahun 1998 hingga 2009. Manakala generasi Z adalah generasi teknologi. Mereka telah mula melayari internet dan web seiring dengan usia mereka sejak mereka masih belum bercakap. Generasi Z telah dibimbing dan digalakkan oleh ibu bapa menggunakan dunia laman sosial sejak kecil lagi. Dengan kata lain, generasi Z membesar di dalam dunia yang semuanya berhubung menerusi teknologi sejak dari awal lagi.

Atlet e-sukan negara yang boleh diambil sebagai contoh oleh golongan muda ialah pemain permainan video yang terkenal iaitu Soloz atau Mohd Faris bin Zakaria, berumur 27 tahun merupakan pemain *games* Mobile Legends yang telah menjadi pemain profesional atau *gamer* Malaysia pertama yang berjaya di arena e-sukan dan turut mewakili negara di Sukan Sea 2019 (Harian Metro, 2020). Selain berjaya sebagai *gamer*, Soloz juga dikenali sebagai *game streamer* yang menjana pendapatan yang sangat lumayan. Menurut analisis di dalam *Sosial Balde*, Soloz mempunyai 1 juta lebih *subscriber* di Youtube yang telah menyumbang pendapatan USD3.1K-USD60K sebulan dan 1 juta lebih pengikut melalui *Facebook streaming* yang menjana pendapatan yang lumayan. Terbaru beliau berjaya mencatat nama di Malaysia Book of Record sebagai 'Most Number of Followers in Facebook (e-Sports)'.

Politeknik Besut Terengganu yang mempunyai bilangan pelajar seramai 104 orang, terdiri daripada pelajar Diploma Teknologi Maklumat (Teknologi Digital) dilihat mula mengorak langkah dengan perkembangan pesat e-sukan ini. Malis Perwakilan Pelajar (MPP) dan Kelab DIC (*Digital Icon Club*) berminat menganjurkan satu kejohanan e-sukan bagi mengasah bakat dan keupayaan minda pelajar-pelajar. Untuk itu kajian ini telah melibatkan semua peserta dalam kejohanan e-sukan iaitu seramai 50 orang. Matlamat utama kajian ini bagi mengenal pasti bakat-bakat muda di kalangan pelajar Politeknik Besut Terengganu dalam bidang e-sukan dengan mengenal pasti faktor-faktor yang mempengaruhi kecenderungan pelajar menceburi e-sukan dan sejauh manakah kesediaan pelajar-pelajar untuk menceburi dalam sukan elektronik e-sukan ini.

2. SOROTAN KAJIAN

E-sukan adalah pertandingan permainan video berkomputer yang mana pemainnya terdiri daripada pemain profesional, didaftarkan di bawah kelab profesional dan menyertai pertandingan-pertandingan yang dianjurkan baik di dalam mahupun di luar negara (Hamari & Sjöblom, 2017). Setiap pertandingan ini memerlukan kemahiran, kebolehan, strategi, taktik dalam merancang, menumpukan perhatian, komunikasi antara pemain, kesatuan anggota pasukan dan juga latihan sukar seperti sukan lain (Zhouxiang, 2016).

Liputan media yang meluas pada setiap kejohanan dengan tawaran hadiah yang amat lumayan sehingga mencecah sebanyak USD1juta, menjadi pendorong utama dan pencetus semangat kegigihan setiap pemain (Tahir & Hasan, 2020). Selain itu sistem kedudukan atau *ranking* pada setiap liga kejohanan dapat memotivasikan pemain dan pasukan untuk terus unggul pada kedudukan teratas (Besombes & Descartes, 2017). Ini sekaligus mendorong peminat untuk turut serta menyaksikan secara atas talian bagi menyaksikan kejayaan pemain idola di dalam kejohanan e-sukan. Fenomena ini adalah

antara faktor yang mempengaruhi minat golongan muda untuk melibatkan diri dalam e-sukan.

Keterbukaan peluang kerjaya di era ekonomi digital dan disokong dengan perkembangan teknologi dalam negara turut menarik minat golongan muda untuk menceburi e-sukan. Kementerian Belia dan Sukan mensasarkan Malaysia sebagai hub bagi e-sukan di rantau Asia. Untuk itu, pelbagai bentuk bantuan akan diberikan bagi meningkatkan potensi atlet dan kualiti pasukan e-sukan baik dari segi mewakili negara ke pertandingan luar negara atau menganjurkan pertandingan di dalam negara. Golongan muda disarankan menceburkan diri dengan lebih aktif di dalam industri e-sukan ini kerana peluangnya adalah sangat besar. *Esports Academy* pertama negara juga telah ditubuhkan dengan kolaborasi bersama Persatuan Sukan Elektronik Malaysia (ESM). Penubuhan akademi ini bukan sahaja memfokuskan kepada melahirkan lebih ramai pemain profesional negara, tetapi turut menekankan aspek lain yang penting di dalam e-sukan iaitu pengurusan acara, pengurus pasukan, kejurulatihan, *shoutcasting*, pengadilan dan lain-lain (Nicolas 2017).

Pertandingan permainan video e-sukan dikategorikan dengan menggunakan ciri-ciri persaingan ruang maya yang dibangunkan oleh program komputer. Istilah *genre* adalah merujuk kepada jenis permainan video seperti dari perspektif *first players* atau *first shooters, sport games simulation, speed racing game, action games* dan *real time virtual gaming* (Lert-asavapatra, 2019). Kesemua *genre* ini boleh dikelompokkan di bawah kategori MMPORPGs. MMORPGs memerlukan pemain yang ramai untuk bermain, perlu adanya komunikasi dan interaksi ketika bermain bagi memenangi perlawanan, mendapatkan ganjaran dan meningkatkan kedudukan di dalam permainan tersebut.

Selain itu, golongan muda yang ingin menceburi e-sukan perlu merancang masa sesi latihan dan masa persiapan sebelum pertandingan dengan betul. Faktor kesihatan perlu diutamakan. Ini adalah kerana didapati kebanyakan pemain permainan video komputer e-sukan ini menghabiskan masa 14–15 jam sehari untuk menjalani latihan sebelum pertandingan sebenar berlangsung. Sesetengah pemain memerlukan masa latihan yang banyak bagi meningkatkan kedudukan yang lebih tinggi. Menurut (Difrancisco-Donoghue et al., 2019) pemain yang berlatih antara 3 hingga 10 jam setiap hari, keluhan yang paling kerap dilaporkan adalah mata keletihan (56%), diikuti dengan sakit leher dan belakang (42%). Pemain e-sukan melaporkan sakit pergelangan tangan (36%) dan sakit tangan(32%). Empat puluh peratus peserta tidak mengambil bahagian sebarang bentuk latihan fizikal.

3. METODOLOGI KAJIAN

Instrumen yang dijalankan adalah menggunakan soal selidik yang telah diubahsuai dari soalan yang telah dibangunkan oleh (D.C Thomson, 2018). Dalam kaedah ini, borang soal selidik telah dijana secara elektronik menggunakan *Google Form* dan para responden diminta untuk menjawab semua soalan yang dikemukakan. Soal selidik yang digunakan mengandungi tiga bahagian iaitu Bahagian I berkaitan demografi responden, Bahagian II berkaitan faktor-faktor yang mempengatuhi kecenderungan pelajar terlibat dalam e-sukan dan Bahagian III pula berkaitan sejauh manakah kesediaan pelajar politeknik untuk menceburi sukan elektronik e-sukan. Di dalam Bahagian I, soalan dalam bentuk pernyataan digunakan yang mana responden perlu untuk menandakan satu pilihan jawapan bagi maklumat berkenaan jantina, semester dan tahun kelahiran. Manakala di dalam Bahagian II dan Bahagian III, maklumbalas soal selidik dalam bahagian ini akan menggunakan Skala Pemeringkatan Likert yang mengandungi lima nilai skor seperti yang ditunjukkan di dalam Jadual 1 berikut.

Jadual 1: Skala Pemeringkatan Likert

Tafsiran	Skala
Sangat Tidak Setuju	1
Tidak Setuju	2
Tidak Pasti	3
Setuju	4
Sangat Setuju	5

Sejumlah 50 puluh orang responden yang dipilih adalah pelajar-pelajar Politeknik Besut Terengganu yang terdiri daripada ahli *Digital Icon Club* (DIC)yang mana telah menyertai Kejohanan E-Sukan 2020 Politeknik Besut Terengganu. Bagi memproses dan menganalisis hasil data, perisian *Statistical Package for the Social Sciences* (SPSS) telah digunakan. Semua data yang diperolehi daripada responden diproses melalui SPSS dan dipersembahkan secara statistik deskriptif.

Analisis kajian rintis telah dilakukan kepada instrumen yang telah dibina. Seramai 10 orang pelajar telah terlibat dalam kajian rintis ini dan nilai Alpha Cronbach telah diperolehi iaitu dengan nilai keseluruhan 0.83. Tiada batasan kepada nilai kebolehpercayaan sesuatu instrumen kajian, tetapi nilai 0.60 dan ke atas sering digunapakai dalam kajian pendidikan (K. Mohd Majid 2005).

4. ANALISIS DAN KEPUTUSAN

4.1 Demografi
Seramai 50 orang responden yang menjawab borang soal selidik adalah terdiri daripada 28 orang pelajar lelaki (56%) dan 22 orang pelajar perempuan (44%) (Jadual 2).

Jadual 2: Maklumat Jantina Responden

Kriteria	n = 50	Peratus (%)
Lelaki	28	56
Perempuan	22	44
Jumlah	50	100

Responden juga terdiri daripada 5 semester yang berbeza iaitu semester 1 seramai 15 orang (30%), semester 2 seramai 3 orang (6%), semester 3 seramai 16 orang (32%), semester 4 seramai 8 orang (16%) dan semester 5 seramai 8 orang (16%) (Jadual 3). Kesemua responden terdiri daripada golongan muda generasi Z iaitu generasi teknologi yang mewakili populasi kajian ini.

Jadual 3: Maklumat Responden Mengikut Semester

Kriteria		n = 50	Peratus (%)
Semester	Tahun Kelahiran		
Semester 1	2002	15	30
Semester 2	2001	3	6
Semester 3	2001	16	32
Semester 4	2000	8	16
Semester 5	2000	8	16
Jumlah		50	100

4.2: Faktor-faktor yang mempengaruhi kecenderungan pelajar menceburi e-sukan
Faktor-faktor yang dikaji diterjemahkan di dalam bentuk skor min. Menurut Moidunny (2019), jumlah min boleh diinterpretasikan sebagai sangat tinggi apabila nilainya sekitar 4.21-5.00,

jika nilainya antara 3.21-4.20 ianya membawa maksud tinggi, 2.61-3.20 pula membawa maksud sederhana. Manakala, jika nilai min adalah antara 1.81-2.60 pula, nilai tersebut adalah rendah, dan nilai di bawah 1.80 pula adalah sama erti dengan sangat rendah (Jadual 4).

Jadual 4: Jumlah Min

Bil	Min	Tahap
1.	4.21-5.00	SANGAT TINGGI
2.	3.21-4.20	TINGGI
3.	2.61-3.20	SEDERHANA
4.	1.81-2.60	RENDAH

Terdapat enam faktor yang mempengaruhi kecenderungan golongan muda menceburi diri di dalam e-sukan (Jadual 5). Hasil daripada kajian ini, faktor keseronokan bermain bersama rakan menunjukkan skor min pada tahap sangat tinggi iaitu 4.3. Diikuti dengan faktor minat yang menunjukan skor min pada tahap tinggi iaitu 4.1. Seterusnya faktor-faktor yang berada pada tahap sederhana adalah seperti faktor kerjaya di masa hadapan, reka bentuk grafik yang menarik, hadiah yang ditawarkan dan kepuasan dan cabaran.

Jadual 5: Faktor yang mempengaruhi kecenderungan pelajar menceburi e-sukan

Bil	Soalan	Min	Gred
1.	Minat	4.1	TINGGI
2.	Kerjaya di masa hadapan	3.08	SEDERHANA
3.	Reka bentuk grafik yang menarik	3.2	SEDERHANA
4.	Hadiah yang ditawarkan	2.7	SEDERHANA
5.	Keseronokan bersama rakan	4.3	SANGAT TINGGI
6.	Kepuasan dan Cabaran	3.3	SEDERHANA

Martoncik (2015) bersetuju faktor keseronokan memberi impak yang tinggi kepada jumlah golongan muda menceburi e-sukan. Melalui konsep permainan itu sendiri yang interaktif serta berdaya saing mencetuskan interaksi sosial secara maya telah memberikan keseronokan kepada pemainnya. Menurut Fredrickson (2004) permainan video menyediakan ruangan komunikasi agar pemain yang terlibat dalam berhubung, berkomunikasi bagi merangka strategi tertentu. Situasi ini secara tidak langsung membantu untuk membina hubungan sosial antara rakan dan juga dengan pemain lain serata dunia.

Faktor kedua tertinggi adalah disebabkan minat responden yang mendalam terutama apabila melihat ramai pemain profesional di dalam negara menempa nama di peringkat antarabangsa adalah merupakan dari generasi Y dan Z. Menurut (Lee & Schoenstedt, 2011) terdapat ramai pemain muda negara yang berjaya menempa nama di dalam pertandingan-pertandingan di luar negara seperti 'Mushi' 'Ohaiyo', 'MidOne' dan 'Ah Fu . Kejayaan ini secara tidak langsung menjadi pembakar semangat kepada golongan muda untuk meminati e-sukan dan menceburi e-sukan secara profesional. Oleh yang demikian, keadaan ini membentuk budaya 'gaming' dikalangan generasi muda sehingga memberi impak terhadap persekitaran sosial mereka.

Faktor grafik dan kecanggihan teknologi permainan atau *gameplay* turut menjadi tarikan kepada golongan muda menceburi diri dalam e-sukan. Menurut (Funk et al., 2018) permainan seperti MMORPGs (*Massively Multiplayer Online Role-playing Games)* misalnya, memberikan kepuasan dari segi reka bentuk permainan yang menarik, konsep yang interaktif yang akhirnya memberikan kepuasan kepada pemainnya.

Faktor kerjaya di masa hadapan mencapai tahap skor min yang sederhana di mana responden sangat bersetuju yang mereka ingin menjadikan sukan elektronik e-sukan

sebagai kerjaya di masa hadapan. Walaupun faktor ini masih berada pada tahap sederhana, pengkaji berpendapat para responden ini perlu dikenal pasti untuk melihat potensi setiap individu dan diberi pendedahan berkenaan sukan elektronik e-sukan sehingga menjadi pemain profesional. Seseorang pemain yang memiliki kebolehan teknikal dan taktikal yang tinggi, mereka akan diterima di dalam sesebuah pasukan. Jika seseorang pemain tidak mahu menjadi pemain, peluang kerjaya di dalam industri ini masih terbuka. Mereka boleh menjadi jurulatih atau pengurus pasukan, mahupun bekerja di belakang tabir (Tahir & Hasan, 2020).

Jadual 6 di bawah menunjukkan antara pilihan kerjaya yang dipilih oleh responden di dalam industri e-sukan dan kerjaya sebagai pemain profesional menjadi pilihan tertinggi responden iaitu sebanyak 58%.

Jadual 6: Kerjaya pilihan di dalam industri e-sukan

Bil	Item	Frekuensi	Peratus
1.	Pemain Profesional *Professional Player*	29	58.0
2.	Juruacara *Shout Caster/ Host*	2	4.0
3.	Jurulatih *Analyst/ Coach*	1	2.0
4.	Pengurus Pasukan *Team Manager / Owner*	7	14.0
5.	Pengadil *Tournament Admin/ Referee*	5	10.0
6.	*Wartawan Content Creator/Journalist*	1	2.0
7.	Pengurus Media Sosial *Community/ Social Media Manager*	3	6.0
8.	Pengurus Jualan *Sales/Partnerships Manager*	1	2.0
9.	Pengurus acrara *Event Manager / Production Executive*	1	2.0
		50	100.0

Terdapat pelbagai jenis atau *genre* dalam permainan video komputer yang dipertandingkan dalam e-sukan. *Genre yang* menjadi pilihan responden adalah seperti jadual 7 di bawah. Tiga *genre* e-sukan yang berada pada skor min tahap tinggi iaitu 3.8 adalah *Sport Games, First Person Shooter Games* dan *Action Games*. Seterusnya *genre Role Playing Games* dan *Massively Multiplayer Online Games* berada pada skor min tahap sederhana iaitu 3.1. Manakala *genre* yang menunjukkan skor min pada tahap sederhana 2.8 dan 2.6 adalah *genre Real time Strategy Games* dan *Simulation Games*. Menurut (Suznjevic & Matijasevic, 2010) kebanyakan permainan di dalam e-sukan adalah permainan berkonsepkan tempur dan strategi seperti *Multiplayer Online Battle Arena (MOBA), First person Shooter (FPS)* dan *Strategy Base Game* merupakan antara *genre* permainan video komputer yang mendapat sambutan paling luar biasa. Banyak pertandingan e-sukan juga dianjurkan dalam kategori permainan strategi tersebut.

Jadual 7: Jenis-jenis permainan video atau genre e-sukan

Bil	Soalan	Min	Tahap
1.	'Sport Games'	3.8	TINGGI
2.	'First Person Shooter Games'	3.8	TINGGI
3.	'Action Games'	3.8	TINGGI
4.	'Grand Strategy Games'	2.5	SEDERHANA
5.	'Role Playing Games'	3.1	SEDERHANA
6.	'Real time Strategy Games'	2.8	SEDERHANA
7.	'Massively Multiplayer Online Games'	3.1	SEDERHANA
8.	'Simulation Games'	2.6	SEDERHANA

4.3 Kesediaan pelajar-pelajar Politeknik Besut Terengganu bersedia untuk menceburi sukan elektronik

Sejauh manakah kesediaan pelajar-pelajar Politeknik Besut Terengganu untuk menceburi bidang e-sukan?. Tahap kesediaan responden yang pertama dilihat dari segi kefahaman berkenaan e-sukan. Hasil daripada analisa didapati responden amat arif dan sentiasa menonton pertandingan e-sukan secara atas talian berada pada skor min yang sangat tinggi iaitu sebanyak 4.3 dan 4.6. Seterusnya responden juga membuat pilihan sangat setuju untuk digelar sebagai seorang pemain atau *gamer* di dalam e-sukan berapa pada skor min tahap tinggi iaitu. 3.9. Jadual 8 menunjukkan Kesediaan pelajar dari segi kefahaman berkenaan e-sukan tersebut.

Jadual 8: Kesediaan pelajar dari segi kefahaman berkenaan e-sukan

Bil	Soalan	Skor Min	Tahap
1.	Saya amat arif mengenai e-sukan dan sentiasa mengikuti perkembangan berkenaan e-sukan.	4.3	SANGAT TINGGI
2.	Saya sentiasa menonton secara dalam talian atau secara langsung dalam acara e-sukan.	4.6	SANGAT TINGGI
3.	Adakah boleh dikatakan anda sebagai seorang *gamer*	3.9	TINGGI

Tahap kesediaan responden juga dilihat dari segi kekerapan masa bermain. Hasil daripada analisa, didapati kekerapan masa bermain video komputer paling tinggi adalah responen bermain setiap hari iaitu 42%. Kekerapan yang ke dua tertinggi adalah responden bermain 2-4 hari seminggu iaitu 22% dan kekerapan yang ke tiga tertinggi adalah responden bermain 5 hari seminggu iaitu 18%. Jadual 10 menunjukkan kekerapan masa bermain video komputer oleh responden.

Jadual 10: Kekerapan masa bermain video komputer

Bil	Perkara	Kekerapan	Peratus
1.	Setiap hari	21	42
2.	5 hari seminggu	9	18
3.	2-4 hari seminggu	11	22
4.	Sekali sebulan	3	6
5.	Sekali seminggu	1	2
5.	Sekali dalam setiap 3 seminggu	2	4
6.	Kurang daripada sekali dalam setiap 3 minggu	2	4
7.	Tidak pernah	1	2

Seterusnya tahap kesediaan responden untuk menceburi e-sukan dilihat dari segi penggunaan masa bermain dalam sehari. Berdasarkan jadual 9, penggunaan masa bermain permainan video diukur mengikut jam dalam sehari paling tinggi adalah 0-5 jam iaitu sebnyak 54%. Penggunaan masa 5-10 jam sehari adalah yang ke dua tertinggi iaitu sebanyak 32% dan penggunaan masa 10-20 jam sehari adalah ke tiga tertinggi iaitu sebanyak 10%. Manakala penggunaan masa 20 jam lebih sehari adalah sebanyak 4%.

Jadual 9: Masa yang digunakan bermain permainan video

Bil	Perkara	Kekerapan	Peratus
1.	0-5 Jam sehari	27	54
2.	5-10 jam sehari	16	32
3.	10-20 jam sehari	5	10
4.	20+ sehari	2	4

Menurut (Fields 2008) atlet e-sukan yang ekstrim, mereka menggunakan masa setiap hari selama 20 jam untuk berlatih bermain permainan video dan makan, 4 jam lagi masa untuk mereka tidur. Selain berlatih bersama rakan pasukan, mereka akan terus 'bekerja' seharian iaitu dengan melakukan aktiviti seperti mempelajari strategi daripada video permainan, merancang strategi dan bersaing dengan pemain lain dalam talian. Begitu juga menurut (Stutter, 2012), pemain e-sukan perlu mengekalkan latihan yang ketat. Sebagai contoh pemain Korea *StarCraf* Li Zhengxuan terkenal menghabiskan sehingga 20 jam sehari untuk meningkatkan kemahiran permainan mereka.

Setiap pendekatan yang diambil dari segi penggunaan masa bermain mestilah tidak menyalahi hukum sebagai seorang manusia dan tidak memberi kesan buruk kepada kesihatan pemain. Menurut pemain profesional *Clinton "Fear" Loomis*, daripada kumpulan *Evil Geniuss*, masa yang terbaik berlatih bersama pasukan adalah di antara 4-6 jam (Ashton, 2017). Manakala pemain Korea dalam pasukan Liquid menghadkan masa latihan 12 -14 jam sehari (Jacobs, 2015). Untuk itu, pelajar-pelajar perlu bijak merancang dari segi penggunaan masa latihan agar latihan yang dilakukan tidak menganggu kesihatan (Difrancisco-Donoghue et al., 2019) dan juga pelajaran.

5. KESIMPULAN

E-sukan membuka ruang dan peluang kepada golongan muda terutama generasi Y dan Z untuk terus maju mencapai tahap pemain profesional bertaraf dunia. Keseronokan bermain permainan video perlu hadir bersama matlamat untuk berjaya dalam industri e-sukan. Minat dan kesungguhan perlu seiring dengan perancangan dan pengurusan masa yang tepat. Pihak institusi pendidikan perlu mengambil peranan penting bersama dengan pihak kementerian untuk bersama memperkasakan e-sukan di Malaysia. Selain memberi galakan, tunjuk ajar, institusi pendidikan juga dicadangkan menyediakan kemudahan peralatan dan talian internet yang dapat menampung keperluan latihan e-sukan. Diharap pada suatu masa nanti institusi pendidikan negara akan menjadi salah satu platform e-sukan yang akan menawarkan kumpulan pemain profesional yang berpotensi untuk memasuki bidang e-sukan. Dari situ syarikat-syarikat besar di luar akan datang melabur dalam bentuk biasiswa kepada pelajar-pelajar yang terpilih. Ini pasti dapat memberikan keuntungan kepada institusi, syarikat dan pelajar itu sendiri. Oleh itu, golongan muda perlu menyahut seruan kerajaan untuk melihat e-sukan sebagai satu industri yang serius. Potensi diri dalam permainan video perlu digilap di peringkat awal usia, supaya keupayaan serta kebolehan bermain sesuatu permainan video itu dapat diasah secara profesional untuk melahirkan nama-nama besar dalam industri e-sukan.

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A STUDY ON THE NEW FIXTURE FOR AN MPV MODEL X STRUT MOUNT MRK 640

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Abstract. This project is regarding a study and analysis of the assembly new fixtures and plungers at Yin Tiang workstation. Continuous improvement or normally known as Kaizen making the work more efficient and effective by creating a team atmosphere, improving everyday procedures, ensuring employee satisfaction, and making a job more fulfilling, less tiring and safer. The main goals in the study to overcome the problem of time taken to complete the assembly process of MRK 640 strut mount for an MPV model X in the assembly department by collecting data, design and fabricate new fixtures and plungers. Meanwhile, the assembly fixture for the strut mount assembly process played a role in avoiding reject during process time. The new fixture and plunger are analyses by using the cycle time taken and using Catia Software for modeling CAD model. The type of material selection for the fixture is one of the important criteria to fabricate the fixture. The material selection must be the focus on the analysis material and reducing cost. This project will also produce a new cycle time in the assembly department. Furthermore, details of the new fixture design, the concept design consideration, materials in creating the fixture, method used and data analysis are discussed. From the cycle time, production line can compare cycle time and takt time.

Keywords: Strut mount; Catia; cycle time; takt time

1. INTRODUCTION

According to the work of (Bhosale et al., 2017), a fixture is a 2 special-purpose tool, used to maintain accuracy, thus ensuring this component is mass-produced is vital and ensure mass production in manufacturing any components, So, the fixture has a big function in manufacturing to develop new cycle time for a new part. In the assembly department, MRK640 will run for the assembly process as the newest product from the department. Two child parts, namely, the top plate and the bottom plate will be assembled. There are several options for the assembly parts of the machine. Therefore, this project focused primarily on data collection and analysis of new assembly fixture as a new part of the strut mount. SM16 machine is selected above several factors according to the size of the child parts and the pressure required for the assembly of the parts. The assembly section is a section to combine between rubber and metal. In this project, the bottom plate is part rubber and the top plate is part metal. As the other part, MRK 640 strut mount should be an assembly in an assembly line. Some parts can be assembled using the old fixture. However, this new strut mount could not be assembled by using the old fixture due to several reasons. First, the D shape must be parallel with one of the support plate holes, which is an important criterion mentioned by customers. Then, there are the specific fixtures, which must be fabricated for the assembly process to fulfill the customer's demand. Besides that, the operators or workers could not assemble these parts without proper steps or standard procedures.

2. LITERATURE REVIEW

In the manufacturing field, jigs and fixtures are a tool that holds the workpiece together to achieve accuracy in designing. They are a unique tool that guides machining and installing a large number of parts. Hoffman (2012) explained that jig and fixtures were built to hold the workpiece or parts to support, and locate every part during the machining process within the specific and special limits for each part.

2.1 Jig and Fixture

There are a lot of advantages of using the jig and fixture devices in industries. Firstly, by using the jig and fixture, it promotes an increase in production, because of the easy installation and processing, has cut down processing time shorter than expected. Second, the jig and fixture reduce the amount of rejected parts because the positioning, clamping and other specification are already set in the jig and fixture device, so there are lesser possibilities for the part to be rejected. All these benefited the industry by reducing the manufacturing cost of production. Third, jig and fixture were designed with a needed dimension of machining process or work process are low variability in dimension which leads to the quality of manufacturing products. Moreover, by ensuring interchangeability and high accuracy of parts, the expenses towards inspection or quality control can also be reduced. Jig and fixture assist low skill or semi-skilled operator to operate because, the locating and clamping of a workpiece is simplified by the jig and fixture (Chen, 2016).

2.2 Cycle Time

Cycle time is the maximum time allowed at each workstation for a set of tasks to be completed (Stevenson, 2009). There are two types of cycle time:

i. Minimum cycle time: Equal to the longest task time (applied for five workstations).
ii. Maximum cycle time: Equal to the sum of the task time (applied if all tasks were performed at a single workstation).

All production lines in manufacturing require a minimum time cycle so the output can be maximized. Based on (Pandya et al., 2017) sometime it happens that products fall in extreme dimensions during an inspection of any product which can be transformed within tolerance by rework by any process. This is done due to a fine tolerance of the manufactured goods. Many organizations use costly high precision equipment where simpler tools would be enough. The redundancy process was caused due to the poor layout of the plant. This can be minimized by linking the steps, which will greatly reduce the waste of over-processing.

2.3 Material Selection

Material selection is a step in the process of designing any object. In the product design topic, the main aim of material selection is to minimize cost while meeting product performance goals. The best material selection for a given application begins with the properties and costs of the candidate material.

3. METHODOLOGY

Several steps must be carried out to complete the fabrication of the plunger. These measures are very important to ensure the project is completed promptly on time. Moreover, the methodology is very important because it helps the researcher to facilitate the smooth running of the project. To ensure that this project goes well, the steps are arranged in systematic order. Several steps must be taken before the project is completed. As the initial step of the project, interviews with assembly leaders and workers performed personally. The interview helps to get a real scenario of the problem, and many viewpoints on the problem as possible since the problem is undefined. All part's criteria are taken before starting the drawing. After gathering the relevant data, discuss with experienced staff, and observation from existing other spray fixture, the fixture will be developed and design using CATIA

software. Before the first step of the assembly process, the fixture must be set to the machine according to the criteria and the fixture base and plunger. During the production trial, the work procedure is taken to produce Standard of Procedure (SOP) when mass production. A sheet of time study analysis will be created to analyze the time is taken and the movement of the operator while assembling the strut mount between the top plate and support plate. This will help to identify and compare the time taken and motion while using the Yin Tian machine during the assembly process.

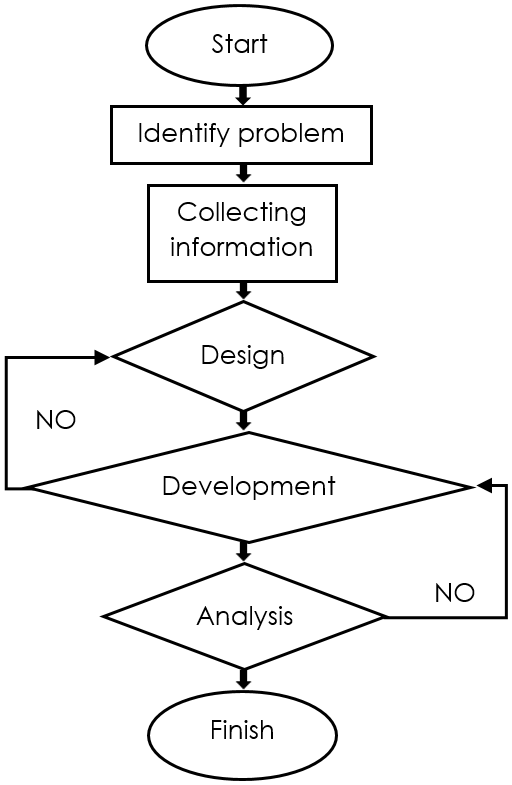


Figure 3: Methodology of the project.

4. RESULT AND ANALYSIS

4.1 Cycle time analysis.

Time study is a process of the calculation of the time taken for each process. Time taken for each process had been taken by using a stopwatch, which makes it easier to obtain the data because the stopwatch is the most suitable medium for collecting data from the process. The time for the strut mount assembly process is taken from the first step to the final step. From the eleven job steps, there are the different time taken for each activity. Table 1 below shows the time for each activity and the average time taken for the assembly strut mount process between the top plate and the support plate.

Table 1 shows the time taken for the assembly MRK 640 strut mount process. Eight production trials have been done to come out of the different time taken for each step. In the tenth and eleventh job steps, 0.3s and 0.2s come out from the number of parts for each poly box after the assembly process. In this case, only one job ticket is needed and fifteen pieces of parts for each poly box. The 4.5s and 3.0s are taken after 15 parts of the assembly process. This means the operator or worker takes 4.5s to write in the job ticket and 3.0s to put the job ticket into a poly box. The equations below show how to come out 0.3s and 0.2s for the tenth and eleventh step of the assembly process procedure.

Table 1: Shows the time for each activity and the average time taken for assembly strut mount

JOB STEP	TIME TAKEN FOR 8 TRIAL (s)								AVERAGE (s)
	1	2	3	4	5	6	7	8	
1. Take Support Plate Assy(WIP/MRK/640) from big polybox.	3.0	2.8	2.8	3.0	2.5	2.7	2.6	2.6	2.8
2. Put part into assembly mould.	3.1	3.3	3.3	3.2	3.0	2.9	3.0	2.9	3.1
3. Take Top Plate(CP/MRK/640B) from big polybox.	2.6	2.5	2.0	2.1	2.2	2.4	2.4	2.3	2.3
4. Place the top plate into the center hole of WIP/MRK/640.	3.5	3.6	3.4	3.5	3.6	3.5	3.4	3.5	3.5
5. Close the cage door.	2.0	2.3	2.0	2.2	2.1	2.4	2.2	2.0	2.2
6. Press 'Downlink-R' button on the LEFT side of the machine.	1.5	1.5	1.5	1.4	1.3	1.5	1.4	1.5	1.5
7. Open the cage door.	2.0	2.0	2.3	2.2	2.0	2.1	2.2	2.3	2.1
8. Take out part from assembly mould.	3.5	3.6	3.3	3.5	3.6	3.5	3.5	3.5	3.5
9. Put part into big polybox.	2.5	2.6	2.4	2.5	2.4	2.3	2.5	2.4	2.5
10. Write in job ticket.	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
11. Attached job ticket to polybox.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL									23.8

Table 2: Average times of 10th and 11th step.

10^{th} step	11^{th} step
$\frac{4.5s}{15pcs} = 0.3s/pcs$	$\frac{3.0s}{15pcs} = 0.2s/pcs$

Yin Tian hydraulic assembly machine is set up to the default parameter. This machine produces 2s pressing time to assemble all parts. Cycle time is the maximum time allowed at each workstation to complete its set of tasks on a unit. There two types of cycle time, which are minimum cycle time and maximum cycle time. In this project, the assembly process for strut mount MRK640 is using maximum cycle time as all tasks or activities were performed on a single workstation. After collecting all data, the cycle time for the assembly process is the equal sum of total average work time and total machine time.

Total cycle time = Total average work time + Total machine time
Total cycle time = 23.8s + 2s
Total cycle time = 25.8

4.2 Cycle times vs Takt Time
In the manufacturing system, cycle time and talk time are very important things to know before mass production occurs. Cycle time is the total time from the beginning to the end of the process, as defined by the company and customer. In this study, the cycle time for the strut mount assembly process is 25.8s. Meanwhile, takt time is the rate or cycle time needed in the production system to match the pace of production to the demand rate. Also, takt time is the number of work minutes per day divided by the number of orders per day. In can be said at the maximum allowable time needed to produce one unit to meet customer demand. The formula for takt time as below:

$$\text{Takt time} = \frac{\text{Available Time}}{\text{Customer demand}}$$

Table 2: Shows the customer's order for MRK640 strut mount 2019.

YEAR	MONTH	CUSTOMER ORDER (PCS)
2019	JANUARY	3000
	FEBRUARY	5000
	MARCH	5500
	APRIL	7000
	MAY	4500
	JUNE	4000
	JULY	6000
	AUGUST	3500
	SEPTEMBER	5000
	OCTOBER	4800
	NOVEMBER	5200
	DECEMBER	7000
	TOTAL	**60500 PCS**

$$\text{Takt time} = \frac{11 \text{ hours} \times 60 \times 60 \times 24}{7000 \text{ pcs}}$$

$$\text{Takt time} = \frac{39600}{7000 \text{ pcs}}$$

Takt time = 135.7s

From the calculation for customer's order for MRK640 strut mount 2019, cycle time and takt time will be compared. The Assembly line takes 25.8s to produce a single finish good product. Meanwhile, the minimum takt time for this product is 135.7s. This mean, cycle time is lower than takt time. In other words, the assembly line can full fill the customer order in 2019 years.

4.3 Material Selection Analysis

Material selection is a vital criterion in the fabrication of the new fixture and plunger. CATIA V5 R21 software was used to analyze the von misses stress and translational displacement between the mild steel and aluminum metal. The analysis of this research covered only von misses stress and total deformation data between the two metals. The default setting of the Yin Tian machine was set, hence the pressure applied during the assembling process is 150 bars. The value is equal to 1.5e+007 N/m2. This pressure was applied at the top of the D-shape fixture for both steel and aluminum metal. During the fixture setup, a screw was tied between the fixtures and the fixture's base. This means in the software analysis, a clamp was used at the bottom of the fixture design to compute the von misses stress and translational displacement for steel and aluminum metal. Moreover, the clamp replaced the screw function during the analysis. The type of mesh was set to linear and 2.5mm in size. Figure 4 shows the setting of the mesh for steel and aluminum metal analysis.

Figure 5 shows the analysis of von mises stresses for steel. From the result, the maximum von mises stress applied on the steel fixture is 1.73 N/m2 and 0N/m2for minimum value. Meanwhile, the maximum and minimum translational displacement of steel shows in figure 6 is 0.00383mm and 0.000383mm respectively. The common yield strength of steel is 30000 psi to 40000 psi. These values are equal to 2.06843e+008N/m2 and 2.7579e+008 N/m2 respectively. This means the fixture's design is safe as the von mises stress analysis 1.73 N/m2 is lower than yield strength values. Besides that, the von mises value for aluminum shows in figure 7 is 1.69e+007. As the yield strength of the aluminum is 2.41317e+8N/m2, the von mises analysis value is lower than the yield strength. This means that the design for the aluminum fixture is

also safe. Meanwhile, the translational displacement for aluminum shows in figure 8 is 0.0109mm. The displacement and von mises stresses generated were observed for two different types of material such as steel and aluminum.

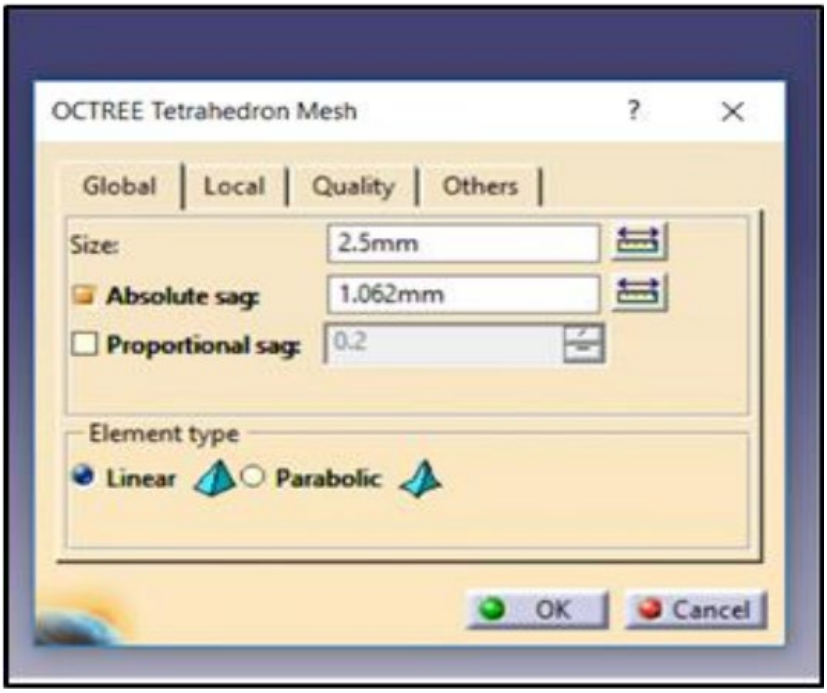


Figure 4: Mesh Set Up

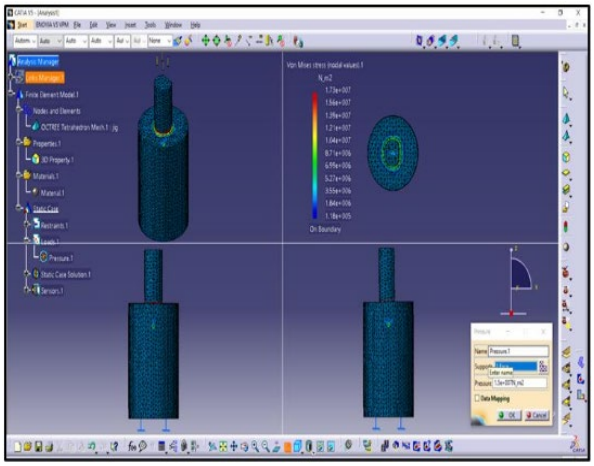


Figure 5: Von Mises Stress of Mild Steel Metal

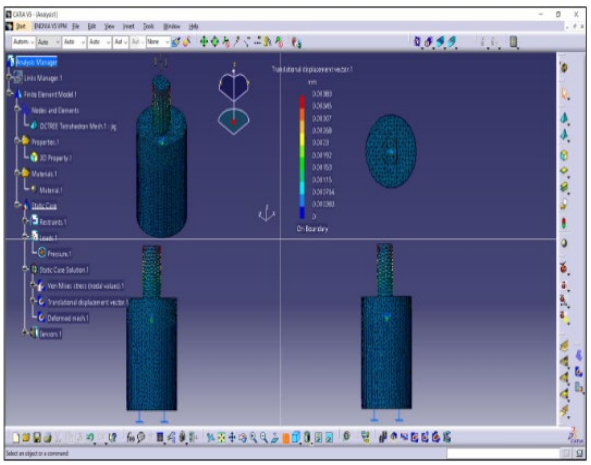


Figure 6: Translational displacement Of Mild Steel Metal

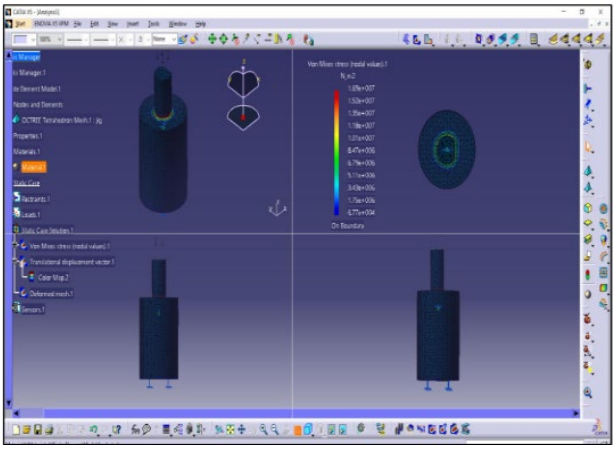


Figure 7: Von Mises Stress of Aluminum Metal

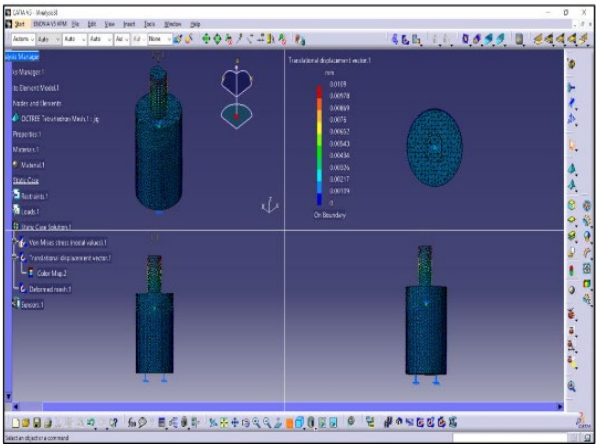


Figure 8: Translational Displacement of Aluminum Metal.

According to the properties of aluminum, this element is best and suit to use as a fixture, having a higher yield strength compared to steel. Aluminum alloy has an excellent strength to weight ratio, making it ideal for use in situations where high strength and low weight are required. The use of the aluminum alloy, however, has a higher initial cost, this has been estimated at 8 to 10 times the price of the steel on a tonnage basis. Besides that, most aluminum alloys require low maintenance because of their good corrosion resistance. Therefore, aluminum is an excellent candidate for all applications where the benefit of freedom from initial protection and maintenance yields a commercial benefit. However, based on the cost factor, steel has been chosen for fixture fabrication to cut costs in the production line.

5. CONCLUSION

According to the objective of the project, a new fixture, and plunger for the assembling process where design using the CATIA V5 software, while the lathing machine was used for fabrication purposes to help of drawing. The selections of material, fixture were also considered according to the usage and durability of the fixture. Secondly, the steel and aluminum material for a new fixture was compared in various aspects, such as cost, von mises stress, and translational displacement analysis. The cycle time for the strut mount assembly process has been created before the mass production. From the cycle time, a production line can compare between cycle time and talk time. After analyzing the time study, the assembly process can fulfill the customer order in 2019. To conclude, create a fixture suitable for its usage, lightweight, suitable material selection, design selections are the most important things to consider. In this project, the aspects considered for a new assembly fixture are designed, fabricate, implement successfully in the assembly spray process of the strut mount MRK 640, which has achieved the objective of this research.

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DEVELOPMENT OF TRIMMING FIXTURE FOR DOOR HANDLE INSIDE DURING TRIMMING PROCESS

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Abstract. Safety remains the most critical factor to be considered in the industry by providing a safe environment and suitable personal protective equipment for the employees. The trimming process represents a secondary process that needs critical attention to provide the employees with suitable safety equipment during the process. In this research study, one of the workstations has been chosen for observation which is the workstation that produces door handle inside for the automobile. Based on Gemba Walk and discussion with senior executives in environmental safety and health, the trimming process remains an important process after separating the runner because of the presence of an excess plastic gate. A significant number of accidents caused by the trimming process has been recorded, as the knife is pointed to the operator's finger. Personal protection equipment that has been prepared by the industry is not effective because the type of glove is unresisting to the cut. Even wearing Kevlar glove can equally affect the operator's performance to support the product firmly due to the product physical appearance. The objective of this research study is to develop trimming fixture to reduce the rate of the accident during the trimming process for the automobile door handle. Qualitative and quantitative methods used in data collected for accident statistic reports. Based on the result and design analysis, the trimming fixture for the door handle inside (D46T) turned out to represent an effective way to reduce the accident rates and bring other benefits for the company which reduces costs and usage of the first aid kit.

Keywords: Personal Protection Equipment (PPE),

1. INTRODUCTION

The secondary process in the plastic industry is needed to produce high-quality parts in-term of appearance where the employees need to trim away the excess gate after the runner is removed from the parts. The trimming process can be led to harm towards the employees because of the cutting direction for the automobile door handle.

Figure 1.1 shows that accidents occurred while trimming the door handle by using a knife, which can cause serious infections which spread through injuries caused by contaminated sharp equipment that which may include serious infections such as HIV and hepatitis which are spread through injuries (Reader et al., 2008).



Figure 1.1: Accident During the Trimming Process

The accident during the trimming process is unpredictable situation where employees tend to make human error due to work redundancy to achieve the targeted output without any special tools to aid for the trimming process. Figure 1.2 illustrates the employees do not wear any PPE while in the trimming process where the knife is pointed towards the employee's finger.



Figure 1.2: Trimming Direction

The trimming process is considered a minor accident which also can interrupt the production schedule in which the employees need to be replaced with others and affect the industry finance due to medicals and PPE expenses. Figure 1.3 illustrates one of the accidents in the trimming process while wearing PPE.



Figure 1.3: Minor Accident While Wearing PPE

Based on the discussion with the Safety and Health Department, there was an accident each month which illustrate in figure 1.4 below where the data have been recorded in 2019 by the Safety and Health Department that involve trimming the automobile door handle. Safety is

the first priority for the industry which to ensure the employees are safe from any danger or incidents, which by including a special tool to aid the employees in a specific task for example jigs and fixtures. It is a work-holding device that ensures the repeatability and accuracy can be done effectively including ensure the safety of the employees.

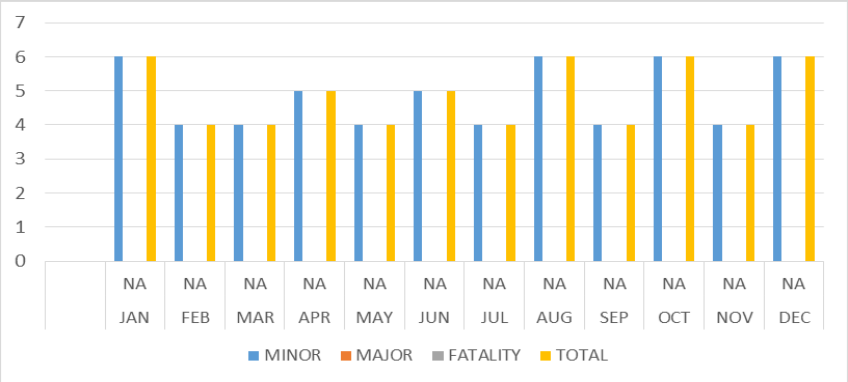


Figure 1.4: Accident Record in 2019

2. LITERATURE REVIEW

2.1 Factor Affecting Industrial Accidents

Safety performance in industry is vital to the organization, because it can also decrease organization profit due to medical expenses (Paper, 2019). Hazards in the industry is an uncrontrolled phenomeno, in which, despite the organization following the organizational health and safety training, procedure, and management, accident remains an uncontrolled situation, and can still occur in the industry. Human error which is a common part of human performance is caused by common error traps such as time pressure, newly delegated tasks, mental pressure, fatigue, distractions, and lastly overconfidence (Wachter & Yorio, 2014).

2.1.1 Awareness of Health and Safety Practices

Health and safety practices is a strategy to provide safety precaution in the working environment, and employees can be exposed with the information and awareness through training. Due to health and safety pratices, employees are able to achieve the goal of safety and health management to reduce number of accidents, by having an awareness of unsafe and unhealthy task or other hazardous situations in the organizations (Paper, 2019).

2.1.2 Utilization of Personal Protection Equipment

Employees need to ensure and be responsible in ensuring the safety and health of the employees, by providing personal protection equipment. Personal protection equipment is the one of the safety methods which is crucial to reduce the rate of accidents. Wearing personal protection equipment is the first priority in the most industries today because in the past, personal protection equipment is only worn when identifying and monitoring the problem at the workstation (Paper, 2019). Training and personal protection equipment should be provided to minimize the hazards in the industry, where the employees has an nformation and skill in hands on task, and the employee can gain better understanding and awareness regarding the hazards in the work place (Hashim & May, 2018)

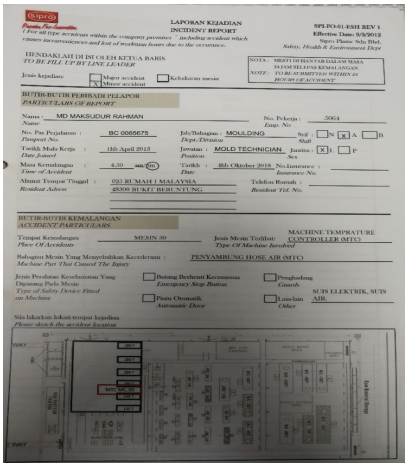
2.1.3 Working Environment

Individual 's perception determines the safety environment at the work place (Neal, Giri & Hart, 2000). The working environment has been categorized into factors namely management values (Concern about employee), communication, and involvement in safety and health workplace (Neal, Giri & Hart, 2000). Working environment can also be included in the area of the workplace for example poorly designed workstations, lack of ventilations, inapproriate lighting, and lack of personal protective equipment. Working environment plays a big role in influencing the employer's quality, motivation, error rate, and communication between other employees (Chandrasekar, 2011)

3. RESEARCH METHODOLOGY

3.1 Data Collection

Based on the discussion with the Safety and Health Department, the accident is recorded by filing the accident record as shown in Figure 3.1 which will specify the name, machine number, and which part of the body is injured during the accidents.



LAPORAN KEJADIAN
INCIDENT REPORT

SPI-PO-01-ESH REV 1

Name : MD MAKSUDUR RAHMAN

No. Pekerja : 5964

No. Pas Penjalanan : BC 0065675

Jab/Tobatan : MOULDING

Tarikh Mula Kerja : 18th April 2013

Jawatan : MOLD TECHNICIAN

Masa Kemalangan : 4.30 am/pm

Tarikh : 4th Oktober 2018

Alamat Tempat Tinggal : 022 RUMAH I MALAYSIA

Telefon Rumah :

BUTIR-BUTIR KEMALANGAN
ACCIDENT PARTICULARS

Tempat Kemalangan : MESIN 30

Jenis Mesin Terlibat : CONTROLLER (MTC)

Bahagian Mesin Yang Menyebabkan Kecederaan : PENYAMBUNG HOSE AIR (MTC)

Jenis Peralatan Keselamatan Yang Dipasang Pada Mesin : Butang Berhenti Kecemasan; Penghadang; Pintu Otomatik; Lain-lain : SUIS ELEKTRIK, SUIS AIR

Figure 3.1: Accident Form

3.2 Data Analaysis

The data is being analyzed by using a fishbone diagram which illustrate in Figure 3.2 below which to identify the possible cause of this event. Fishbone is one of the 7 basic quality tools, which is used to help in the brainstorming session of a specific event or problem.

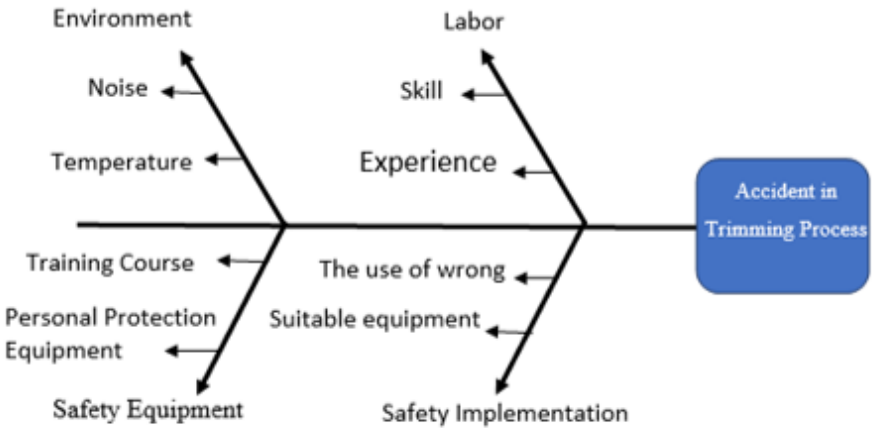


Figure 3.2: Fishbone Diagram

3.3 Design

The trimming fixture is designed by using CATIA V5R1 as illustrate in Figure 3.3 below. The design is taking the trimming direction as a consideration where the knife direction is pointing downward to ease the trimming process due the help of gravity.

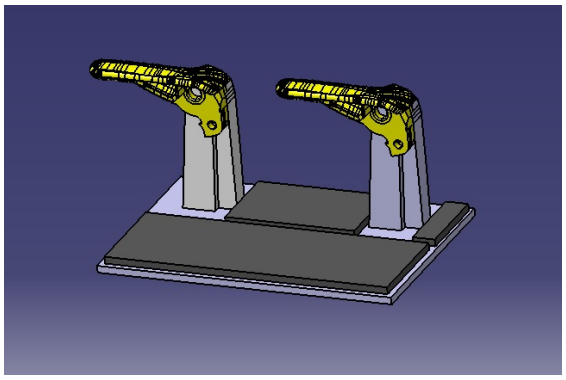


Figure 3.3: Trimming Fixture CAD Design

4. RESULTS AND ANALYSIS

4.1 Design Analysis Based on Finite Element Analaysis
Finite element analysis is a computerized method for predicting how a product reacts to a real world forces during the trimming process where the operator will apply a force to the trimming fixture itself which to measure the fixture reliability by applying a structural analysis to determine the physical behavior after a certain of load is applied.

4.1.1 Equivalent Stress Analysis
Figure 4.1 illustrates the result from equivalent stress analysis where 251 N is applied to the product design to predict the yielding of the product design under specific amount of load. The maximum equivalent stress is at 1.3029e6 pascal.

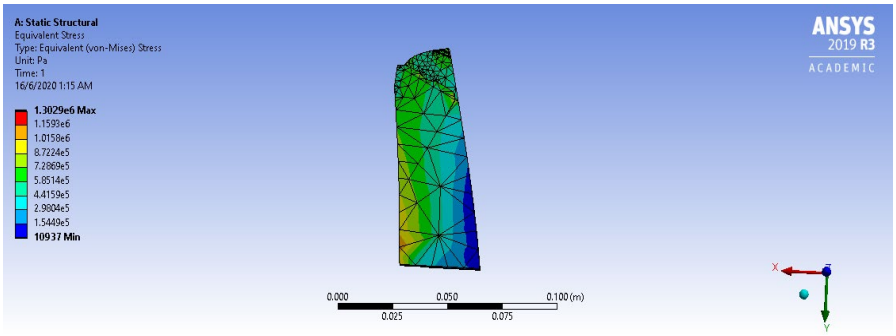


Figure 4.1: Result of Equivalent Stress

4.1.2 Total Deformation Analysis
Total deformation analysis is a condition where the product might change in size or shape caused by the force acting on it. Figure 4.2 presented the result from total deformation analysis where the maximum amount is at 5.2674e-5m by applying 251 N on the product design to predict the product deformation.

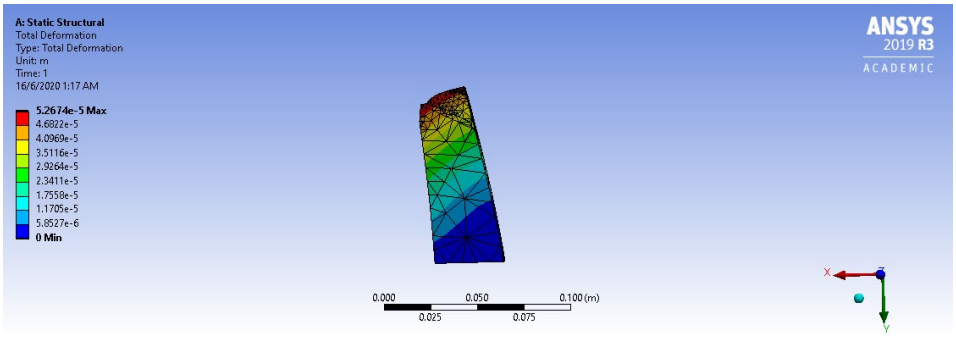


Figure 4.2: Result of Total Deformation

4.1.3 Thermal Analysis

To take necessary precaution during the fabrication of product to aid in the trimming process, the product design undergoes a thermal analaysis to evaluate whether the product is equivalent or suitable or the workplace temperature. The temperature is recorded by using a hygrometer which is a specific tool to record humidity and temperature around the workstation. Figure 4.3 presented the result from transient thermal analysis where the product design is being analyze to measure how long the product takes to reach the maximum temeperature which the peak temperature around the workstation is at 36.2° . Figure 4.3 highlights the result where the product design is shown in graphical data, blue color represents the minimum temperature. As the heat increase, the color changes from blue to yellow and finally to red color mapped at the edge of the product. Based on the Figure 4.3, the result from transient thermal analysis, the product nearly reached the maximum temperature if the temperature remains the same at 36.2° in 12 hours.

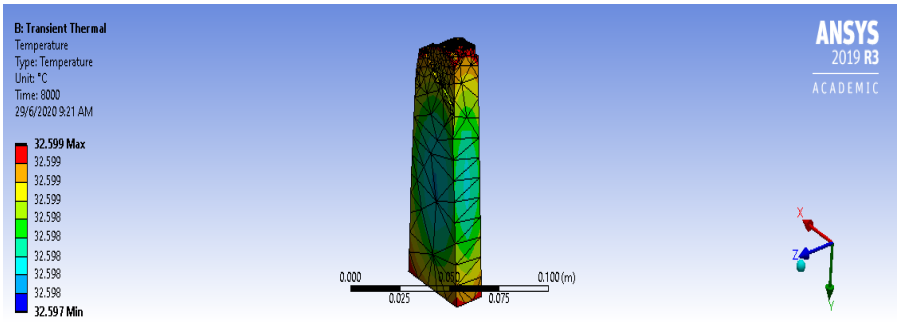


Figure 4.3: Result From Transient Thermal Analysis

4.2 Result after Implementing the Trimming Fixture

As shown in Figure 4.4 below, the incident rates from the previous condition without the trimming fixture and the actual condition between 2019 and 2020 were compared. The total of minor accidents is also combined to get the total results. From the data, it was found that there are 116 cases due to the trimming process. The objective of this research study is achieved where the incidents considerably decreased due to the presence of trimming fixture as a guide during the trimming process where the number of incidents suddenly dropped in January 2020 and continued to reach 0 number of cases in March 2020. Without doubt, the implementation of this fixture was also able to maintain the quality and work efficiency without having secondary operators for backup if accidents occurred.

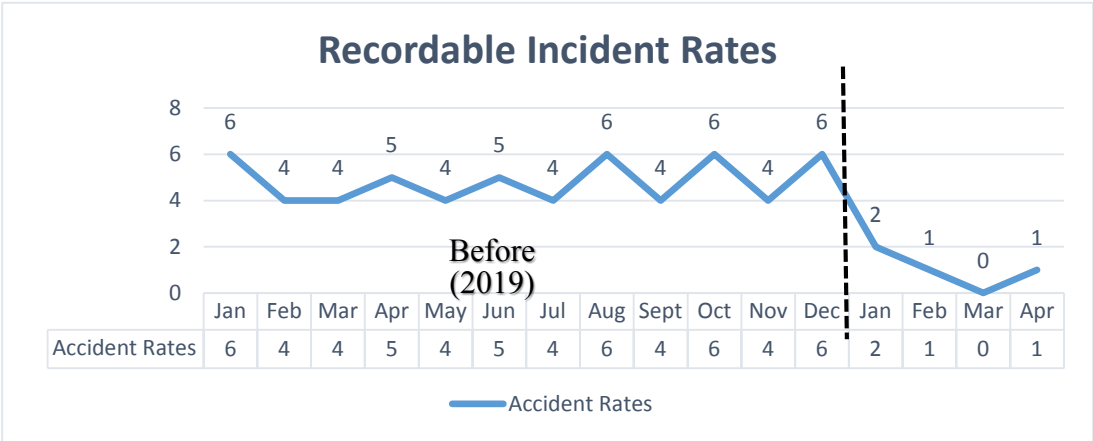


Figure 4.4: After Fixture Implementation

5. CONCLUSION

The objective of this research study is to identify the problem at the trimming process, to develop a new trimming fixture which comes with a proper analysis to reduce the rate of accidents during the production of automobile door handle. Based on the result, the trimming fixture for door handle turned out to be an effective way to reduce the accident rates which able to reduce the costs and usage of medical expenses.

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IMPAK PEMERKASAAN AMALAN PEMBUNGKUSAN HIJAU DALAM INOVASI PROJEK AKHIR PELAJAR DIPLOMA TEKNOLOGI MEDIA CETAK

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Abstrak. Kajian ini dijalankan dengan tujuan bagi mendeskripsi impak inovasi pembungkusan yang mempraktikkan amalan dasar teknologi hijau dalam meningkatkan potensi pemasaran produk komersil. Pembungkusan produk komersil bukan sahaja bagi melindungi fizikal produk itu sendiri, bahkan ianya berfungsi sebagai medium pemasaran dalam mengiklankan maklumat dan mempromosi. Pembungkusan yang terdiri dari bahan kadbod, plastic dan aluminium memberi kesan terhadap alam sekitar akibat pembuangan dan pembakaran pembungkusan setelah digunakan. Seramai 4 orang usahawan mikro dan 20 orang pengguna produk sekitar Selangor telah dipilih sebagai sampel kajian menggunakan kaedah pensampelan rawak sistematik. Instrumen kajian ini menggunakan soal selidik dengan 6 skala *likert* yang mempunyai 8 item yang mempunyai nilai kebolehpercayaan yang baik dan disahkan. Penganalisisan dapatan kajian ini dianalisa secara statistik deskriptif iaitu merujuk kepada nilai min dan juga peratusan. Kajian mendapati tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau adalah berada pada tahap yang sederhana. Amalan atau tingkah laku seseorang usahawan untuk melaksanakan inovasi pembungkusan hijau dipengaruhi oleh tahap keprihatinan alam sekitar untuk melaksanakannya. Kecenderungan ini dipengaruhi oleh diri usahawan dan kesedaran serta keinginan untuk menyokong kempen hijau di Malaysia. Penemuan dari kajian ini membuktikan bahawa purata jumlah peratusan dan nilai min bagi impak inovasi pembungkusan yang mempraktikkan amalan dasar teknologi hijau dalam meningkatkan potensi pemasaran adalah mempunyai tahap yang agak tinggi. Oleh itu, hasil kajian ini menunjukkan bahawa inovasi pembungkusan yang mempraktikkan amalan dasar teknologi hijau bukan sahaja mengurangkan kesan terhadap alam sekitar tetapi memberi penambahbaikan terhadap rupa bentuk, fungsi pembungkusan dan pemasaran produk.

Kata Kunci: Pembungkusan, inovasi pembungkusan, amalan pembungkusan hijau

1. PENGENALAN

Pembungkusan hijau merujuk kepada pembungkusan produk komersil yang memiliki spesifikasi menitikberatkan kelestarian alam sekitar, berciri mesra alam dan boleh diaplikasikan dengan tujuan yang lain. Pembungkusan hijau memelihara alam sekitar lebih baik untuk diwariskan kepada generasi kemudian. Terdapat penegasan Allah swt dalam Al-Quran yang berkenaan dengan pemeliharaan alam yang selari dengan objektif pembungkusan hijau. Menjadi tanggungjawab manusia sebagai khalifah Allah swt untuk menjaga amanah Allah Swt iaitu alam ini. Surah Taha ayat 53-54 menjelaskan tentang keindahan alam ini:

ٱلَّذِى جَعَلَ لَكُمُ ٱلْأَرْضَ مَهْدًا وَسَلَكَ لَكُمْ فِيهَا سُبُلًا وَأَنزَلَ مِنَ ٱلسَّمَآءِ مَآءً فَأَخْرَجْنَا بِهِۦٓ
أَزْوَٰجًا مِّن نَّبَاتٍ شَتَّىٰ ﴿٥٣﴾ كُلُوا۟ وَٱرْعَوْا۟ أَنْعَٰمَكُمْ ۗ إِنَّ فِى ذَٰلِكَ لَءَايَٰتٍ لِّأُو۟لِى ٱلنُّهَىٰ ﴿٥٤﴾

Maksudnya: (Dialah Tuhan) yang telah menjadikan bumi bagi kamu sebagai hamparan, dan ia telah mengadakan bagi kamu padanya jalan-jalan lalu-lalang; dan ia juga telah menurunkan hujan dari langit. Maka Kami keluarkan dengannya berjenis-jenis tanaman dan buah-buahan yang berlainan keadaannya. Makanlah kamu daripadanya dan berilah makan binatang-binatang ternak kamu; sesungguhnya semuanya itu mengandungi tanda-tanda yang membuktikan kemurahan Allah, bagi orang-orang yang berakal fikiran.

Kepenggunaan hijau adalah berkaitan rapat dengan amalan pembangunan lestari serta perlakuan pengguna mampan. laitu, amalan penggunaan yang bertujuan untuk menyelamat, memelihara dan memulihara alam sekitar bagi generasi kini dan masa depan dengan menjadi pengguna mesra alam. Gaya hidup pengguna yang dituntut ialah kurangkan kegunaan, guna semula, kitar semula serta pulaukan amalan, servis dan produk musuh alam.

Ketika ini, bahan pembungkusan hijau terbahagi kepada empat jenis: bahan pembungkusan yang boleh dimakan, bahan pembungkusan yang boleh diguna semula dan dikitar semula dan bahan kertas yang boleh rosak. Bahan pembungkusan kitar semula terutamanya merujuk kepada bahan pembungkusan kotak plastik PP, yang boleh dibuat ke dalam produk pembungkusan kitar semula selepas rawatan kimia, dan bekas pembungkusan yang dikitar semula boleh dibuat selepas rawatan fizikal. Namun, kelemahan kedua-dua kaedah adalah seperti berikut: mereka hanya mengurangkan pencemaran terhadap alam sekitar, dan mereka akan menghadapi masalah pencemaran kepada alam sekitar dalam rawatan terakhir. Inovasi pembungkusan hijau yang boleh digunakan semula merujuk kepada pembungkusan terinovasi yang akan digunakan semula setelah produk habis digunakan atau dimakan. Pembungkusan jenis ini akan diubah berdasarkan pelarasan semula secara teknikal mudah dan boleh digunakan untuk tujuan lain.

Pengurusan hal ehwal berkaitan tenaga, teknologi hijau dan air diselaras oleh Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA) sejak Dasar Teknologi Hijau Negara di lancarkan pada tahun 2009. Usaha menggerakkan dan mempromosikan teknologi hijau di Malaysia juga didukung oleh Malaysian Green Technology Corporation yang juga penggerak dan pengelola kepada KeTTHA.

Bgai menyokong promosi bidang teknologi hijau kerajaan mengambil inisiatif menawarkan pengecualian cukai pelopor, duti eksais, pengiktirafan dan promosi khas kepada penggiat sector teknologi hijau (Roslin 2012). Kepekaan kerajaan terhadap teknologi hijau dalam sistem kehidupan telah diberi penekanan dengan mengumumkan peruntukan tambahan Green Technology Financial Scheme (GTFS) sebanyak RM 2 bilion menjadikan keseluruhannya RM 3.5 bilion sebagai insentif bagi penghasilan dan penggunaan produk berasaskan teknologi hijau (Roslin 2012).

1.1 Permasalahan Kajian

Sikap pengguna berhubung rapat dengan kesedaran dan amalan kepenggunaan hijau. Kesan terhadap alam sekitar kurang diberi perhatian kerana kebanyakkan pengguna hanya mementingkan produk dan tidak mengambil kira kesudahan pembungkusannya yang bakal memberi kesan terhadap alam sekitar. Kajian ini dijalankan dengan tujuan bagi mendeskripsi impak inovasi pembungkusan yang mempraktikkan amalan dasar teknologi hijau dalam meningkatkan potensi pemasaran produk komersil melalui inovasi pembungkusan Projek Akhir Pelajar Diploma Teknologi Media Cetak (DMC) disamping menilai tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau. Kerajaan menyasarkan lebih banyak produk usahawan dapat dipasarkan di pasaraya (Anon. 2018b) dan menjelang tahun 2020 kerajaan menyasarkan 50% usahawan mikro berjaya migrasi ke status PKS (Anon. 2018c). Kelemahan yang paling ketara adalah disebabkan kualiti pembungkusan yan tidak mencapai tahap piawaian yang ditetapkan seperti penggunaan bahan pembungkus yang tidak berkualiti, informasi yang tidak lengkap, reka bentuk dan reka grafik yang tidak menarik, dan kaedah pembungkusan yang kurang sesuai dan tidak mesra alam. Persoalannya sejauhmanakah usahawan memgaplikasikan pembungkusan hijau terhadap

produk mereka berdasarkan pengetahuan mereka dan bagaimanakah pembungkusan hijau ini dapat meningkatkan potensi pemasaran produk. Oleh itu, objektif kajian ini adalah untuk menilai tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau dan sejauhmanakah amalan pembungkusan hijau mempengaruhi potensi pembelian produk dalam kalangan pengguna.

1.2 Objekti Kajian

i. Menilai tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau.
ii. Sejauhmanakah amalan pembungkusan hijau mempengaruhi potensi pembelian produk dalam kalangan pengguna.

1.3 Persoalan Kajian

i. Sejauhmana tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau.
ii. Adakah inovasi pembungkusan hijau mempengaruhi potensi pembelian produk.

1.4 Skop Kajian

Kajian ini hanya tertumpu kepada pengeluar dan pengguna produk komersil Projek Akhir Pelajar Diploma Teknologi Media Cetak.

2. SOROTAN KAJIAN DAN PEMBINAAN HIPOTESIS

Merujuk kajian lepas berkenaan pembungkusan produk makanan lebih memfokuskan penelitian terhadap keputusan membeli yang dibuat oleh pengguna (Azad & Masoumi 2012; Beneke, Mathews, Munthree, & Pillay 2015; Kurtkoti 2016; Siti Hasnah, Wai Leng, & Wong Wai 2012; Tinne 2016; Zekiri & Hasani 2015) dan kajian berkaitan faktor-faktor kejayaan atau kegagalan sesebuah perniagaan (Alfoqahaa 2018; Atiqah, Binti, Nazri, & Azmi 2016; Islam & Muktadir-Al-Mukit 2016; Jernström, Karvonen, Kässi, Kraslawski, & Hallikas 2017; Sayal & Banerjee 2017; Suhaila, Suhaily, & Muhammad Firdaus 2014). Manakala, kajian berkaitan inovasi pula lebih memfokuskan kepada inovasi produk, inovasi proses, inovasi peralatan dan inovasi pemasaran berbanding inovasi pembungkusan (Suraiya, Abd Hair, Mohd Yusof, Ahmad Raflis, Sarmila, Suhana, Zaimah, & Azima 2015; Zaim Shah & Hartini 2016). Selain itu, kajian terdahulu tidak memfokuskan terhadap tahap amalan inovasi pembungkusan di kalangan usahawan mikro. Kajian Esa, Ab.Hadi dan Mohd Yunos (2002) pula mendapati amalan peniaga kecil terhadap etika perniagaan adalah sederhana. Kajian lepas membuktikan pengguna memberikan reaksi positif dalam membeli sesuatu produk disebabkan oleh pembungkusan yang menarik (Magnier, Schoormans, & Mugge 2016) dan berinformasi (Luminer, Lakewood & N.J., 2017), memberikan keselesaan penggunaan dan ketahanan (Wyrwa & Barska 2017) berbanding penggunaan pembungkusan konvensional. Hal ini menggambarkan penambahbaikan yang dibuat pada pek pembungkusan dapat menarik perhatian pengguna untuk membeli dan seterusnya kekal relevan dalam pasaran yang sangat kompetitif pada hari ini (Kotler & Armstrong 2012). Malah, lebih daripada 80% usahawan di Amerika Syarikat menyatakan pembungkusan adalah 'jurujual' dalam pemasaran (Anon. 2018a). Terdapat juga kajian lepas menyatakan bahawa kejayaan promosi kepenggunaan hijau telah mempengaruhi masyarakat umum dengan membawa impak yang besar kepada alam sekitar hasil daripada trend pembelian dan amalan kepenggunaan mereka. Selain itu, penambahbaikan pembungkusan dapat membantu meningkatkan pemasaran produk seperti yang dicadangkan oleh Kalsonm dan Ab. Rahim, (2015).

Melalui kajian yang dijalankan ini, hipotesis diambil bagi mengetahui jangkaan atau andaian yang bakal berlaku dalam hasil kajian ini nanti adalah benar atau sebaliknya. Dua hipotesis kajian ini adalah:

i) Tahap pengetahuan usahawan terhadap inovasi pembungkusan hijau berada di tahap yang rendah dan tidak mendorong usahawan menyokong kempen hijau yang dijalankan oleh kerajaan.

ii) Amalan mempraktikkan pembungkusan hijau memberi impak yang rendah dalam meningkatkan potensi pemasaran.

3. METODOLOGI KAJIAN

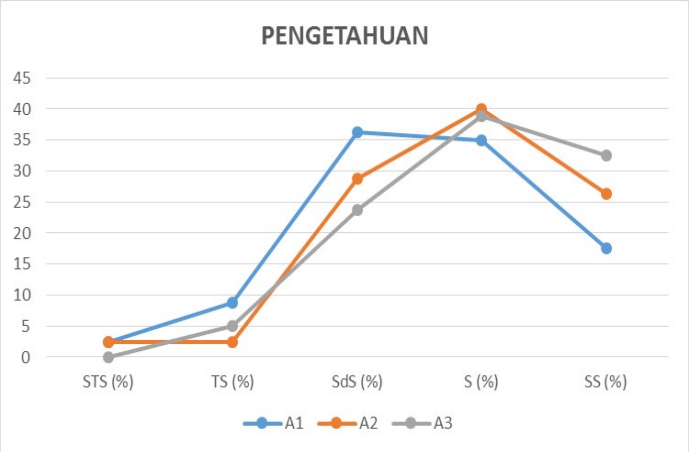
Kajian ini menggunakan kaedah kuantitatif secara tinjauan yang menggunakan platform soal selidik secara digital. Kajian ini telah dijalankan di negeri Pahang dan populasi kajian adalah 54 orang usahawan yang telah dipilih sebagai syarikat kerjasama untuk Projek Akhir Pelajar Diploma Teknologi Media Cetak. Jumlah sampel kajian yang diperolehi dalam kajian ini adalah 40 sampel dan bilangan sampel yang diperlukan mencukupi berdasarkan jadual pengiraan saiz sampel kajian. Kaedah pensampelan menggunakan teknik pensampelan rawak. Instrumen kajian ini terdiri daripada soal selidik yang diubahsuai berdasarkan kajian-kajian lepas selaras dengan objektif kajian. Instrumen ini terdiri daripada 8 item yang telah disahkan oleh 3 orang pakar penilai dalam bidang keusahawanan dan perniagaan, teknologi pembungkusan, dan rekabentuk pembungkusan. Data kajian diperoleh melalui edaran borang soal selidik kepada usahawan secara pertemuan bersemuka, melalui pos dan pengisian secara maya menggunakan google dokumen. Analisis deskriptif digunakan bagi menjawab objektif kajian. Tahap amalan inovasi pembungkusan yang dikaji adalah menggunakan peratusan.

4. ANALISIS DAN KEPUTUSAN

Jadual 1 menunjukkan analisis tahap pengetahuan pembungkusan hijau dikalangan usahawan dan pengguna. Item A3 yang mempunyai skor yang tertinggi adalah sebanyak 71%, diikiuti dengan item A2 dengan jumlah peratus setuju dan sangat setuju sebanyak 66.3% dan sedikit setuju 28.7%. Manakala item A1 mendapat peratus setuju dan sangat setuju yang paling rendah dengan jumlah peratusan sebanyak 52.5 %, sedikit setuju 36.3% dan kurang setuju 2.5%.

Jadual 1: Analisis Tahap Pengetahuan Usahawan dan Pengguna

A	PENGETAHUAN
A1	Saya mempunyai tahap pengetahuan pembungkusan hijau yang luas.
A2	Saya mendapat ilmu pengetahuan tentang pembungkusan hijau dari media semasa.
A3	Saya mempunyai tahap kesederan kempen hijau di Malaysia.

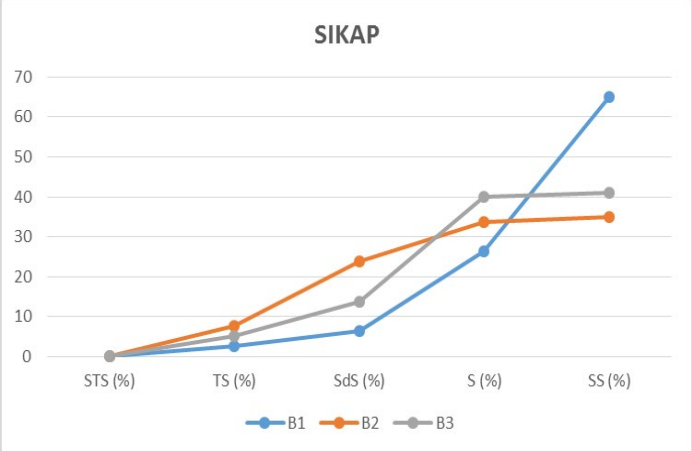


Nota: STS – Sangat Tidak Setuju, TS – Tidak Setuju, SdS –Sederhana Setuju, S – Setuju dan SS –Sangat Setuju

Analisis dalam Jadual 2 dapatan peratusan bagi setiap item sikap usahawan dan pengguna mengenai pembungkusan hijau. Kesemua tiga item tersebut mempuyai nilai peratus melebihi 50%. Item yang mempunyai skor yang tertinggi adalah item B1 iaitu 91.3% dan diikuti dengan item B3 dengan nilai peratusan 81%. Kedua -dua item berkenaan menunjukkan jumlah peratus responden setuju dan sangat setuju adalah tinggi.

Jadual 2: Analisis Sikap Usahawan dan Pengguna

B	SIKAP
B1	Saya menyokong kempen alam sekitar dan juga pembungkusan hijau.
B2	Diatas kesedaran saya, saya akan membeli produk yang menggunakan pembungkusan hijau.
B3	Saya memilih produk yang menggunakan pembungkusan hijau yang memberi kebaikan kepada alam sekitar.

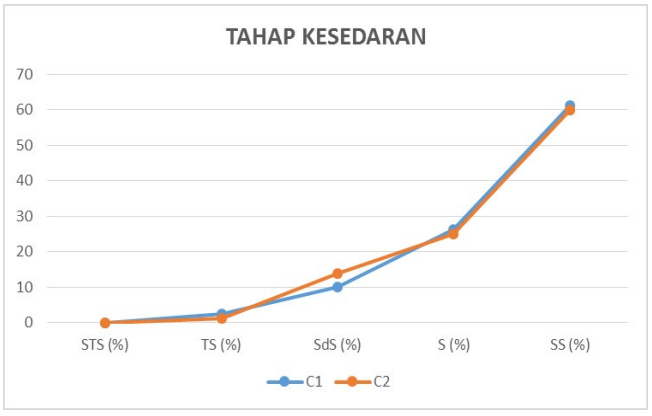


Nota: STS – Sangat Tidak Setuju, TS – Tidak Setuju, SdS –Sederhana Setuju, S – Setuju dan SS – Sangat Setuju

Manakala analisis dalam Jadual 3 menunjukkan dapatan peratusan bagi setiap item tahap kesedaran usahawan dan pengguna mengenai pembungkusan hijau. Kesemua item tersebut mempuyai nilai peratus melebihi 50%. Item yang mempunyai skor yang tertinggi adalah item C1 iaitu 87.3% dan diikuti dengan item C2 dengan nilai peratusan 85%. Kedua - dua item berkenaan menunjukkan jumlah peratus responden setuju dan sangat setuju adalah tinggi.

Jadual 3: Analisis Tahap Kesedaran Usahawan dan Pengguna

C	TAHAP KESEDARAN
C1	Saya mempunyai kesedaran bahawa setiap tindakan yang saya lakukan akan memberi kesan kepada teknologi hijau.
C2	Saya sedar produk yang menggunakan pembungkusan hijau dapat menjaga alam sekitar adalah kepentingan untuk diri saya.

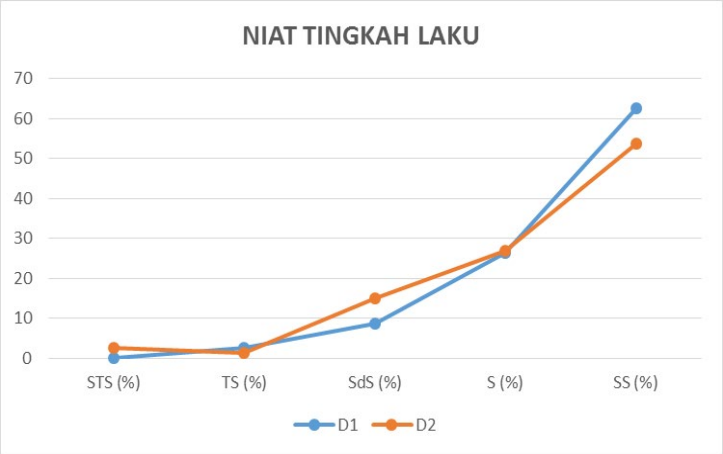


Nota: STS – Sangat Tidak Setuju, TS – Tidak Setuju, SdS –Sederhana Setuju, S – Setuju dan SS – Sangat Setuju

Jadual 4 menunjukkan analisis dapatan peratusan bagi setiap item niat dan tingkah laku usahawan dan pengguna mengenai pembungkusan hijau. Kesemua item tersebut mempuyai nilai peratus melebihi 50%. Item yang mempunyai skor yang tertinggi adalah item D1 88.8% dan diikuti dengan item D2 dengan nilai peratusan 80.8%. Kedua -dua item berkenaan menunjukkan jumlah peratus responden setuju dan sangat setuju adalah tinggi.

Jadual 4: Analisis Niat Tingkah Laku Usahawan dan Pengguna

D	NIAT TINGKAH LAKU
D1	Amalan hijau harus disokong dan dipraktikkan seluasnya agar matlamat pemeliharaan alam sekitar dapat dicapai.
D2	Jika ia terserah kepada saya, saya yakin akan membeli produk yang menggunakan pembungkusan hijau.



Nota: STS – Sangat Tidak Setuju, TS – Tidak Setuju, SdS –Sederhana Setuju, S – Setuju dan SS – Sangat Setuju

5. KESIMPULAN

Secara keseluruhan, kajian mendapati bahawa usahawan dan penguna mempunyai pengetahuan dan kesedaran terhadap pembungkusan hijau yang agak baik hasil dari keberkesanan kempen yang dijalankan oleh kerajaan. Usahawan dan pengguna juga sedar bahawa mereka cenderung untuk menyokong kempen alam sekitar dengan mengaplikasikan amalan hijau terhadap pembungkusan dan membeli produk yang menggunakan pembungkusan hijau demi memberi kebaikan kepada alam sekitar. Ini kerana kedua-dua pihak iaitu usahawan dan pengguna mempunyai kesedaran yang tinggi terhadap kesan daripada tindakan yang diambil oleh mereka adalah untuk kepentingan mereka juga. Disamping itu usahawan juga sedar mengenai sambutan pengguna terhadap kempen ini sekaligus mendorong pengguna untuk memilih produk yang menggunakan pembungkusan hijau. Kecenderungan ini dipengaruhi oleh diri usahawan dan sokongan agensi pembimbing untuk melakukan sesuatu tindakan seperti mana dalam Teori Tingkahlaku Terancang (TPB) (Ajzen 1991). Selain itu, kajian ini juga mendapati bahawa usahwan dan pengguna menyokong agar matlamat pemeliharaan alam sekitar melalui pembudayaan amalan inovasi pembungkusan hijau. Oleh itu, usahawan perlu melakukan strategi melihat, membandingkan dan menambahbaik melalui kecenderungan potensi pasaran. Strategi ini akan memberikan impak yang positif di dalam perniagaan dan pemasaran kerana produk yang menggunakan pembungkusan hijau bukan sahaja kreatif dan menarik tetapi dalam masa yang sama ianya dapat menyokong Pelan Strategik Kementerian Sumber Manusia 2020-2025) yang mengalakkan pengurangan sumber secara keseluruhan di samping mengekalkan pertumbuhan ekonomi negara. Cadangan tindakan pada masa akan datang adalah memantapkan lagi pembudayaan inovasi pembungkusan hijau terhadap Projek Akhir Pelajar Diploma Teknologi Media Cetak.

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NATURAL VENTILATION PERFORMANCE STRATEGIES BASED ON MALAY VERNACULAR HOUSE ELEMENTS TO ENHANCE HEALTH AND THERMAL COMFORT

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Abstract. Passive design strategy is a major consideration in building industry nowadays to enhance green technology effort for reducing sick building syndrome (SBS) and cater global warming issue. Natural ventilation is one of the effective strategies to enhance indoor air quality (IAQ) for health, thermal comfort and save energy consumption in buildings. Although many studies suggest a good recommendation to improve natural ventilation performance in recent buildings, the assessment of IAQ and thermal comfort in the buildings remains less than the required rate for the living environment. This paper reviews natural ventilation performance in Malay vernacular house, which has a potential to enhance the natural ventilation performance in buildings for health and thermal comfort. Previous computational fluid dynamics (CFD) results were reviewed to relate the passive design elements in the studied buildings with Malay vernacular house elements. The results indicate that open-able windows, roof inclination angle and building position are important aspect in building design and construction to sustain future development. Several further investigations are suggested to enhance health and thermal comfort in buildings by the consideration of Malay vernacular house elements.

Keywords: Natural ventilation, Thermal comfort, Indoor air quality, Passive design strategy, Malay vernacular house, Computational Fluid Dynamics (CFD).

1. INTRODUCTION

Strategies to enhance natural ventilation performance in buildings reflects to the great concern of global warming issues that affect the excessive heat and solar radiation in buildings (Aflaki et al., 2015; Pisello et al., 2016). Thus, previous studies suggested that the ideas of vernacular architecture's design principles have significance when it is applied into modern buildings, specifically on environmental aspect(Huang, Liu, et al., 2017; Huang, Wu, et al., 2017; Niroumand et al., 2017). Among all the passive design strategies, the enhancement of natural ventilation performance in buildings is the dominant technique in tropical buildings compared to the other strategies(Jones et al., 2016; Mateus et al., 2016; Nomura & Hiyama, 2017). Natural ventilation performance is one of the effective low-cost passive cooling strategy used in buildings (Huang et al., 2016; Pisello et al., 2016; Sorgato et al., 2016). But, few design of buildings provide an effective natural ventilation performance, which consequently decreases thermal comfort and causes sick building syndrome (SBS)(Lin et al., 2016).

Recently, building industries have started to value the vernacular architecture to be implemented in modern buildings (Martínez-Molina et al., 2016; Niroumand et al., 2017). Although vernacular architecture presents the simplest response to the occupants'

requirements, it is seemingly ignored in recent building design and construction to sustain living environment (Niroumand et al., 2017). Thus, this paper reviews the studies of natural ventilation performance in buildings, which is relating to the elements of Malay vernacular house. The results of CFD simulation modeling is discussed for the suggestions of better passive design buildings. Air velocity, *V* (m/s) and ventilation rate, *Q* (m^3/s) are important parameters in the investigation to measure indoor air quality (IAQ) and thermal comfort.

2. NATURAL VENTILATION AS A 'PASSIVE DESIGN STRATEGY'

'Passive design strategy' is a set of natural processes and techniques to reduce indoor temperatures, which is in opposition to the use of 'active' mechanical equipment (Prieto et al., 2018). Recently, renewed interest has appeared in passive strategies because of its low extra capital investment cost compared to the potential benefit in energy saving (Chen et al., 2015). Passive design strategy for residential buildings are amongst the world's leading concepts for the design and construction of energy efficient buildings (Fokaides et al., 2016). Many technologies have been developed for residential passive design strategy(Wang et al., 2017). The enhancement of natural ventilation performance in buildings is the most preferable passive design strategy to achieve better thermal comfort and health purposes for living environment (Aflaki et al., 2015; Nomura & Hiyama, 2017; Saleem et al., 2016). A suitable passive design and construction for the residential buildings are definitely necessary to achieve the major decrease in heating energy consumption required for the occupants(Wang et al., 2017).

2.1 Natural ventilation performance in Malay vernacular house

A 'Malay vernacular house', which is also called as 'Traditional Malay house' is an indigenous house which is designed based on the needs and cultures of the owner(Husli, 2011; Kamal et al., 2004). It is mostly found in Southeast countries and dominantly located in Malaysia, which are geographically near the equator with coordinates of 2° 30' North of the Equator and 112° 30' East of the Prime Meridian. It reflects the creative and aesthetic values of the vernacular architecture to fulfil the socioeconomic, cultural and environmental needs(Husli, 2011; Kamal et al., 2004). In this study, an environmental need in terms of natural ventilation performance is focused on. Numerous features in the Malay vernacular house geared towards providing effective ventilation. The quantity of openness reflects the importance given to ventilation in the design of the Malay vernacular house. Previous study suggested that the Malay vernacular house was designed to fit the local climate, for instance, the abundance of fully open-able windows and hollow wood carving capable to maximize the natural ventilation at the body level and cooling the entire house for thermal comfort(Ramli, 2012)(Figure 1).

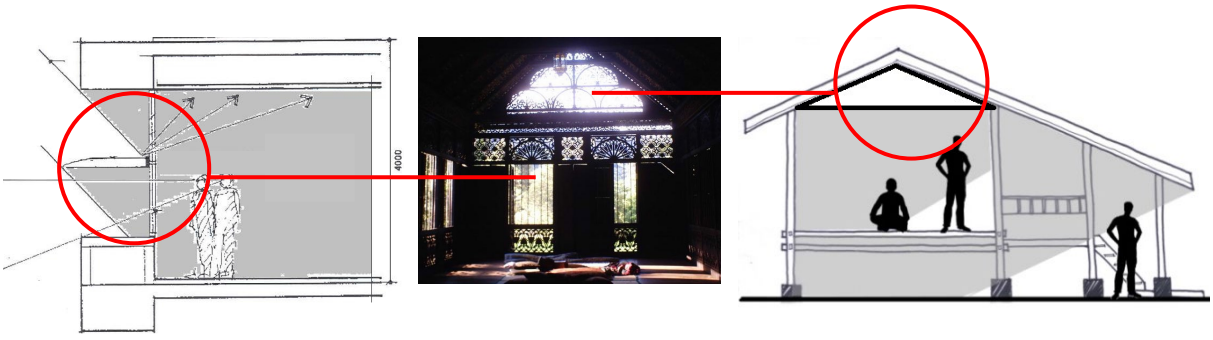


Figure 1: The fully open-able windows and hollow wood carving enhance the natural ventilation performance in the house
Source: Ramli, 2012

The elongated structure with minimal partitions in the interior will allow easy passage of air and cross ventilation(Kamal et al., 2004; Ramli, 2012). Besides, the simple structure of long roof (*bumbung panjang*); which consists of upper and lower parts with different roof slopes, can trap hot air and push through the air vent design under the roof. As a result, the heat in the

interior space will be decreased(Ramli, 2012). The upper pitch roof is relatively about 45-55% and the lower pitch roof is relatively about 25-35% slope (Aflaki et al., 2015; Ariffin et al., 2015).

3. METHODOLOGY

The comparison study of the passive design elements in Malay vernacular house with the Malaysian modern house design is conducted. The previous results of CFD analysis of each element is analyzed and discussed (as illustrated in Figure 2).

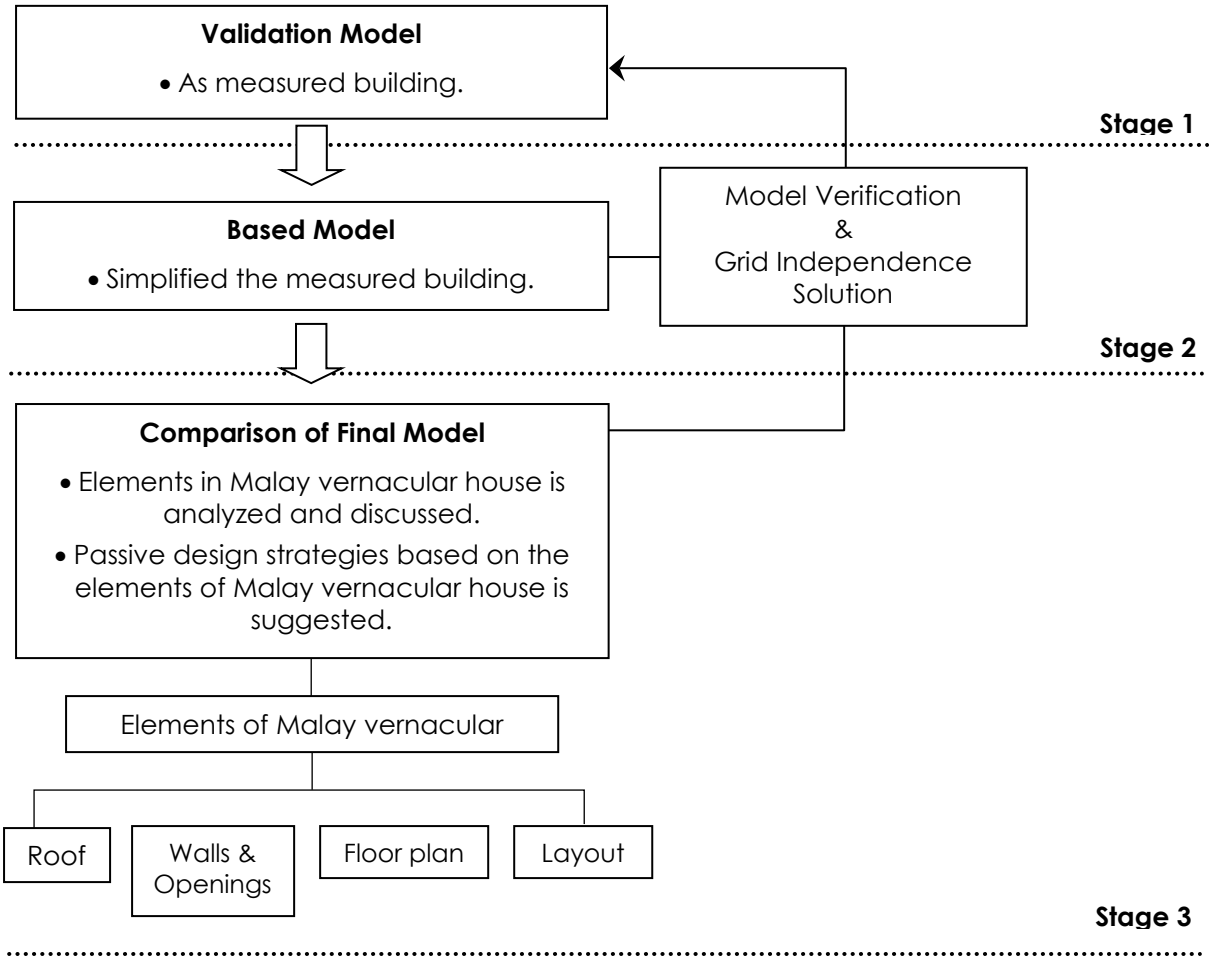


Figure 2: Stages of CFD modelling studies

4. RESULTS AND DISCUSSION

The natural ventilation performance in Malay vernacular house is compared with Malaysian modern house design, which is summarized in Table 1. Various studies on natural ventilation performance in modern buildings related to the elements of Malay vernacular house are tabulated in Table 2. The summarization determines the potential of elements of Malay vernacular house as a passive design strategy to provide a better natural ventilation performance in modern buildings.

Table 1: The comparison of natural ventilation performance in Malay vernacular house with modern building

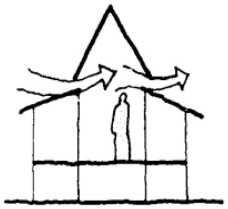
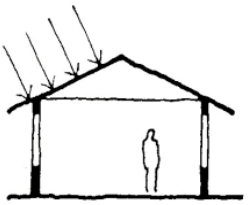
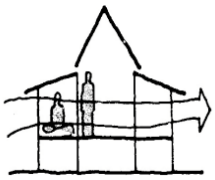
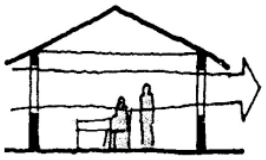
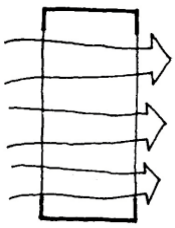
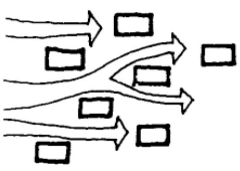
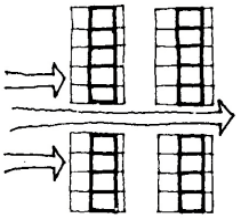
House Elements	**Passive Design Strategies**			
	Malay Vernacular House		**Malaysian Modern House**	
Roof		▪ The joints and panels in the roof structure allow cross ventilation through the house and also enhance stack effect in the house. ▪ The use of wood materials (*attap* roof) serves as an excellent insulator.		▪ The joints and panels in the roof structure trap the cross ventilation. ▪ The use of tile roof and concrete stores up heat and radiates the heat into the house.
Walls & Openings		▪ The full-length and openable windows and doors maximize cross ventilation at the body level.		▪ The window reduces cross ventilation at the body level because it is elevated higher than the floor level to provide privacy.
Floor plan		▪ The elongated open plans allow easy passage of air and good cross ventilation. ▪ There are minimal interior partitions to enhance the natural ventilation performance inside the house.		▪ The house is partitioned to form different size of rooms that reduce the natural ventilation performance inside the house.
Layout		▪ The houses are clustered, which create a multiple passage of cross ventilation.		▪ The houses are arranged in the rigid forms that reduce the passage of cross ventilation.

Table 2: The elements of Malay vernacular house as a passive design strategy to enhance natural ventilation performance in buildings

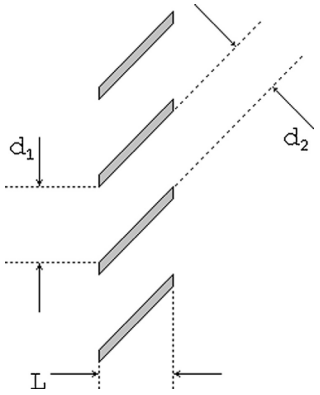
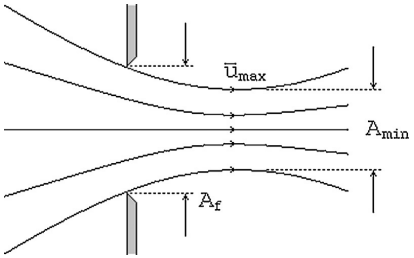
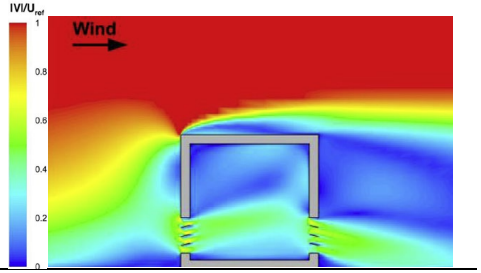
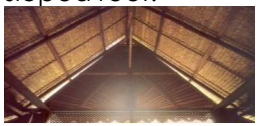
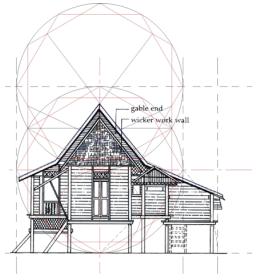
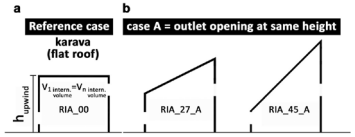
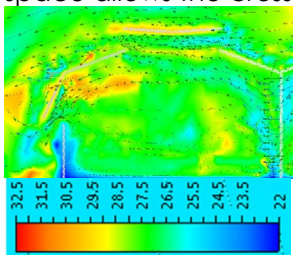
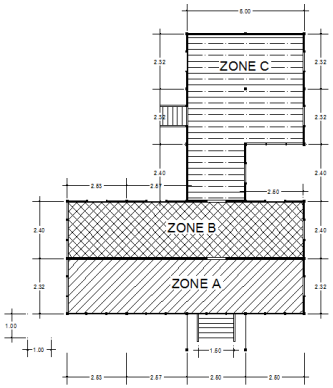
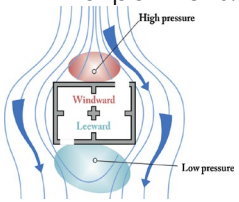
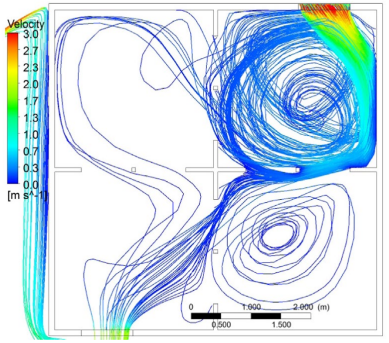
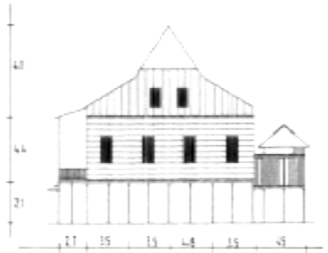
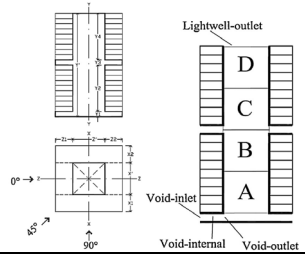
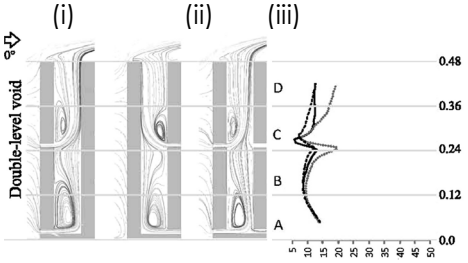
Ref.	Elements of Malay Vernacular House	Passive Design Strategies	Output	CFD Analysis
	Louvered window panels and wall. 	Ventilation opening is designed with louvers. Ambiguity in the specification of free area, A_f, where $d_1 \neq d_2$. 	The air passes through the orifice accelerates and contracts to form a *vena contracta*, the point at which increases the air velocity at the highest streamline, u_{max} (m/s), the streamlines are parallel, and the flow area is smallest, A_{min}(m). 	In the case with louvers, the incoming fresh air is directed upwards where it is mixed with the air inside of the building, while in the case without louvers the flow is short-circuiting through the building without any significant mixing. It stated the absolute difference (9.1%) between the case with and without louvers. 
	Long and steeply sloped roof.  	The upper long roof is relatively about 40˚- 60˚ and the lower pitch roof is relatively about 30˚-40˚. 	The ventilated roof space and elevated floor maximizes air velocity streamline, u_{max} (m/s), crossing the interiors and remove warm air. The building with a 45˚ roof inclination angle (RIA_45) provides 22% higher than all the other cases; 9˚, 18˚, 27˚, 36˚. 	The reduction of indoor temperature is at the average reduction of 5.23˚C when the roof space allows the cross ventilation. 

Table 2 (cont.): The elements of Malay vernacular house as a passive design strategy to enhance natural ventilation performance in buildings

Ref.	Elements of Malay Vernacular House	Passive Design Strategies	Output	CFD Analysis
	Building layout and the position of windows / openings. 	Divided into three important zones; public, semi-private and private with minimal partitions. 	The average indoor wind speed levels barely reach 3.4 m/s under gentle breeze condition which is the ideal wind speed level. The geometry used here is a simplified form of a real building as the Malay vernacular house has minimal partitions. 	The simple position of openings stated the highest air velocity (m/s), which is between 3 m/s to 4 m/s. 
	Elevated / raised floor. 	The floor rose at 2m-2.5m above the ground level to elevate the building. In modern building, a podium is one example of elevated floor that allows cross ventilation in buildings. 	Three different horizontal positions; (i) windward, (ii) leeward and (iii) cross configurations, are investigated. The average air velocity of cross configuration is more than other configurations by 29% and 62%, respectively. 	The results demonstrate that the average air velocity (m/s) in cross configuration is relatively higher compared to the other two configurations, which is between 0.3 m/s to 0.6 m/s. 

In general, for most domestic buildings, the common requirement for a minimum fresh air flow rate is about 10 L/s per person (equal to 0.01 m^3/s per person) to be 10 m^2 based on the removal of body odours and this is usually sufficient to cope with other contaminants generated within occupied building (Etheridge 2012). While, for thermal comfort, the acceptable range for a human being is between 0.3 – 1.5 m/s. For hot and humid climatic conditions, indoor air velocity of 0.4 m/s could enhance indoor thermal comfort, where 1 m/s is pleasant and indoor air velocities of up to 1.5 m/s are acceptable (Andris Auliciems & Steven V. Szokolay 2007; Seyedehzahra Mirrahimi et al. 2016). Therefore, the following suggestions are synthesized based on the CFD results:

i. The implementation of Malay vernacular houses elements enhances the natural ventilation performance by increasing the indoor air velocity into 0.3 m/s to 4 m/s that achieve the thermal comfort level.
ii. The reduction of indoor temperature is at the average reduction of 5.23˚C by following the roof inclination angle of Malay vernacular houses.
iii. The range of indoor air velocity leads to the better scale of fresh air ventilation for residential building, which is 0.14 m^3 per minute per construction area (m^2) that equal to 0.002 m^3/s per m^2 or 8.4 ACH for 1 m^2.

5. CONCLUSION

This paper outlines the recommendations of passive design strategies based on the elements of Malay vernacular house. Thus, can reduce the current global warming issues and develops sustainable buildings for better built environment. Previous studies found that passive design strategy by enhancing natural ventilation performance in buildings is the most preferable technique compared to other passive design strategies for thermal comfort and health of the occupants, of which has been implemented in the Malay vernacular house. The review also suggested that the Malay vernacular house is a good example of passive design strategy to be implemented in designing modern building. This design response to the climatic condition while preserving the better living environment.

As a result, the value of Malay vernacular house as an environmental-friendly design can be preserved and apply in modern house design for future generations. This paper contributes to link vernacular building elements to modern building's design to preserve human life and living environment. The discussion of passive design strategies in this paper provides useful examples for sustainable development.

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SIKAP PELAJAR TERHADAP STATISTIK DALAM KALANGAN PELAJAR POLITEKNIK

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Abstrak. Kajian ini bertujuan untuk meninjau sikap pelajar terhadap mata pelajaran statistik. Sampel kajian terdiri daripada 152 orang pelajar politeknik (N=152). Kajian ini menggunakan instrumen *Survey of Attitude towards Statistics* (SATS) yang mengandungi 36 item positif dan negatif serta terdiri daripada enam dimensi sikap terhadap statistik. Statistik deskriptif digunakan untuk mendapatkan maklumat berkaitan dimensi-dimensi sikap pelajar terhadap statistik. Para pelajar menunjukkan skor yang paling tinggi bagi dimensi sikap pelajar tentang kegunaan, kaitan dan nilai statistik dalam kehidupan peribadi dan profesional (min = 21.32, SP = 2.230), diikuti dimensi kesukaran statistik sebagai subjek (min = 19.78, SP = 2.113), pengetahuan dan kemahiran intelektual (min = 15.68, SP = 1.878), perasaan pelajar mengenai statistik (min = 15.19, SP = 2.143), jumlah masa pelajar habiskan untuk belajar statistik (min = 13.47, SP = 1.651) dan minat individu dalam statistik (min = 12.38, SP = 1.718). Enam item hasil dapatan yang positif dari kajian ini menunjukkan mata pelajaran statistik bukan sahaja merupakan disiplin yang khusus, tetapi juga merentasi pelbagai bidang seperti sains, teknologi, ekonomi, sosial dan kejuruteraan. Oleh itu penerapan nilai-nilai positif terhadap mata pelajaran statistik dilihat dapat membantu pelajar untuk melihat bagaimana statistik boleh dipelajari dan diamalkan di luar kuliah.

Kata Kunci: sikap terhadap statistik, pelajar politeknik, *Survey of Attitude towards Statistics*

1. PENGENALAN

Istilah statistik dipakai untuk menyatakan bilangan mahupun non bilangan kumpulan data, yang disusun dalam jadual atau diagram bagi melukiskan atau menggambarkan suatu persoalan (Sudjana, 2005). Statistik juga mengandung pengertian lain yakni dipakai untuk menyatakan "ukuran" sebagai wakil dari kumpulan data mengenai sesuatu hal. Ukuran ini diperoleh berdasarkan perhitungan menggunakan kumpulan sebahagian data yang diambil dari keseluruhan tentang persoalan tersebut. Sudjana (2000) pula menyatakan bahawa statistik adalah pengetahuan tentang cara-cara pengumpulan, pengolahan atau penganalisaan data dan membuat kesimpulan berdasarkan data tersebut.

Kebanyakan kajian statistik adalah cenderung kepada hubungkait terhadap pencapaian pelajar. Sikap memainkan peranan penting dalam menentukan kejayaan pelajar bagi menyelesaikan masalah. Namun terdapat kekurangan kajian yang mengukur perasaan, sikap dan minat pelajar terhadap statistik. Kebanyakan pelajar selalu mengeluh kerana kurang berkeyakinan bagi menyelesaikan masalah pembelajaran mereka. Berdasarkan keprihatinan pentingnya sikap, maka kajian ini dijalankan bagi menganalisis sikap pelajar politeknik terhadap pembelajaran statistik bagi menentukan pengaruh sikap terhadap pencapaian statistik serta menganalisis perbezaan sikap.

2. SOROTAN KAJIAN

Pelbagai kajian telah dilakukan sama ada di dalam atau luar negara berkaitan sikap pelajar terhadap matematik. Kajian di luar negara menunjukkan terdapat hubungan yang positif di antara sikap terhadap matematik dengan motivasi, jangkaan dan minat terhadap matematik (Moodaley, Grobler & Lens, 2006). Motivasi merupakan kesanggupan memberi

tumpuan, masa, tenaga dan ketekunan untuk belajar. Jangkaan pula merujuk kepada pembelajaran matematik yang bermakna seperti memahami konsep, mengetahui teorem, formula, strategi dan teknik penyelesaian untuk cemerlang dalam ujian atau peperiksaan (Steyn & Maree, 2002). Manakala, minat pula merujuk kepada keseronokan, keyakinan, bakat dan faedah pembelajaran matematik kepada kehidupan.

Statistik merupakan sebahagian daripada komponen dalam matematik. Sikap terhadap statistik merupakan variabel yang penting untuk dikaji kerana ia membantu meringkaskan data untuk dipersembahkan ke dalam bentuk yang mudah difahami (Nguyen, Charity & Robson, 2016). Prayoga dan Abraham (2017) menambah bahawa, mempelajari statistik membantu pelajar untuk memerihalkan fenomena dalam tatacara yang lebih baik, mengenal pasti hubungan di antara faktor yang menyumbang kepada masalah yang dikaji, dan membuat anggaran terhadap keputusan akan datang (membuat ramalan). Dari sudut pasaran buruh, pekerja yang mempunyai kemahiran numerikal seperti statistik lebih mudah direkrut (Wellman, 2010).

Sorotan kajian menunjukkan faktor yang mempengaruhi sikap terhadap statistik termasuklah faktor guru seperti kaedah pengajaran, persekitaran pembelajaran seperti latar belakang keluarga dan juga faktor pelajar itu sendiri, contohnya seperti kebimbangan, motivasi dan pengalaman dengan subjek statistik (Chiesi & Primi, 2010). Namun begitu, faktor pelajar dilihat sebagai fokus utama kajian-kajian lepas. Sebagai contoh, pengalaman lepas merupakan peramal yang dominan bagi sikap terhadap statistik (Coetzee & van der Merwe, 2010; Tempelaar & Schim van der Loeff, 2011). Pelajar yang mempunyai pencapaian yang baik dalam statistik pada masa lepas dilihat mempunyai sikap yang lebih positif terhadap statistik berbanding pelajar lain.

Sikap terhadap statistik juga merupakan peramal yang signifikan kepada pencapaian dalam kursus statistik (Carlson & Winquist, 2011; Emmioğlu, 2011; Verhoeven, 2011). Sikap yang positif akan membantu pelajar untuk melihat kebaikan yang ada dalam subjek statititstik terutamanya untuk kursus-kursus akan datang. Sebaliknya, sikap yang negatif akan menghadkan peluang pembelajaran dan seterusnya akan menghalang perkembangan pelajar. Satu hal yang perlu diambil perhatian ialah sikap merupakan variabel yang boleh berubah. Justeru itu amatlah penting untuk para guru dan pensyarah membantu mengubah sikap terhadap statistik dalam kalangan pelajar mereka.

Oleh itu, kajian ini dijalankan bertujuan mengkaji sikap terhadap statistik dalam kalangan pelajar Politeknik Sultan Azlan Shah. Kajian berbentuk deskriptif ini memerihalkan perkara berkaitan aspek-aspek yang sukar dikuasai oleh pelajar dalam mempelajar statistik. Para pensyarah statistik boleh menggunakan maklumat dari kajian ini bagi menambah baik pengajaran mereka, terutamanya dalam meningkatkan minat terhadap subjek statistik.

3. METODOLOGI KAJIAN

Sampel kajian terdiri daripada 152 orang pelajar Politeknik Sultan Azlan Shah, Tanjung Malim, Perak. Kaedah persampelan bertujuan (purposive sampling) digunakan untuk mendapatkan maklumat berkaitan sikap terhadap statistik. Kaedah persempelan bertujuan dipilih untuk kajian ini kerana ciri-ciri sampel yang terlibat adalah berfokus kepada pelajar yang mengambil matapelajaran statistik di politeknik. Maklumat sempel yang digunakan ini terdiri dari 41 orang lelaki dan 111 orang perempuan berumur antara 18 tahun hingga 21 tahun. Kesemua pelajar ini terdiri dari 4 bidang diploma di politeknik iaitu Diploma Pemasaran, Diploma Akauntasi, Diploma Pengurusan Peruncitan dan Diploma Pengajian Perniagaan. Maklumat berkaitan sampel diberikan di dalam Jadual 1 di bawah.

Jadual 1: Maklumat Sampel

Maklumat	Bilangan	Peratus
Jantina		
Lelaki	41	27.0
Perempuan	111	73.0
Umur		
18 tahun	6	3.9
19 tahun	105	69.1
20 tahun	28	18.4
21 tahun	10	6.6
Bidang		
Diploma Pemasaran	30	19.7
Diploma Akauntasi	34	22.4
Diploma Pengurusan Peruncitan	49	32.2
Diploma Pengajian Perniagaan	39	25.7

Kajian ini menggunakan instrumen Survey of Attitudes Towards Statistics (Shau, 2003). Instrumen ini mengandungi 36 item positif dan negatif yang terdiri daripada enam dimensi sikap terhadap statistik, iaitu (1) perasaan pelajar mengenai statistik, (2) sikap pelajar mengenai pengetahuan dan kemahiran intelektual mereka apabila menggunakan statistik, (3) sikap pelajar tentang kegunaan, kaitan dan nilai statistik dalam kehidupan peribadi dan profesional, (4) sikap pelajar tentang kesukaran statistik sebagai subjek, (5) tahap minat individu dalam statistik dan (6) jumlah masa pelajar habiskan untuk belajar statistik. Pelajar perlu memilih salah satu daripada empat respons iaitu sangat tidak setuju, tidak setuju, setuju atau sangat setuju bagi setiap pernyataan di dalam instrumen ini. Terjemahan ke dalam Bahasa Melayu dilakukan oleh seorang pensyarah bahasa dan seorang pensyarah bidang pengukuran pendidikan daripada Universiti Sains Malaysia. Maklumat lanjut bagi setiap komposisi item diberikan di dalam Jadual 2 di bawah.

Jadual 2: Item Setiap Dimensi

Dimensi	Bil. Item	Nombor Item
Perasaan pelajar mengenai statistik	6	3, 14*, 15*, 18*, 19, 28*
Sikap pelajar mengenai pengetahuan dan kemahiran intelektual mereka apabila menggunakan statistik	6	5*, 11*, 26*, 31, 32, 35*
Sikap pelajar tentang kegunaan, kaitan, dan nilai statistik dalam kehidupan peribadi dan profesional	9	7*, 9, 10, 13*, 16*, 17, 21*, 25*, 33*
Sikap pelajar tentang kesukaran statistik sebagai subjek	7	6, 8*, 22, 24*, 30*, 34*, 36*
Tahap minat individu dalam statistik	4	12, 20, 23, 29
Jumlah masa pelajar habiskan untuk belajar statistik	4	1, 2, 14, 7
Bilangan	36	

* item negatif

Prosedur kajian yang dilakukan adalah seperti berikut. Soal selidik SATS ditadbir kepada sampel kajian semasa kuliah dijalankan bagi memastikan kualiti dapatan kajian yang memuaskan. Selepas data dikutip dan dimasukkan ke dalam perisian IBM SPSS 22.0, respons bagi item negatif dikodkan semula. Selepas itu prosedur *compute* digunakan untuk mendapatkan skor pelajar bagi setiap item di dalam SATS.

4. ANALISIS DAN KEPUTUSAN

Bagi menjelaskan sikap terhadap statistik dalam kalangan sampel kajian, statistik deskriptif peratusan, min dan sisihan piawai digunakan bagi dimensi dan juga bagi setiap pernyataan.

Bagi dimensi SATS, berdasarkan Jadual 3 di bawah, dapatan kajian daripada sampel yang digunakan menunjukkan skor yang paling positif adalah daripada dimensi sikap pelajar tentang kegunaan, kaitan dan nilai statistik dalam kehidupan peribadi dan profesional (min = 21.32, SP = 2.230), diikuti dengan sikap pelajar tentang kesukaran statistik sebagai subjek (min = 19.78, SP = 2.113) dan sikap pelajar mengenai pengetahuan dan kemahiran intelektual mereka apabila menggunakan statistik (min = 15.68, Sp = 1.878). Ini merupakan dapatan yang positif memandangkan statistik bukan sahaja merupakan disiplin yang khusus, tetapi juga merentasi pelbagai bidang seperti sains, teknologi, ekonomi, sosial dan kejuruteraan. Oleh itu, diharapkan sikap yang positif ini dapat membantu para pelajar untuk melihat bagaimana statistik boleh dipelajari dan diamalkan di luar bilik kuliah. Namun begitu, sampel kajian menunjukkan skor yang paling rendah dalam dimensi minat terhadap statistik (min = 12.38, SP = 1.718). Ini dilihat sebagai sesuatu yang membimbangkan kerana minat seringkali dikaitkan dengan variabel-variabel penting seperti pencapaian (Noor Erma & Leong, 2014), pembelajaran pelajar dan pemikiran statistik (Schau, 2003) dan pencapaian matematik (Arumugam, 2014).

Jadual 3: Min dan Sisihan Piawai bagi Dimensi-dimensi SATS

Dimensi	Min	SP
Sikap pelajar tentang kegunaan, kaitan, dan nilai statistik dalam kehidupan peribadi dan profesional	21.32	2.230
Sikap pelajar tentang kesukaran statistik sebagai subjek	19.78	2.113
Sikap pelajar mengenai pengetahuan dan kemahiran intelektual mereka apabila menggunakan statistik	15.68	1.878
Perasaan pelajar mengenai statistik	15.19	2.143
Usaha	13.47	1.651
Tahap minat individu dalam statistik	12.38	1.718

Maklumat berkaitan peratusan respons, min dan sisihan piawai bagi setiap item pula ditunjukkan dalam Jadual 4 di bawah. Dapatan menunjukkan sampel kajian mempunyai sikap yang paling positif bagi Item 2 (Saya berhasrat untuk bekerja keras di dalam kursus statistik – dimensi usaha) (min = 3.42, SP = .521) dan diikuti dengan melengkapkan semua tugasan statistik (min = 3.41, Sp = .507). Para pelajar juga dilihat sukakan statistik (min = 3.36, SP = .545). Keputusan ini menunjukkan dapatan yang positif kerana ia menggambarkan pelajar melihat statistik sebagai subjek yang penting. Pengkaji melihat ada ruang untuk para pensyarah membantu pelajar untuk lebih positif melalui pengajaran dan pembelajaran semasa kuliah, tanpa perlu mengadakan bengkel atau kem khusus. Para pensyarah boleh menunjukkan kegunaan statistik dalam kehidupan seharian. Sebagai contoh, pelajar boleh didedahkan dengan kepentingan mencari statistik sisihan piawai dalam membuat pemilihan tentang produk apa yang mempunyai konsistensi yang paling tinggi.

Selain daripada itu terdapat beberapa pemerhatian menarik dari kajian ini. Sebagai contoh, terdapat lebih daripada 30% pelajar mengatakan bahawa statistik merupakan subjek yang rumit (min = 2.21, SP =.725). Harus diingat bahawa melihat satu-satu subjek sebagi rumit akan merencatkan motivasi untuk belajar. Seharusnya para pelajar dan pensyarah mengenal pasti apakah aspek dalam statistik yang dikatakan rumit dan bagaimanakah cara untuk mengatasinya dengan kadar segera. Begitu juga, lebih 60% pelajar berpendapat bahawa subjek statistik sangat teknikal, manakala 75% berpendapat formula statistik sukar difahami. Justeru, perlu wujud perbincangan dan kajian lanjut dijalankan bagi mendalami isu-isu ini bagi menjalankan intervensi yang sesuai supaya sikap yang lebih positif terhadap statistik dapat diterapkan.

Jadual 4: Peratusan Respons, Min dan Sisihan Piawai bagi Dimensi-dimensi SATS

	STS	TS	S	SS	Min	SP
2: Bekerja keras dalam kursus statistik saya.		1.3	55.3	43.4	3.42	.521
1: Melengkapkan semua tugasan statistik		.7	57.2	42.1	3.41	.507
3: Suka statistik		3.3	57.9	38.8	3.36	.545
14: Belajar dengan bersungguh-sungguh bagi setiap ujian statistik.	1.3	3.9	53.9	40.8	3.34	.621
27: Merancang untuk menghadiri setiap sesi kelas statistik.	1.3	3.9	59.2	35.5	3.29	.605
31: Boleh belajar statistik	.7	1.3	66.4	31.6	3.29	.523
29: Berminat belajar statistik		8.6	59.2	32.2	3.24	.595
30: Memerlukan banyak pengiraan		9.9	65.8	24.3	3.14	.569
23: Berminat untuk memahami maklumat statistik		5.3	76.3	18.4	3.13	.470
32: Dapat memahami persamaan statistik	2.0	6.6	68.4	23.0	3.13	.601
10: Boleh meningkatkan peluang untuk saya diambil bekerja		7.2	73.7	19.1	3.12	.501
19: Menikmati kursus statistik		9.2	73.0	17.8	3.09	.514
20: Berminat untuk menggunakan statistik	.7	8.6	76.3	14.5	3.05	.506
24: Memerlukan banyak disiplin	2.0	15.1	63.8	19.1	3.00	.651
12: Berminat untuk menyampaikan maklumat statistik kepada orang lain.	2.0	16.4	65.1	16.4	2.96	.640
9: Statistik sepatutnya menjadi sebahagian daripada latihan profesional saya.	.7	15.8	71.7	11.8	2.95	.549
22: Subjek yang cepat dipelajari oleh kebanyakan orang.	.7	19.7	66.4	13.2	2.92	.593
36: Perlu belajar cara berfikir baharu untuk melakukan statistik.		23.7	60.5	15.8	2.92	.625
6: Formula statistik mudah difahami	1.3	22.4	63.2	13.2	2.88	.630
34: Sangat teknikal	3.9	32.2	53.9	9.9	2.70	.700
17: Menggunakan statistik dalam kehidupan seharian	2.6	34.9	55.9	6.6	2.66	.640
21: Kesimpulan statistik jarang ditunjukkan dalam kehidupan seharian.	2.6	42.8	50.0	4.6	2.57	.627
5: Menghadapi masalah memahami statistik disebabkan cara saya berfikir	5.9	46.7	44.7	2.6	2.44	.648
35: Sukar memahami konsep matematik	7.2	49.3	36.8	6.6	2.43	.724
4: Berasa tidak selamat apabila saya perlu melakukan masalah statistik	10.5	44.7	39.5	5.3	2.39	.747
26: Akan melakukan banyak kesilapan matematik dalam statistik	13.2	47.4	34.2	5.3	2.32	.767
8: Subjek yang rumit.	14.5	53.3	28.9	3.3	2.21	.725
25: Tidak akan menggunakan statistik dalam profesion saya.	11.2	63.2	21.1	4.6	2.19	.688
28: Takut dengan statistik	19.1	49.3	26.3	5.3	2.18	.798
15: Berasa kecewa bila menghadapi ujian statistik	17.1	53.9	27.0	2.0	2.14	.710
11: Tidak mempunyai idea tentang apa yang akan berlaku di dalam kursus statistik	17.8	57.9	22.4	2.0	2.09	.690

33: Statistik tidak relevan dalam hidup saya.	14.5	63.8	19.7	2.0	2.09	.644
18: Berada di bawah tekanan dalam kelas statistik	15.8	67.1	14.5	2.6	2.04	.640
13: Tidak berguna kepada profesion biasa	16.4	67.8	13.2	2.6	2.02	.635
16: Pemikiran statistik tidak terpakai dalam hidup saya di luar tugas saya.	17.1	69.1	11.8	2.0	1.99	.609
7: Statistik tidak mempunyai apa-apa nilai	34.2	59.2	5.3	1.3	1.74	.617

STS = Sangat Tidak Setuju, TS = Tidak Setuju, S = Setuju, SS = Sangat Setuju

5. KESIMPULAN

Kajian ini dijalankan untuk mengenal pasti sikap terhadap statistik dalam kalangan pelajar politeknik. Kajian yang dijalankan didapati terdapat hubungan secara positif dalam sikap terhadap mata pelajaran statistik. Bagi enam dimensi SATS, dapatan sampel menunjukkan skor yang paling positif dalam dimensi sikap pelajar tentang kegunaan, kaitan, dan nilai statistik dalam kehidupan peribadi dan profesional, diikuti dengan sikap pelajar tentang kesukaran statistik sebagai subjek , sikap pelajar mengenai pengetahuan dan kemahiran intelektual mereka apabila menggunakan statistik, perasaan pelajar mengenai statistik, jumlah masa pelajar habiskan untuk belajar statistik dan tahap minat individu dalam statistik. Enam item hasil dapatan yang positif dari kajian ini menunjukkan mata pelajaran statistik bukan sahaja merupakan disiplin yang khusus, tetapi juga merentasi pelbagai bidang seperti sains, teknologi, ekonomi, sosial dan kejuruteraan. Oleh itu penerapan nilai-nilai positif terhadap mata pelajaran statistik dilihat dapat membantu pelajar untuk melihat bagaimana statistik boleh dipelajari dan diamalkan di luar kuliah.

Keseluruhannya, pelajar mempunyai sikap yang positif terutamanya dalam kesungguhan untuk mempelajari subjek ini dengan jayanya. Walau bagaimanapun, masih terdapat peratusan yang tinggi yang melihat subjek statistik ini sebagai rumit, teknikal dan sukar difahami. Justeru, pihak politeknik sebaiknya perlu melihat aspek ini dengan lebih terperinci bagi memastikan para pelajar mempunyai sikap yang lebih positif terhadap statistik.

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INVESTIGATION OF HUMAN MOTION VIBRATION FREQUENCY CONTENT USING FOURIER SERIES

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Abstract. This paper presents the study of frequency content of human motion that is beneficial for micro-energy harvesting devices. In a single-degree-of-freedom (SDOF) vibration based system, the maximum amplitude can be observed when the excitation frequency is equal to the system's natural frequency. A slight mistuned of its natural frequency can significantly reduce the amplitude response. Thus, it is important to investigate the vibrational frequency content of the human motion as it acts as the excitation force to the system. The investigation of the human motion vibrational response was conducted by using Mide 3-axis accelerometer. The accelerometer was strap to a subject weighing at 70 kg and with height of 170 cm. The accelerometer was placed in four different locations, namely the head, wrist, waist and leg. Measurement of the vibration signals was performed with to different scenario which were walking and jogging at the speed of 5 km/h and 9 km/h respectively. Then, the recorded vibration signals were processed using Fourier series to translate the raw time-amplitude signals into frequency-amplitude signals to investigate the vibrational frequency content of the human motion. It was found that the dominant amplitude of the human motion was in the range of 1Hz t0 25 Hz. This finding has given the range of the natural frequency that should be implemented towards designing an energy harvesting devices that is excited by the human motion.

Keywords: Energy Harvesting, Fourier Transform, Human Motion, Renewable Energy

1. INTRODUCTION

Power consumption of mobile gadgets and wireless sensing elements has significantly reduced over the past year. This has been one of the key points of interest in harvesting energy from ambient sources (Carroll & Heiser, 2010). One of the examples is the vibration source. Typically, most vibration based harvesting devices are constructed as a single degree of freedom (SDOF) resonator due to its simplicity for having a mass-spring-damper in its system. This type of vibration resonator produces maximum energy when the excitation energy matches its natural frequency. Slight mistuned of these two frequencies may results in large decrement in power generation. Figure 1 illustrates the schematic diagram of an SDOF system, particularly the base excited system. The input of the system is defined by the displacement of the base and the output response across the spring-damper is governed by the relative displacement between the mass and the base.

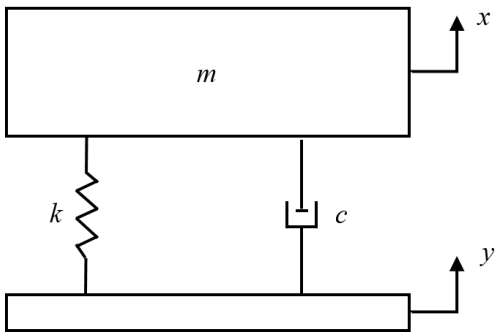


Figure 1: Mass-spring-damper model for base excited system (Rao, 1995).

The equation of motion of the base excited system is given by Eq 1(Rao, 1995):

$$\text{Eq 1: } m\ddot{x} + c\dot{z} + kz = -m\ddot{y}$$

Where m is defined as system's mass, k is the stiffness, c is the damping coefficient, $y = Y_o \sin(\omega t)$ is defined as the displacement of the base, x is the displacement of the mass and z is defined as the relative displacement between the mass and the base, z=x-y. Solving the equation for the response of relative displacement Z_o yields:

$$\text{Eq 2: } Z_o = \frac{m\omega^2 Y}{\sqrt{(k-\omega^2 m)-(\omega c)^2}}$$

Considering that the power is dissipated in the damper, the average power dissipated is given by:

$$\text{Eq 3: } P = \frac{1}{T}\int_0^T c\dot{x}dx$$

Where T is the motion period that can be represented in terms of excitation frequency, ω, $T = \frac{2\pi}{\omega}$. Solving the relative displacement in term of power dissipation results in:

$$\text{Eq 4: } P = \frac{cm^2\omega^6 Y^2}{2\left[(k-\omega^2 m)^2 + (\omega c)^2\right]}$$

Expressing Equation 4 as a dimensionless form by substituting its natural frequency, $\omega_n = \sqrt{k/m}$ and damping ratio, $\zeta = c/2m\omega_n$ gives:

$$\text{Eq 5: } P = \frac{m\zeta Y^2 \left(\frac{\omega}{\omega_n}\right)^6 \omega_n^3}{\left[1-\left(\frac{\omega}{\omega_n}\right)2\right]^2 + \left(2\zeta\frac{\omega}{\omega_n}\right)^2}$$

By observing Equation 5, it emphasised that the maximum power is generated when the excitation frequency is equal to the natural frequency, $\omega = \omega_n$. Thus Equation 5 becomes:

$$\text{Eq 6: } P = \frac{\omega^3 m Y^2}{4\zeta}$$

Equation 6 dictates that the power generated by the systems depends on the cube root of the excitation frequency as well as the square of the input displacement. It is also worth noting that increasing the damper ratio would decrease the power generation. Figure 2 shows the power generation of the system with respect to the frequency input and different damping ratio.

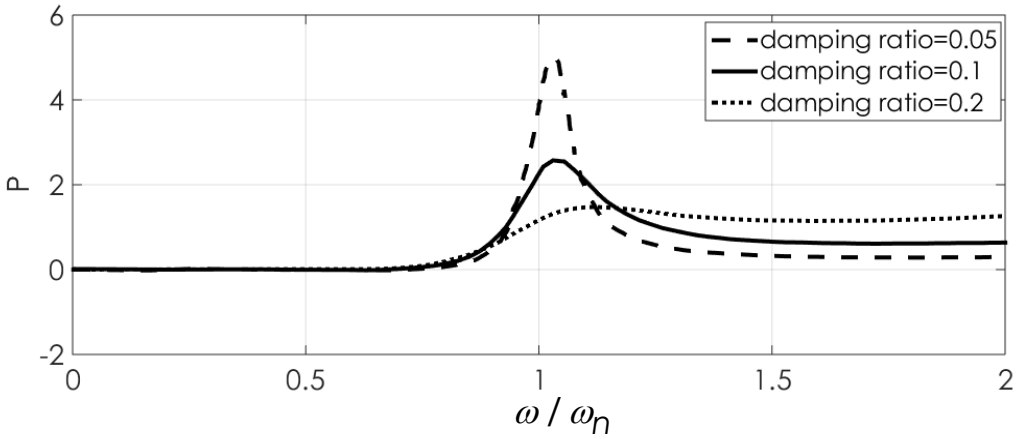


Figure 2: Response of excitation based system

Figure 2 depicts that the optimum power is harvested when the excitation frequency match the system natural frequency. The highest response peak is also achieved with the lowest damping ratio setting. However, the bandwidth of the peak response is slimmer compared to the response with higher damping setting. This makes the system more sensitive towards the excitation frequency. One way of increasing the bandwidth response is by increasing the damping ratio. This however, will sacrifice the peak power that could be harvested. These characteristics of the SDOF base excitation system shows that in order to achieve optimum power harvested, the excitation frequency of the applied input should always be in range of the systems natural frequency. Thus, it is important to identify the frequency range of the human motion so that a vibration based energy harvesting device can be designed with its natural frequency tuned specifically to the human motion. The content of this paper is organised as follows. Next section discusses the method of measuring the human motion with the accelerometer placed at different location as the subject walk and jogs at 5 km/h and 9 km/h respectively. The following section describes the analysis and process of the measured signals using Fourier Series to investigates the distribution frequency of the human motion signals in term of frequency.

2. HUMAN MOTION SIGNAL MEASUREMENT

During the signal measurement, a volunteer subject weighing at 70 kg and with height of 170 cm was utilized for the signals recording. The subject was strap with an accelerometer (MIDE Slam Stick Vibration Data Logger) at the location of head, wrist, waist and leg. This location was selected due to the placement of recent electronic gadget at the said location. For example, a Bluetooth headset or ear buds are placed on the head, sport monitoring devices placed near the legs or integrated within the shoes and smart watches are strapped on the wrist. The vibration recorder was able to record signals in the vertical, fore and aft, and lateral direction or x, y and z-axes respectively. The vibration recorder was strapped tightly to each chosen location so that the relative motion between the subject and the vibration recorder were eliminated or at least reduced until the relative motion can be neglected. The measurement of the vibration motion was executed when the subject starts to walk with 5 km/h and jog with 9 km/h on a treadmill. The measurement was carried out on a treadmill so that the speed variable is consistent for each period of measurement and steady state of the vibration motion could be achieved.



Figure 3: Example of experiment setup for human motion measurement

The vibration recorder was configured with 5 kHz sampling rate. After the measurement, the raw data was filtered with low-pass filter with cut off frequency of 1 kHz to eliminate noise during its measurement. Figure 4 shows some of the recorded signal in term of time histories with a period of 10 seconds.

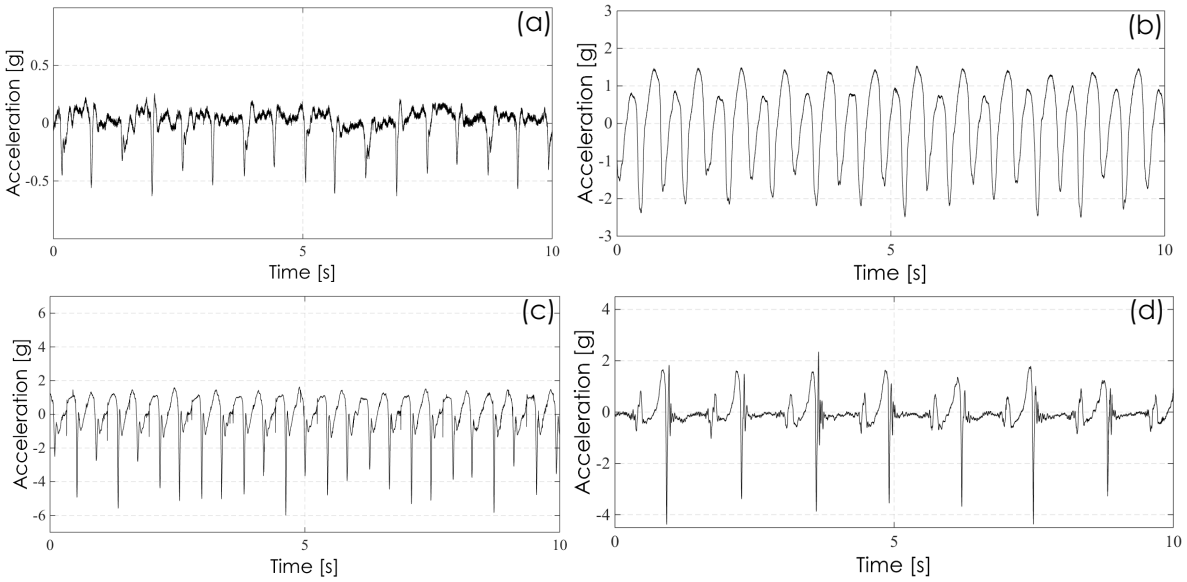


Figure 4: Measurement results: (a) Head, 5 km/h, z-axis. (b) Wrist, 9 km/h, y-axis. (c) Wrist, 9 km/h, z-axis. (d) Leg, 5 km/h, y-axis.

The results from all measurement depicts that the amplitude increases as the speed of activities increases. In general, the signals in x-axis recorded weak responses. While for the y, and z-axis, the strength of the signals depended on speed of activities and location of the recorder. For example, the strength of the waist signals is higher in the direction of z-axis compared to y-axis. However, for the leg signals, the strength of y-axis is greater than of the z-axis. It also depicts that the signals measured form the legs produced high pitch amplitude signals. This is due to the shock motion of the leg impacting with the floor surface. Similar results are also observed in the study done by Fan et al. (2017). This shows that the orientation of the axis also plays a role in determining the design of the energy harvesting device. Correct orientation of the device according to it location should yields optimum power generation.

3. FREQUENCY CONTENT OF HUMAN MOTION VIBRATIONAL SIGNAL

In order to identify the bandwidth frequency of the measured signals, the signals are processed using Fourier Series. In term of vibration signals, the signals are comprise of several harmonics. Fourier Series decomposed each of the signals into a sum of sinusoidal signals (Ramlan et. al., 2011). The decomposed signals can be then plotted according to its frequency and also magnitude. The Fourier Series are given by Equation 7 (Stroud, 1996).

$$\text{Eq 7: } a(t) = \sum_{n=1}^{\infty} \left\{ a_n \cos(n\omega t) + b_n \sin(n\omega t) \right\}$$

Where *a(t)* are the measured acceleration in steady state, ω is the fundamental frequency, a_n and b_n is the Fourier coefficients. The Fourier Coefficients can be calculated using Equation 8.

$$\text{Eq 8: } a_n = \frac{2}{T}\int_0^T a(t)\cos(n\omega t)dt$$

and

$$b_n = \frac{2}{T}\int_0^T a(t)\sin(n\omega t)dt$$

Whereas the magnitudes of the Fourier coefficients, c_n and it is given by:

$$\text{Eq 9: } c_n = \sqrt{a_n^2 + b_n^2}$$

Figure 5 shows the time history signals from Figure 4 constructed to frequency domain (spectra) plot.

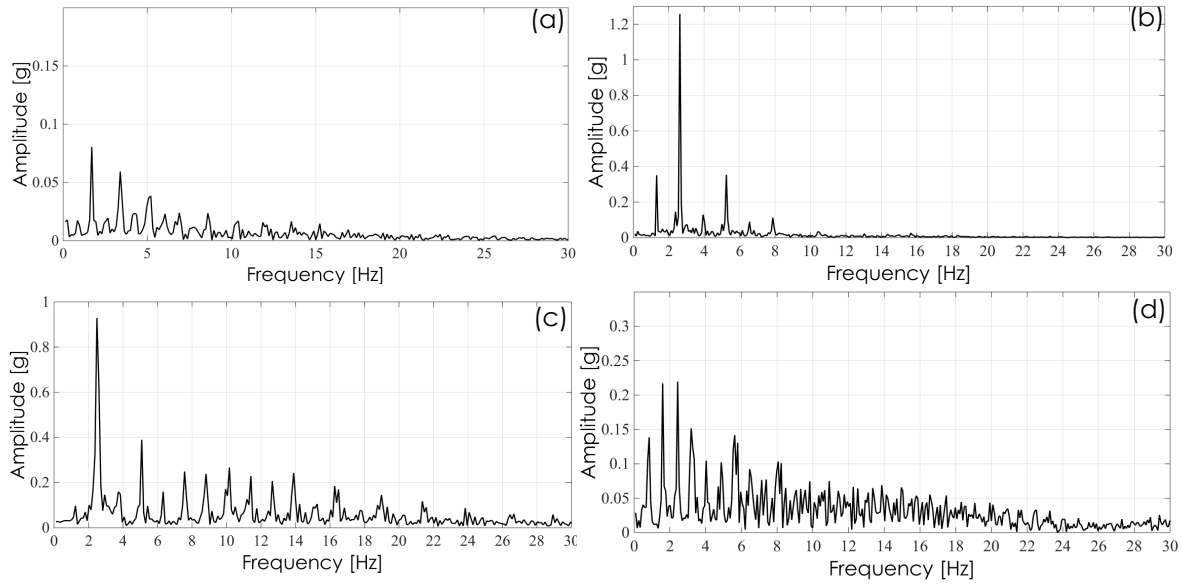


Figure 5: Frequency against amplitude plot: (a) Head, 5 km/h, z-axis. (b) Wrist, 9 km/h, y-axis. (c) Wrist, 9 km/h, z-axis. (d) Leg, 5 km/h, y-axis.

From Figure 5, it is worth noting that the peak dominant amplitude is at different frequency for each case. For example, in the case of head, 5 km/h, z-axis, the peak amplitude lies at the frequency of 1.694 Hz. While for the case of wrist, 9 km/h, y-axis, the peak amplitude is at 2.624 Hz. This shows that by increasing the speed of activities, the number of motion oscillation also increases in a given period of time, thus making the peak amplitude lies in the higher frequency region compared to slower activity speed. Figure 5 also shows that effective the bandwidth of amplitude differs for each case. In the case of Figure 5(d) the effective bandwidth spans from 1 Hz until 23 Hz even though the peak amplitude is much lower than in

Figure 5(b) which from observation registered a narrower effective frequency bandwidth (1Hz to 8 Hz) than Figure 5(d). Table 1 lists the peak amplitude and its corresponding frequency for each of the human motion. From the table, the peak amplitudes is shown scattered in the region of 0.790 Hz up to 3.696. For most cases of measurement location, it can be seen that 2 out of 3-axis of measurement would have the same peak frequency amplitude. This shows that most of the human motion would have similar oscillation response in 2 of its axis.

Table 1: Peak Amplitude and its corresponding frequency for all experiment measurement

Location	Activity Speed [km/h]	Axis	Peak Amplitude [g]	Peak Frequency [Hz]
Head	5	x	0.1723	0.847
		y	0.0626	1.694
		z	0.0805	1.694
Head	9	x	0.0901	1.312
		y	0.2831	2.542
		z	0.6282	2.542
Wrist	5	x	0.7999	0.904
		y	0.1666	0.904
		z	0.1786	1.695
Wrist	9	x	0.2053	1.312
		y	1.2580	2.624
		z	0.7318	2.624
Waist	5	x	0.1006	0.790
		y	0.1183	1.695
		z	0.1449	4.972
Waist	9	x	0.1219	1.243
		y	0.2010	2.486
		z	0.9289	2.486
Leg	5	x	0.05166	0.840
		y	0.2198	2.436
		z	0.3350	2.436
Leg	9	x	0.1290	2.436
		y	0.6140	1.260
		z	0.3888	3.696

Compiling all of the frequency response for each measurement into a single plot would illustrate the effective frequency bandwidth of the vibrational human response as shown in Figure 6. The graph depicts variability of the magnitude and frequency content. This is due to the different body part location. For example, the response from head and wrist, the motion commonly lie in the bandwidth below 10 Hz. Whereas for the waist motion, the signals sweeps below 20 Hz region and for the leg motion, the signal harmonics produced is higher than 25 Hz region. In general, the graph shows that the desired frequency with high amplitude is in the 5 Hz and below frequency region and it also shows that the utmost frequency range of effective vibration response of human motion lies in the region of 25 Hz and below. This suggests that any energy harvesting device that receives input from human motion response should be design with its natural frequency below 25 Hz, the optimum natural frequency would be in the range of 0.84 Hz until 5.085 Hz specifically. The research done by Ylli et al. (2015) showed that the leg step frequency to be in the range of 0.82 Hz to 1.2 Hz. Even though that their motion was measured at the speed of activities ranging from 4 km/h to 10 km/h the findings of both work are considered comparable. Whereas the, frequency content measured by the work done by Halim et al. (2016) is in the range of 0.9 Hz to 4.9 Hz for the activities of hand-shaking, walking and slow-running.

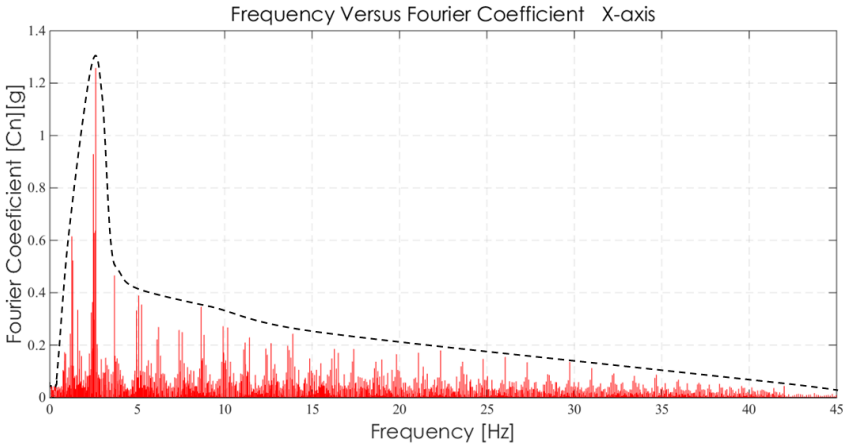


Figure 6: Effective bandwidth of vibrational human response.

4. CONCLUSION

This study has presented the investigation of human motion vibrational frequency content. The investigation was conducted in order to find the suitable natural frequency of an energy harvesting device that receives input from human motion. The signals of human motion were measured using a 3-axis accelerometer placed in four different locations, namely the head, wrist waist and leg. The time histories signals of each measurement were processed using Fourier Series to investigate the frequency content of each signals. The results show that the effective bandwidth of human motion frequency response is below 25 Hz range and the most optimum frequency is in the region of 0.84 Hz to 5.085 Hz. Therefore, in order to design a vibration based energy harvesting device that receives input from human motion, the natural frequency of the harvesting device should be tuned according to the optimum region frequency. The study also shows that the axis of orientation also determines the peak response of the human motion and each location would have different peak response orientation. Aligning the harvesting device to the correct orientation would improve its harvesting capability. By doing such tuning and alignment, it will ensure that maximum energy could harvested from the human motion.

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DETERMINATION ON THE ULTIMATE TENSILE STRENGTH OF DIFFERENT COMPOSITION OF POLYMER BLEND THROUGH EXTRUSION OF PVC-ABS-PP

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Abstract. This is a study on analyzing and determining the effects on different composition of material after extrusion process and the mechanical properties obtained from the experiment. The material involved in this experiment is ABS, PVC and PP where PVC acts as the main material. This experiment will involve a few machines and the method used in this experiment is by processing the polymer blend into an extruder according to the standard of ASTM. The next step is to process the material into a crusher before it is transferred to a hot press as a step to prepare the sample cutter for Tensile Test. Tensile Test is one of the most widely used medium in mechanical testing. By measuring the force required to elongate a specimen to breaking point, material properties can be determined. From the experiment, the data gained through a stress strain curve will be compared by each combination and the highest value of the Ultimate Tensile Strength will be the reference. The result shows that the combination of material with the main material that is PVC+ABS shows the best ultimate strength.

Kata Kunci: PVC, ABS, PP, Tensile test, Stress Strain Curve

1. INTRODUCTION

Polymer is one of the three classifications of a matrix composite besides metal matrix composites and ceramic matrix composites. It consists of polymer resin as the matrix and it is divided into three aspects that are thermosetting, thermoplastics and rubber. Polymer is widely used due to the characteristic that is ease of processing, light of weight and desirable mechanical properties (Lemaitre, 1990). Polymer or plastics extrusion is a high volume manufacturing process in which raw plastic material is melted and formed into a continuous profile. Raw thermoplastic material in the form of small beads which is often called as resin in the industry is gravity fed from a top mounted hopper into the barrel of the extruder (Lemaitre, 1990). Extrusion technique is very versatile, and it can be adapted to produce wide range of products. Some of the applied polymer extrusion processes are a co-extrusion molding in which two or more polymers are combined in a single process to produce a multi-layer film of the required mechanical properties. A polymer that is applied under different processes will result a different characteristic. In some applications, the mechanical properties will be the prime of interest while others of the physical properties will be the major concern (Crosara, 2007). Tests such as tensile tests will be applied onto the polymer in identifying the changes in the characteristics and the observation will be done on the surface morphology.

This research is to examine the characteristic of polymer after it is extruded by a different composition between polymers which is also known as polymer blend. The purpose of this

research is also to figure out the behaviors of plastic after applied process by different composition. The material will undergo through tensile test that will be done in a required experiment based on the reference standard of American Standard Testing Material (ASTM D638).

Polymer is found out to be a solution as an alternative in many aspects these days. The specialty and benefits of a polymer especially for human beings these days has widened the use of it in variety of ways. The criteria that synchronized with its benefits such as it requires lower costs compared to the other matrix composite apart from it is lighter in weight, friendly user, easy to manufacture and a lot more (Lemaitre, 1990). Research is being done until nowadays to establish the use of a polymer in ensure the better quality from many aspects such as the strengths and appearances. Inventions have been done since years in obtaining the best research in engineering of polymer.



Figure 1: Polymer Resin

2. LITERATURE REVIEW

The polymer plastics can be classified into two cases that are thermoplastics and thermosetting plastics (G'sell & Jonas, 1983). Thermoplastic polymers consist of the four most important commodity materials that are polyethylene, polypropylene, polystyrene and polyvinyl chloride. The term 'thermoplastic' indicates that these materials melt on heating and may be processed by a variety of molding and extrusion techniques. Thermoplastics offer many advantages over traditional materials including: low density, low energy for manufacture and low processing costs.

Polyvinyl chloride or PVC rigid, is a widely used thermoplastic polymer. In terms of revenue generated, it is one of the most valuable products of the chemical industry. Globally, over 50% of PVC manufactured is used in construction. Despite appearing to be an ideal building material, concerns were raised about the costs of PVC to the natural environment and human health. PVC also is widely used as dashboards and car parts in automotive industry.

Acrylonitrile butadiene styrene or ABS chemical formula $(C_8H_8 \cdot C_4H_6 \cdot C_3H_3N)_n$ is a common thermoplastic used to make light, rigid and molded products such as piping, automotive body parts, wheel covers, enclosures and protective head gear.

Polypropylene or polypropylene (PP) is a thermoplastic polymer, made by the chemical industry and used in a wide variety of applications, including food packaging, loudspeakers, automotive components, and polymer banknotes. [1]. It can also be made opaque and or have many kinds of colors. Polypropylene has very good resistance to fatigue, so that most plastic living hinges, such as those on flip-top bottles, are made from this material.

After materials are extruded, the extrudate might need to be crushed before hot isostatic press process is to be applied. This is due to the requirements of the added compositions and also, values for new mass must be calculated so that there will be enough materials to be pressed. Tensile strength is also the process to be applied onto the specimens after extrusion

process and the problem occur since the tensile strength of polymers tends to degrade with increasing temperature. Since the materials have been through hot isostatic press also, the structure might not perform well since there might be void for some parts of the plate being hot pressed and this will affect the tensile strength.

From this experiment, we are going to determine the best material out of the combination from PVC and ABS to provide better mechanical properties and produce better end products.

3. METHODOLOGY

In implementing this project, there are some procedures to be applied in obtaining the best output. As stated in previous chapters, polymers that are to be used are the Polyvinyl Chloride (PVC soft), Polypropylene (PP) and ABS. The most important thing is the composition before it is mixed and being processed.

3.1 Mixing Stage.
Mixing Stage that includes a 60:40 composition of material. In this experiment, PVC is used as the main material so it will be presented by 60 percent and the rest of the composition is the other materials. Polyvinyl Chloride (PVC soft) will be added by 60 percent of composition with 40 percent of Acrylonitrile Butadiene Styrene (ABS) and the process is repeated to Polypropylene as well. The mixed material will be poured into extrusion machine.

3.2 Extrusion Process.
Extrusion is the process to be applied after the exact composition has been calculated and mass measured, the following process is to extrude the materials. Thermo Haake Extruder is used in this experiment. The ASTM standards for Extrusion is ASTM D5422.



Figure 2: Thermo Haake Extrusion Machine

Table 1 Table for extruder test parameter for PVC, ABS and PP

Material	Extruder	Screw, Feedings, Preparation	Temperature [° C]				
			Feeding	1st zone	2nd zone	3rd zone	Die
ABS	25	2,3	A	195	200	205	210
PVC soft	25	2	A	120…150	140…160	210…230	210…230
PP	25	2,3	A	140…180	160…200	210…230	210…230

3.3 Crusher

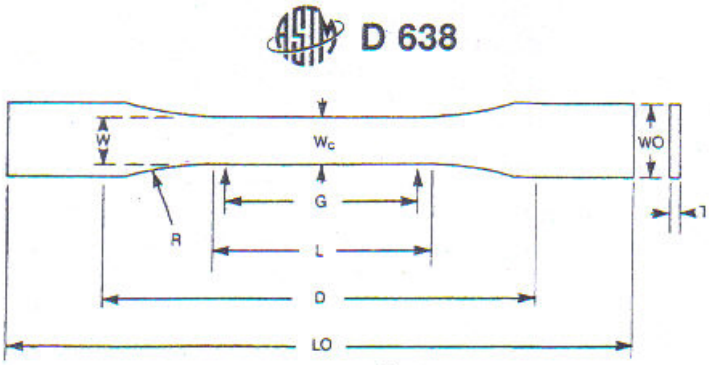
The crushed material is put into a Hot Isostatic Pressing Machine which is one of material processing methods. In this step, the combination is pressed by the category to meet the requirement before the next procedure.

3.4 Sample Cutter

After being hot pressed into plate, the material needs to be cut into sample for testing procedure. This procedure is done by referring to the standard of ASTM D6348. The standard of sample is as below.



Figure 3: The material is being shaped into the required form



Dimensions (see drawings)	Specimen Dimensions for Thickness, *T*, mm (in.)[A]					Tolerances
	7 (0.28) or under		Over 7 to 14 (0.28 to 0.55), incl	4 (0.16) or under		
	Type I	Type II	Type III	Type IV[B]	Type V[C,D]	
W—Width of narrow section[E,F]	13 (0.50)	6 (0.25)	19 (0.75)	6 (0.25)	3.18 (0.125)	±0.5 (±0.02)[B,C]
L—Length of narrow section	57 (2.25)	57 (2.25)	57 (2.25)	33 (1.30)	9.53 (0.375)	±0.5 (±0.02)[C]
WO—Width overall, min[G]	19 (0.75)	19 (0.75)	29 (1.13)	19 (0.75)	...	+ 6.4 (+ 0.25)
WO—Width overall, min[G]	...	...	...	...	9.53 (0.375)	+ 3.18 (+ 0.125)
LO—Length overall, min[H]	165 (6.5)	183 (7.2)	246 (9.7)	115 (4.5)	63.5 (2.5)	no max (no max)
G—Gage length[I]	50 (2.00)	50 (2.00)	50 (2.00)	...	7.62 (0.300)	±0.25 (±0.010)[C]
G—Gage length[I]	...	...	...	25 (1.00)	...	±0.13 (±0.005)
D—Distance between grips	115 (4.5)	135 (5.3)	115 (4.5)	65 (2.5)[J]	25.4 (1.0)	±5 (±0.2)
R—Radius of fillet	76 (3.00)	76 (3.00)	76 (3.00)	14 (0.56)	12.7 (0.5)	±1 (±0.04)[C]
RO—Outer radius (Type IV)	...	...	...	25 (1.00)	...	±1 (±0.04)

Table 2 Table of ASTM specimen for Tensile Test
(Source : ASTM Volume 01.03-05)

3.6 Tensile Testing

Testing test is the final stage of testing on the specimen. From this tensile test, the result obtained from the stress strain curve will be measured. The data from the highest Ultimate Tensile Strength will be referred as a comparison to determine the best outcome among the combination.



Figure 4: Specimen Undergo Tensile Testing

4. RESULTS AND ANALYSIS

Result from the methodology used in precious section is fully elaborated. The element will be discussed such as a comparative analysis with three different material according to specification. Below is the result obtained from Tensile test.

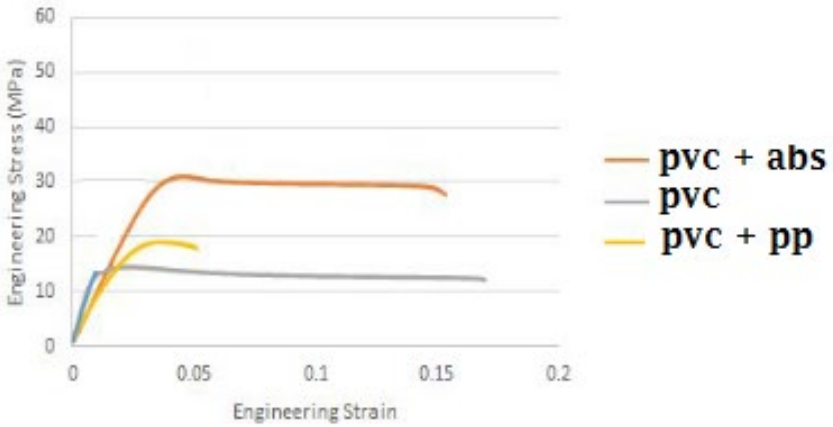


Figure 4 Graph of Stress vs Strain of PVC, PVC+ABS and PVC +PP

Table 2: Result Obtained From The Stress Strain Curve

No	Material	Ultimate Tensile Strength (N/mm^2)	Sample Preparation (m^2)	Maximum Load (N)	Area of Specimen (m^2)
1	PVC + ABS	29.88	3.375×10^{-5}	1803.23	3.375×10^{-5}
2	PVC + PP	18.53	3.375×10^{-5}	1803.23	3.375×10^{-5}
3	PVC	13.33	3.375×10^{-5}	1803.23	3.375×10^{-5}

As for polymer, some stress strain curves might look similar to ones for metals, polymers are mechanically different than metals (Crosara, 2007). A highly elastic polymer may stretch over 10 times the original length before breaking, while a metal might elastically stretch 10% of the original length elastically and may stretch plastically to double the original length before

reaching its fracture point. As seen in the figure below, the highest ultimate strength shows that for combination for PP and ABS has the highest value in the graph of stress strain curve (Crosara I, M. (2007). The Ultimate tensile strength (UTS) is the maximum stress that a material can withstand while being stretched or pulled. Data obtained from the result also shows that the combination of PP and ABS shows the best outcome.

5. CONCLUSION

The result shows that the combination of material with the main material that is PVC and ABS as a new material can stand a better strength and it is proved from graph of stress and stress curve for the experiment of Tensile Testing.

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DESIGN AND FABRICATION OF BELT CONVEYOR FOR NVH FIBER

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Abstract. In the industry, the raw material and products need to be transported from point to point. Material handling equipment is necessary where they are designed such that they fast, safe and cheap. Belt conveyor is the material handling equipment used in a conveyor setup from one end of a conveyor to another end of the conveyor to transport materials from the current invention. In this project, a belt conveyor needs to be developed where there was a gap between two machines that bring the raw material of carpet floor fall on the floor during the production process. The belt conveyor is designed by using Catia V5R21 and a fabrication of belt conveyor is needed to reduce the amount of NVH Fiber fall on the floor. The method that has been used in this project is CDIO concept where it represents Conceive, Design, Implement and Operate. The successful completion of this research work has generated design for industrial uses to convey the raw material of carpet floor which is fast and efficient. The drive mechanism modification suggested to improve the performance and reduce maintenance cost.

Keywords: Belt Conveyor, Carpet Floor, NVH Fiber, CDIO

1. INTRODUCTION

ABC Engineering Sdn. Bhd is a leading company which is well recognized for the quality of its automotive floor carpet. The automotive floor carpet is mounted on the car's floor. The product that ABC Engineering produces is of high durability as it is made of NVH (Noise, Vibration, and Harshness) Fiber material containing 3 different Fibers which are Low Melt, Black and Recycled fibers.

The production of carpet floor is known to be the major contributor to the profit gained by ABC Engineering Sdn Bhd. This product is made from NVH Fiber material where it excellently absorbs the noise. This project was conducted at the production process of the carpet floor where the issue is the NVH Fiber falling on the floor during the transfer process. This problem occurs between the carding machine and the lapping machine. This happens because there was a gap between these two machines.

In this project, a material handling system needs to be developed to make sure that the NVH Fiber does not fall on the floor during the production process of carpet floor. One of the material handling systems that is suitable to convey this NVH Fiber to the lapping machine is the belt conveyor. The research needs to be run in order to achieve the target. This project will begin with the literature review, methodology, data analysis and conclusion.

2. LITERATURE REVIEW

2.1 Noise, Vibration and Harshness
Noise, vibration, and harshness (NVH) is a study and alteration of vehicle noise and vibration features, especially motor vehicles and trucks. According to Sobieszczanski-Sobieski et al.,

(2001) interior NVH deals with noise and vibration experienced by cabin occupants, while NVH's exterior is largely concerned with vehicle-radiated noise and includes drive-by-noise tests.

2.2 Belt Conveyor

A belt conveyor is the carrying medium of a belt conveyor scheme. One of the many kinds of conveyor systems is a belt conveyor system. A belt conveyor system comprises of two or more pulleys. One or both of the pulleys are driven, pushing the belt and the material on the belt forward. The powered pulley is called the pulley of the cycle while the powerless pulley is called the idler pulley.

Figure 2.1 shows the belt conveyors are used in a conveyor setup from one end of a conveyor to another end of the conveyor to transport materials from the current invention. To transport material at a required job site over a comparatively lengthy range, one strategy is to build a belt conveyor assembly that is continuously installed on the floor. The cost and time associated with the construction of the conveyor assembly, as well as the lack of mobility of the conveyor system in the event of a need or desire to move to a new worksite, are the limitations of such conveyor assemblies (Felton & Us, 2019).



Figure 2.1: Belt conveyor (Bhosale & Gaur, 2017)

2.3 Design Consideration of Belt Conveyor

2.3.1 Belt Dimension, Capacity and Speed

According to Taiwo et al., (2005) the driver and driven pulley diameter are identified by the type and dimension of belt conveyor. The size of the belt depends on the diameter and the center of the pulley.

2.3.2 Roller Diameter

Roller conveyor is the device used to move the materials over a set road (Bhosale & Gaur, 2017). According to Daniyan et al., (2014) the roller supports the belt and makes the belt conveyor easy and safe to rotate in all directions. Based on the Figure 2.2, the right diameter of the roller must consider the width of the belt.

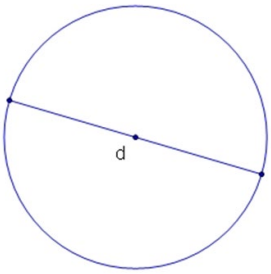


Figure 2.2: Roller diameter (Wikimedia Commons, 2020)

2.3.3 Belt Power and Tension

To move the belt at the conveyor, enough power is required. The power needed depends on the length of the belt. The longer the belt length, the greater the power needed for the conveyor to move, and the greater the lift's vertical reach, the greater the power needed (Daniyan et al., 2014).

According to Daniyan et al. (2014) the rotation of the electric drive gives an impact load to the belt of the conveyor. Figure 2.3 shows the rotation of the belt conveyor. The belt tension must be sufficiently large to avoid slipping between the drive pulley and the belt (Besser Service Bulletin, 2006). The stress in the belt will be higher than the steady state during the beginning of the conveyor system.

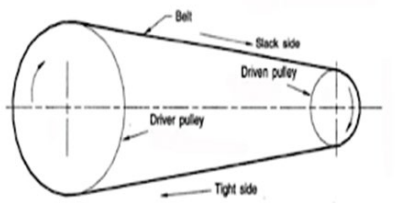


Figure 2.3: Rotation of belt conveyor (Design of Transmission Systems, 2020)

2.3.4 Motor

The belt conveyor is rotated based on electric motor where it converts the electrical energy into mechanical energy. It is mainly driven by motors operating the pulley to continuously push the chain (Shuyuti, 2017). Belt conveyors are usually operated by pulleys or sprockets installed on drive shafts driven by a motor and drive train, including a gearbox, a power transmission belt or a roller chain.

3. METHODOLOGY

The empirical and systematic analysis of the approaches used in the field of study is called a methodology. The significant feature of the Conceive Design Implement Operate (CDIO) is one of the educational framework initiatives to develop deep learning of the disciplinary knowledge base while there is a simultaneously developing personal, interpersonal, product, process and system building skills.

i. Conceive - Description of customer requirements
ii. Design - Creation of the design
iii. Implement - Transforming the design into the product
iv. Operate - Use of the product to deliver the intended value

3.1 Conceive

This method is used to understand the problem that occurs. Problem has been detected during the production process of the carpet floor. Specifically, the problem arising while producing the floor carpet is the NVH Fiber falling on the floor after the carding process. This happens because there was a gap between the carding machine and the lapping machine so the NVH Fiber be transferred smoothly to the lapping machine.

3.2 Design

3.2.1 Concept Design

Figure 3.1 shows the concept design of the belt conveyor that will be used to transfer the NVH fiber that falls on the floor. This conveyor will be generated by the motor located below the conveyor by transmitting the power to the sprocket and chain and finally, moving the belt. The structure of this belt conveyor is not strong enough to hold the tension of the belt in the beginning because of the high torque from the motor. This will make the belt conveyor vibrate, and causing the fiber to fall back on the floor.

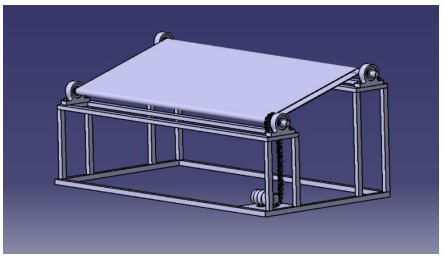


Figure 3.1: Concept design of belt conveyor

3.2.2 Appropriate Design

Figure 3.2 shows that the structure of the belt conveyor that is rigid and strong enough to hold the force when the belt starts to move. This design is better compared to the belt conveyor in Figure 3.1. The belt conveyor can operate without fail if the supporting structure is aligned accurately in all planes.

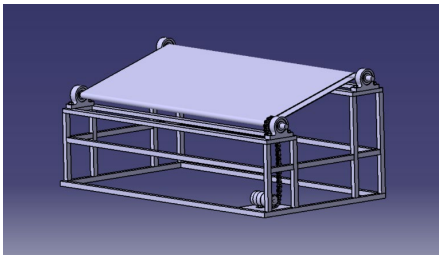


Figure 3.2: Appropriate design of belt conveyor

3.3 Implement

3.3.1 Frame

Once the design, location and budget have been approved for the conveyor, the process of fabricating and assembling the conveyor begins. Figure 3.3 shows the fabrication of the frame structure.



Figure 3.3: Fabrication frame of belt conveyor

3.3.2 Supporting and Shaft

After the frame of the belt conveyor has been fabricated, the supporting shaft must be installed. Based on the Figure 3.4, the supporting shaft used to fabricate this belt conveyor is pillow block bearing housing with an inner dimension of 20 millimeters.



Figure 3.4 Process of installing the pillow block bearing housing

3.3.3 Sprocket and Chain

Once the supporting shaft and shaft have been installed, the drive mechanism that is used to drive the shaft is using the sprocket and chain as Figure 3.5.



Figure 3.5: The sprocket and chain that installed at the shaft

3.3.4 Motor and Rubber Belt

When the sprocket and chain has been installed, the motor and rubber belt need to be installed. The motor installation started by using a plywood as the base for the motor. When the base is ready, the motor will be installed on the base by using 4 screws. The last part that needs to be installed is the rubber belt. Based on the Figure 3.6, the dimension for the belt is 1120 millimeters for the length and 1400 millimeters for the width.



Figure 3.6: The installation of motor and rubber belt

3.4 Operate

The last process for this CDIO concept is operate. In this phase, it will show the function and how to use the belt conveyor. Table 3.1 shows the standard operating procedure of the belt conveyor.

Table 3.1 (a – c): SOP for the belt conveyor

Standard Operating Procedure			
Model	**Part Name**	**Process Name**	**Machine Name**
XXX	Carpet Floor	Convey NVH Fiber	Belt Conveyor
Working Instruction			
a) 		I. Firstly, the drive mechanism must be lubricated before operating the belt conveyor. II. Notice at the surface of the rubber belt whether have interference or not.	

b) 	III. Switch on the main control of the belt conveyor. IV. Notice the condition of the belt conveyor whether it operate in normal condition.
c) 	V. Switch off the main control of the belt conveyor. VI. The area of the belt conveyor must be cleared especially at drive mechanism to prevent any problem from happen at future.

4. RESULTS AND ANALYSIS

4.1 Before and After Using Belt Conveyor

Based on Figure 4.1, shows the weight of the drop fiber and the length of rolls for the carpet floor before and after using the belt conveyor. Based on the collecting data of drop fiber, the higher and lowest weight of the drop fiber before using the conveyer belt is 4 kg and 2 kg. After applying the belt conveyor, the weight of the drop fiber decrease to 1.2kg at the high weight and 0.8 kg at the lower weight per role. The percentage decrease is about 80% of the drop fiber weight when using the belt conveyer between the carding machine and the lapping machine. Figure 4.2 is referring to the length roll carpet before and after using the belt conveyer. A length recorded before and after using the belt conveyer is 85m and 87m. The length of the roll carpet floor increase about 2.35% after using belt conveyor, thus can produce more carpet floor to meet the customer demand.

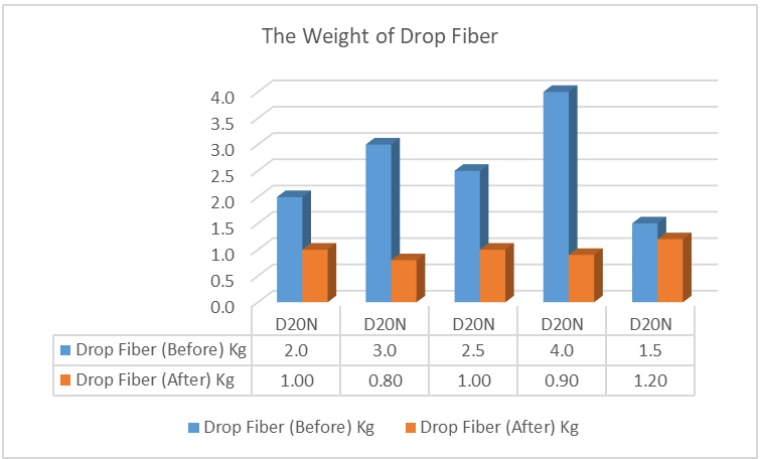


Figure 4.1: The weight before and after using belt conveyor

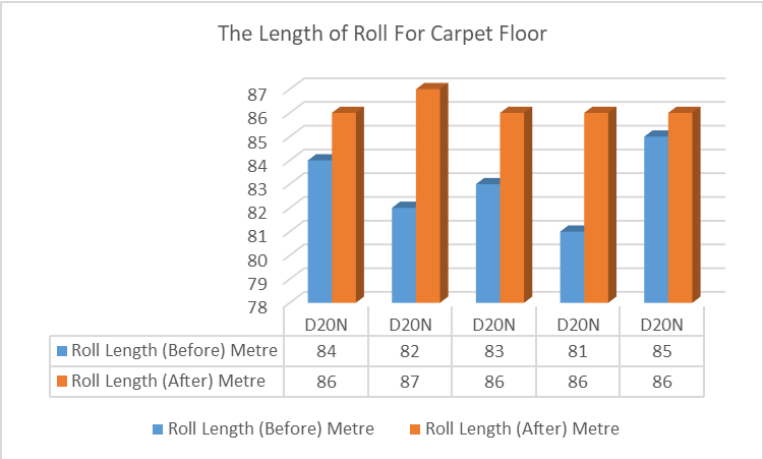


Figure 4.2: The length of roll for carpet floor before and after using belt conveyor

5. CONCLUSION

In conclusion, this project identified the problems associated with the carding machine and lapping machine where there was a gap between these two machines. The CDIO concept was implemented for generating many ideas and methods to solve the problem. The study is aimed to fulfill the objectives of the study, which are to design and fabricate a belt conveyor for NVH Fiber and to reduce the amount of NVH Fiber that falls on the floor by using a belt conveyor. Based on the data that has been collected after using belt conveyor, the weight of the NVH Fiber fall on the floor is decrease where it around 0.8kg to 1.2kg per roll. This prove that by using belt conveyor can reduce the amount of NVH Fiber that falls on the floor.

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AGRO-TECH CLAY BRICK

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Abstract. Construction is an activity that involves the use of technology and building materials such as wood, cement, aggregate, metal, brick, and concrete. The materials used depend on the design of the building as contained in a building contract document. One of the most commonly used building materials is brick. Brick is a material often used to make walls and pavements. Rapid development activities in construction lead to high demand for building materials and there is an increase in cost every year. Therefore, researchers have innovated in the manufacture of clay bricks that is to reduce the use of clay in bricks by adding agricultural waste material to rice husk ash. This can reduce the cost of processing clay and at the same time apply the elements of green technology in the manufacture of clay bricks. There are three laboratory tests that have been done namely compression test, water absorption and moister content. The analysis obtained that the lowest water absorption percentage for clay bricks with 10% RHA is 24%, the highest compressive strength is 15.5 N / mm2 with 10% RHA and the lowest moisture content value is 24% with 10% RHA. Therefore, the researchers found that the use of rice husk ash is able to be an additive in soil bricks because its strength and durability tests successfully surpass the set standards. In conclusion, the use of 'Agro Tech Clay Brick' as a new innovation is better than the existing clay bricks because this feature has reached the standard, reduced production costs, reduced the amount of agricultural waste disposal, protects the environment from pollution and serves as an efficient material energy to build and also be environmentally friendly.

Keywords : Clay Brick, Agricultural waste, Rice Husk Ash (RHA),

1. INTRODUCTION

Rapid development in construction industry sector leads to positive economic growth. Growth activity in the third quarter of 2017 shows an increase of growth rate in the infrastructure and civil engineering sub-sector at 18.0%. The increasing in this construction activity will causing an increase in demand for building materials. Material production domestic construction varies from year to year on several types main building materials.

The construction activities can adversely affect the environment if it is not well planned. The production of building materials generally uses a source of electricity in every process involved. This will result in the generation of greenhouse gasses emissions. Therefore, the use of low-cost building materials with an equivalent quality with the existing products is very important in reducing construction costs and will reduce the effect of the environmental pollution. The usage of agricultural waste such as rice husk ash in building materials production will open some opportunities for manufacturers in producing more environmentally friendly products. Moreover, the volume of agricultural waste can be greatly reduced, and the farmers will get profit in rice husks sales. Therefore, others benefit of green product in construction material will reduce the calculation of carbon footprint and had significant impact towards greenhouse effect.

Construction industry help researchers to identify a suitable material to completely replace Portland cement in concrete. Previous research focused on the technology to detect alternative materials to replace part of the cement in concrete with new material called 'supplementary cementing materials' (SCM). As awareness of the importance of environmental conservation, research and sustainable concrete green concrete were carried out. There are a few alternative methods in order to solve the problem mentioned above. Some researchers have used rice husk ash (RHA) in concrete mixtures as a partial re-placement of cement. The usage of new cement substitutes from industrial or agricultural waste as the solution towards high dependency of building toward cement supply. This is because the shortage of cement supply which occurred during last century not only caused hardship in obtaining cement but has shot the prices of cement up causing the cost of all building materials made of cement increase as well. Research about ongoing. Therefore, the creation of a new material is not only avoiding the disposal of agriculture waste but also able to contribute towards improvement of Malaysian construction technology.

The increasing in human population were directly causing high demand in the food production industry as well as agricultural activities including an increase in rice demand. Rice is a staple food for most countries in Asia. Therefore, the agricultural waste for rice cultivation is rice husk. Accordingly, researchers have chosen this rice husk as a study material in the production of clay bricks. The rice husk should be burned to ashes. Rise husk ash also known as RHA is an agricultural waste that has the potential to be used as 'supplementary cementing materials' (SCM). The use of RHA as SCM can indirectly reduce the volume of agricultural waste dumped into landfills. Therefore, the proper use of RHA can also reduce environmental pollution. Thus, researchers have chosen RHA as an additive in the production of clay bricks that can reduce the cement content.

2. LITERATURE REVIEW

Bricks is a part of building materials that are widely used as walls, pillars and pavements. Generally, rectangular bricks are made of hard, rugged inorganic materials. Its size and weight are designed to be easy to hold with one hand. The length measures 2 times the width, mixed with the thickness of 1 layer of mortar bond, the thickness is approximately 2/3 the width of 216 mmx 103 mm x 65 mm. there are many types and forms, depending on the type and source of the raw material, the method of manufacture and its use.

High quality brick should have properties such as having a sufficient and balanced brick burning period that is dark red in color, sounds of iron knock if tapped with each other, has a straight, flat surface and doesn't crack. The water infiltration rate does not exceed 1/6 of the volume of brick. Common types of bricks found in Malaysia consist of clay bricks, facing bricks and engineering bricks.

The archaeologists have found bricks in the Middle East date 10,000 years ago. The bricks are made from the mud left the river in that flooded area. The brick was molded by bare hand and was left under the sun in order for drying process. The layering process using mud and tar as a mortar is the way to build the structure of the bricks. The ancient city of Ur (modern Iraq) was built with mud bricks around 4,000 BC. Clay dug from earth mixed with straw, and baked in crude ovens or burned in a fire were the technique used to make these bricks. Great Wall of China and Roman buildings are some example of many ancient structures that made of bricks and still standing today. The roman further developed kiln-burned bricks and spread the art of bricks making throughout Europe. Adobe brick that made up from adobe soil, comprised of clay, quartz, and other minerals, and dried in the sun is the oldest types of brick in the Western Hemisphere.

Bricks were used as early as the seventeenth century in North America. During the Industrial Revolution, bricks were used extensively for building new factories and homes. Until the nineteenth century, raw materials for bricks were mined and mixed, and bricks were formed,

by manual labor. The first brick making machines were steam powered, and the ricks were fired with wood or coal as fuel. Modern brick making equipment is powered, and the bricks were fired with wood or coal as fuel. Modern brick making equipment is powered by gas and electricity. Some manufactures still produce bricks by old method, but the majorities are using the modern method as reported by (Arthur Lyons,2014)

2.1 Concept and Theory
The researchers use rice husk ash as an additive and at the same time reduce the use of clay in the production of clay bricks. the researcher has also set the amount according to the percentage that has been set in the mixture of clay brick ratios of 10%, 20%, 30% and 40%.

2.1.1 Materials in Agro-Tech Clay Brick
The material that used in making an existing clay brick are water, clay, sand and cement. The researcher had innovated the existing brick by mixing rice husk ash as an additive named 'Agro-tech Clay Brick'. The researcher will reduce the use of cement by replacing some amount of RHA.

The early recommendation on the utilization of rice husk in concrete was proposed by the America Department of Agriculture contained in reports by URS Research Co. (1970). Two major factors which primary affect the reactivity RHA of RHA are its burning method and fineness of the particles. The burning temperature will affect the ash produced. Al-Khalaf (1984) and James (1988) studied came from on the effects of burning temperature of husk on the reactivity of the resulting ashes produced. He showed that lower temperature ashes gave higher reactivity with a peak value around 500°C as written by (Daggal, 2003)

During the process of rice husk ashes, eliminating combustion of organic substances and leaves a residue rich in silica. Heat treatment at a husk to produce structural changes that have an impact on two things: the level of activity and the fineness of grain ash pozzolan. Rice husk ash as an additive pozzollan including mineral admixture used to improve concrete performance. Additives used in this study is that rice husk ash rice husks from rice mills got Gandus area. Rice husk oven at temperatures between 600°C - 700°C in laboratory Transport Polytechnic resulting ash. The results of rice husk ash experiment in Table 2.1 had been conducted in the laboratory of the Department of Mines and Energy of South Sumatera.

Table 2.1: Rice Husk Ash Testing Results

No.	Types of Tests	Unit	Result
1	SiO_2	%	89,64
2	Al2O3	%	0,73
3	$Fe2O_3$	%	0,06
4	CaO	%	3,56

Judging from the content of those compounds, the rice husk ash can be used as a pozzolan for containing SiO2 + Al2O3 + Fe2O3 more than 70% in accordance with the required quality pozzolan as reported by (Dharma Putra, 2006).

3. RESEARCH METHODOLOGY

In this research, there were several methods that had been carried out such as materials preparation, RHA burning process, and formwork.

3.1 Preparation of Rice Husk Ash (RHA)
Rice Husk was burnt in controlled temperatures which is below 700 degrees centigrade. This ash was generated is amorphous stage in nature. The transformation of this amorphous state

to crystalline state takes place if the ash is exposed to high temperatures of above 850 degrees centigrade. Husk charcoal has many uses in the world of agriculture or industry needs. The farmers use rice husk charcoal as cultivators of land, material composting, Takakura composting method, planting media and media hotbed. Husk charcoal made from incomplete combustion of rice husk. Husk charcoal row material can be recovered easy in places where rice milling. In fact, in some areas, husk ash treated as waste. 20% -30% of rice milling process will be cast in the form rice husk ash.

3.2 Burning Process

The rice husk ash is a highly siliceous material that can be used as an admixture in concrete if the rice husk is burnt in a specific manner. The characteristic of the ash is de-pendent on the components, temperature and time of burning (Hwang, 1985). During the burning process, the carbon content is burnt off and all that remains is the silica content. The silica must be kept at a non-crystalline state in order to produce an ash with high pozzolanic activity. The high pozzolonic behavior is a necessity if it intent to use it as a substitute or admixture in concrete. It has been tested and found that the ideal temperature for producing such result is between 600 Co and 700 Co. If the rice husk is burnt at too high a temperature or for too long the silica content will become a crystalline structure. If the rice husk is burnt at too low a temperature or for too short a period of time the rice husk ash will contain too large an amount of un-burnt carbon.

3.3 Preparation of Mold

The researcher used wood formwork with the size of the actual brick 216mm x 103mm x 65mm and the formwork was wrapped with aluminum to facilitate the process of molding clay bricks.

3.4 Preparation of Clay

Clay preparation consists of mixing materials, removal of large stones (say over 5mm), roots, crushing of large particles, etc. There are 4 main methods of preparation clay which is the plastic method, the wet method, the dry meth-od and the semi-dry method. The dry method is used in this produce this clay brick where clay is dried, pounded and crushed into a powder form. The preparation of clay begins where the clay is obtained from the factory at Tanah Mas, Kuala Pilah, Negeri Sembilan. This factory has its own stock of clay where it obtained from their own land. Sieve analysis was done to assess the particle size distribution (also called gradation) of granular material.

3.5 Sampling Technique

Sample had divided into four techniques as stated in Table 3.1 which was controller, clay with 10% RHA, clay with 20% RHA, clay with 30% RHA and clay with 40% RHA.

Table 3.1: Sampling Technique

Percentage of mixture	Water		RHA (g)	Clay (g)
	Used (g)	Add (g)		
Controller	1,000	-	0	3,000
Clay + RHA (10%)	1,000	400	300	2,700
Clay + RHA (20%)	1,000	800	600	2,400
Clay + RHA (30%)	1,000	1,200	900	2,100
Clay + RHA (40%)	1,000	1,700	1,200	1,800

3.6 Testing
Researcher had done two main testing that is compressive strength and water absorption test.

3.6.1 Water absorption testing
This testing was done by following the procedures which has been set. All the clay brick is facing water absorption test to determine the percentage of water absorption of clay bricks. The total of clay brick will be used is thirteen. These bricks will be immersed in water at room temperature for 24 hours.

3.6.2 Compressive strength testing
This testing will be done after water absorption test done. The total of brick that will use to face this testing is thirteen pieces. The bricks that have passed this test will be recorded.

4. RESULTS AND ANALYSIS

The amount of bricks used for water absorption and compressive strength test is thirteen bricks where each brick is divided into 10%, 20%, 30% and 40%. Each percent has three bricks to be tested and the value to be taken is the average of the three bricks. The result of testing was collected by two methods which is from water absorption and compressive strength.

4.1 Mass of Clay Brick
The brick was burnt and dried out in a week after being formed in a mold. After that, the clay brick is rooted for seven days and cooling takes about three days. The burning process was carried out in the factory. The percent of RHA used is 10%, 20%, 30% and 40%. The result of comparison between wet mass and dry mass was stated in Table 4.1, Table 4.2 and Table 4.3.

Table 4.1: Mass of Clay Brick before Firing

Percentage of mixture	Sample 1 (kg)	Sample 2 (kg)	Sample 3 (kg)	Average of mass (kg)
Controller	2.20	-	-	2.20
Clay + RHA (10%)	2.13	2.13	2.17	2.14
Clay + RHA (20%)	2.04	2.03	2.05	2.04
Clay + RHA (30%)	1.95	1.93	1.92	1.93
Clay + RHA (40%)	1.73	1.81	1.84	1.79

Table 4.2: Mass of Clay Brick after Firing

Percentage of mixture	Sample 1 (kg)	Sample 2 (kg)	Sample 3 (kg)	Average of mass (kg)
Controller	1.90	-	-	1.90
Clay + RHA (10%)	1.73	1.73	1.74	1.73
Clay + RHA (20%)	1.50	1.59	1.57	1.55
Clay + RHA (30%)	1.42	1.46	1.46	1.45
Clay + RHA (40%)	1.26	1.25	1.29	1.27

Table 4.3: The Comparison of Dry and Wet Mass

Percentage of mixture	Wet mass (kg)	Dry mass (kg)	Moisture content (%)
Controller	2.20	1.90	30
Clay + RHA (10%)	2.14	1.73	41
Clay + RHA (20%)	2.04	1.55	49
Clay + RHA (30%)	1.93	1.45	48
Clay + RHA (40%)	1.79	1.27	52

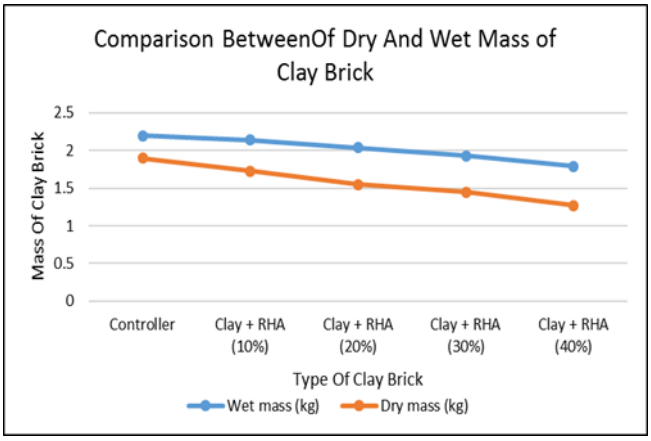


Figure 4.1: Comparison Between Dry and Wet Mass

Based on Figure 4.1, the highest mass for clay brick before firing was 2.20 kg of standard clay brick. Meanwhile, the lowest mass for clay brick before firing was 1.97 kg where the mixture was 40% RHA. Then, for clay brick after firing the highest mass was 1.90 kg of standard clay brick and the lowest mass was 1.27 kg which come from 40% RHA.

4.2 Water Absorption Test

Thirteen samples were used to determine the water absorption. The weight before was recorded before the curing process. Then, the mass of each clay brick was recorded in Table

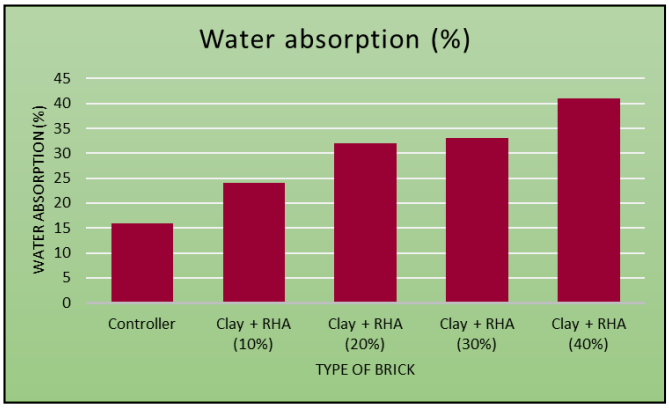
Table 4.4: Comparison Of Water Absorption Test

Type of brick	Wet Mass (kg)	Dry Mass (kg)	Moisture content (%)	Water absorption (%)
Controller	2.20	1.90	30	16
Clay + RHA (10%)	2.14	1.73	41	24
Clay + RHA (20%)	2.04	1.55	49	32
Clay + RHA (30%)	1.93	1.45	48	33
Clay + RHA (40%)	1.79	1.27	52	41

4.4 for mass of water absorption after 24 hours.

Figure 4.2 shown the highest percentage of water absorption for clay brick with 40% RHA was 41% . The reason is the properties of RHA is lightweight where the more RHA is used the more water was absorbed. Meanwhile, the percentage of water absorption for standard clay brick is 16% which is the lowest value.

Figure 4.2: Water Absorption result



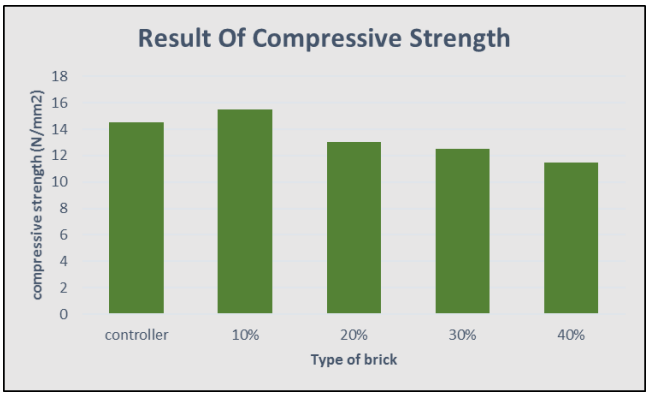
4.3 Compressive Strength

The result of compressive strength was shown in Table 4.5 below.

Table 4.5: Compressive Strength Results

Percentage of mixture	Brick mass (kg)	Compressive strength (N/mm2)
Controller	1.90	14.7
Clay + RHA (10%)	1.73	15.5
Clay + RHA (20%)	1.55	13.0
Clay + RHA (30%)	1.45	12.5
Clay + RHA (40%)	1.27	11.5

Figure 4.3: Compressive Strength result



Based on Figure 4.3, the result of compressive strength was found that 10% RHA is the best with a reading of 15.5 N / mm2, exceeds the prescribed standard with the reading of 14.0 N / mm2. While the RHA percent 20%, 30% and 40% did not exceed the prescribed standards.

Overall, the result of water absorption, clay with RHA 40% is the highest that absorb water where the value is 41%. The lowest value for this testing is from clay with RHA 10% is 16%. From the studies conducted, RHA 10% with clay is stronger than the controller where the results are 15.5 N/mm2 and 14.7 N/mm2. This means that RHA clay bricks can bear larger loads than the controller clay bricks. For the weakest result of compressive strength is from clay with 40% RHA and the value is 11.5 N/mm2.

5. CONCLUSION

As conclusion, the research of Agro-Tech Clay Brick was succeeding because this product archive both objective in this study, which is the innovating of existing clay brick using RHA from agriculture waste as additive materials. The highest compressive strength of clay with 10% RHA is 15.5 N/mm2 and the lowest is clay with 40% RHA is 11.5 N/mm2. Compressive strength was succeeded because have reached the standards of permitted standards. For water absorption, the highest is clay with 40% RHA where is the value is 41% and the lowest is standard clay brick where is the value is 16%.

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DESIGN OF MICROCONTROLLER TRAINER USING PIC18F4520

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Abstract. A microcontroller is a compact integrated circuit created to manage a specific process in an embedded system. It is commonly used in vehicles, robots, instruments, medical appliances, mobile radio transceivers, and house gadgets. Due to its various applications, a trainer needs to be designed to expose the user to the operation and application of the microcontroller. In this paper, a microcontroller trainer by using PIC18F4520 has been presented. This trainer is designed to demonstrate hands-on practice on how to set-up and program the PIC18F4520 for use in controlling input-output operations. This trainer composes two parts, hardware, and software. In the software part, the user uses the MPLAB IDE to program the microcontroller and watch the output result on the hardware part. It shows that this microcontroller trainer can work effectively to facilitate users in understanding hardware-software interfacing programming better.

Key Words: Microcontroller, PIC18F4520 MPLAB IDE, I/O port

1. INTRODUCTION

An embedded system is a merger of hardware and software which when incorporated forms a component of a larger system. An embedded system is created to run on its own without human interference. This product is controlled by its internal microcontroller with a purpose for specific functions or tasks needed for the system. The microcontroller receives input, processes this information, and outputs a certain action based on the information received.

Peripheral Interface Controller (PIC) is new to electronics control. PIC microcontroller has special function registers, power-on reset, interrupts, user RAM for storing of program data, EPROM program memory, timer, and onboard analog to digital converters. All this item is embedded in a single chip. It replaces conventional control of industrial machinery (e.g., motor-speed control) (Al Mashhadany, 2012). It operates at lower speeds, around the 1MHz to 200 MHz range, and needs to be designed to consume less power because they are embedded inside other devices that can have greater power consumption in other areas.

Embedded system using PIC microcontroller has been introduced into polytechnic curriculum. In order to meet the objective of this course, the curriculum framing, teaching, and learning programs, and laboratory facilities have to be improved at undergraduate and graduate level embedded system courses (Chintakunta & Kanchi, 2014). A comparison with existing trainers has been made before developing the microcontroller board. From the observation, the following issues have occurred when using the existing trainer.

a. Out-dated
   The trainer provided by the institution is using INTEL8051/MOTOROLA MC68H11 microcontroller, developed in 1979. This microcontroller was 31 years backdated to be used for laboratory. Even though the software still compatible but the microcontroller used in this trainer not available in the market anymore. This aligns with Asad et al.,2014, which said that usually, boards provided by vendors come with a specific

microcontroller with some fixed features that cannot be changed; even when there is a possibility of changing the microcontroller. This sometimes happens because the new one does not match the present peripherals of the board.

b. Limited numbers of trainer
The ratio between groups of students to the trainer is not enough to run the experiment. Commonly, experiments were carried out within the laboratory at special fully equipped workstations that come complete with microprocessor or microcontroller training kits. However, the price range for one trainer is very high and additional costs such as maintenance of the board should be taken into account. This contributes to the limited number of boards and the ratio of the available board to the students (Asad et al., 2014)

c. Minimum application
Modules are produced with fixed features and usually have constraints in adapting to the changing needs of a technical institution (Asad et al., 2014). This cause a limited amount of experiment can be done compared to the requirement in the syllabus.

Based on Chintakunta & Kanchi,2014 statement and observation, developing microcontroller board is essential to produce a versatile mini-board that can be used across courses offered at polytechnic especially embedded systems application, embedded robotic, and final year project. This paper presents a practical implementation of a microcontroller board able to execute related experiments and being applied in actual projects.

2. LITERATURE REVIEW

PIC18F4520 was built with a 40-pins chip. A total of 36 pins are Input-Output pins which can be configured as input or output pins by setting registers associated with them. The rest of the pins are designated as Vdd (Vcc) 2 pins and Vss (GND) 2 pins. It comes with the following features:

- 100,000 Erase/Write Cycle Enhanced Flash Program Memory Typical
- 1,000,000 Erase/Write Cycle Data EEPROM Memory Typical
- Priority Levels for Interrupts
- 8 x 8 Single-Cycle Hardware
- Single-Supply 5V In-Circuit Serial
- Programming™ (ICSP™) via Two Pins
- In-Circuit Debug (ICD) via Two Pins
- Wide Operating Voltage Range: 2.0V to 5.5V
- On-chip peripherals: Analog to Digital Converter, Timers and USART, Digital I/O pin, Watchdog Timer, Enhanced Capture/Compare/PWM (ECCP) module and Interrupt

The 40-pins configuration is shown in Figure 2 respectively.

3. METHODOLOGY

3.1 Microcontroller Board

The microcontroller board in Figure 1 is a unique development tool for programming and practice with PIC microcontroller from Microchip. The board was installed with PIC18F4520, USB port connected to the burner, and others peripheral such as push-button, light-emitting diode, buzzer, external pin for serial communication, and external pin for LCD. Flexibility design makes this trainer suitable for conducting experiments and being applied in actual projects. The microcontroller board can be programmed using MPLAB Integrated Development Environment (IDE) software, using C language and C18 compiler.

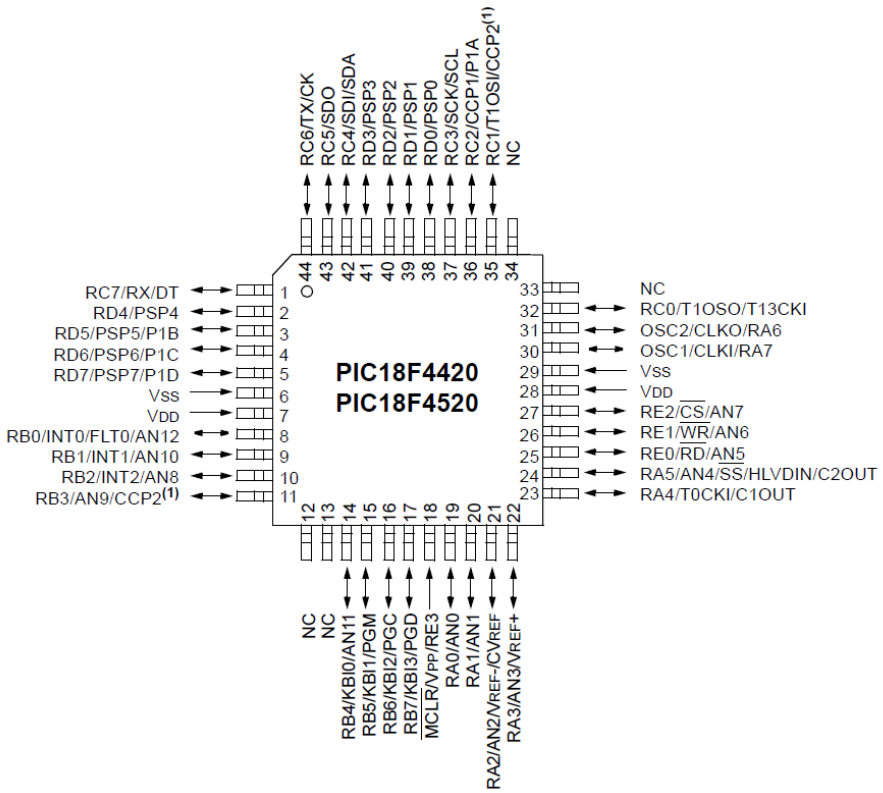


Figure 1: Pin diagram of PIC18F4520

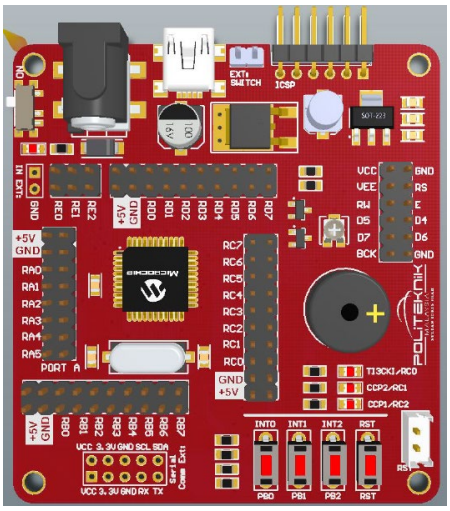


Figure 2: Microcontroller board

Figure 3 shows the block diagram for the board. It contains 5V power supply and built in push button, LEDs, and buzzer. The board also consist of external pins for PORTA, PORTB, PORTC, PORTD and LCD connection.

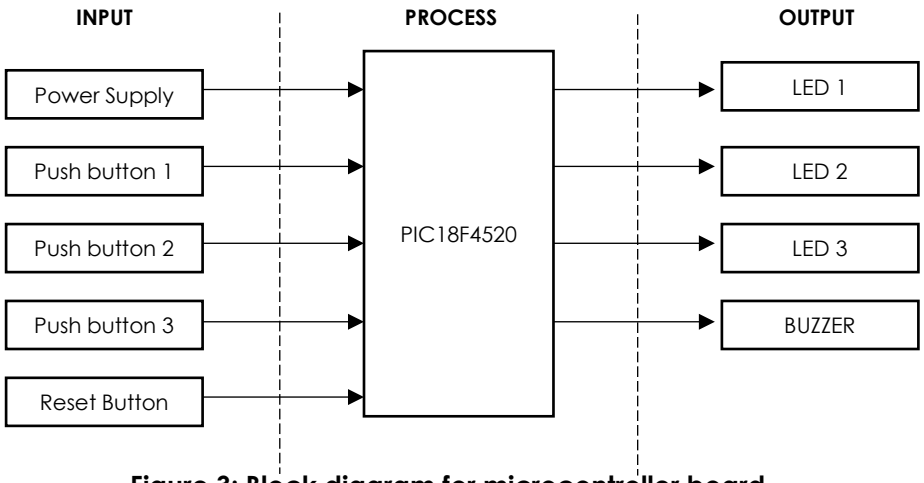


Figure 3: Block diagram for microcontroller board

3.2 Programming procedure for PIC18F4520

MPLAB IDE software with C18 compiler used to write and programmed the PIC18F4520 chip. It uses PIC Kit-2 programmer to program PIC18F4520 flash memory. The C18 compiler is a free program for students used for programming the PIC in C language. All the experiments are fits with this limit (Chintakunta & Kanchi, 2014). A program written for a specific task must free from error, then the generated .hex file is loaded into the PIC18F4520 flash memory using PIC Kit-2 programmer. After that, the board is ready to work on standalone mode.

Step 1: Write the C program in the New File tab using MPLAB IDE software as Figure 4. Then, save the file with extension .c.

Step 2: Add the saved file below the source code and compile the c file to figure out the error. Fix it until the program is free from error and give the following output in Figure 5.

Step 3: After that, convert the .c file into a .hex file using the Build All button as Figure 6. Then, the program is ready to be downloaded into a device.

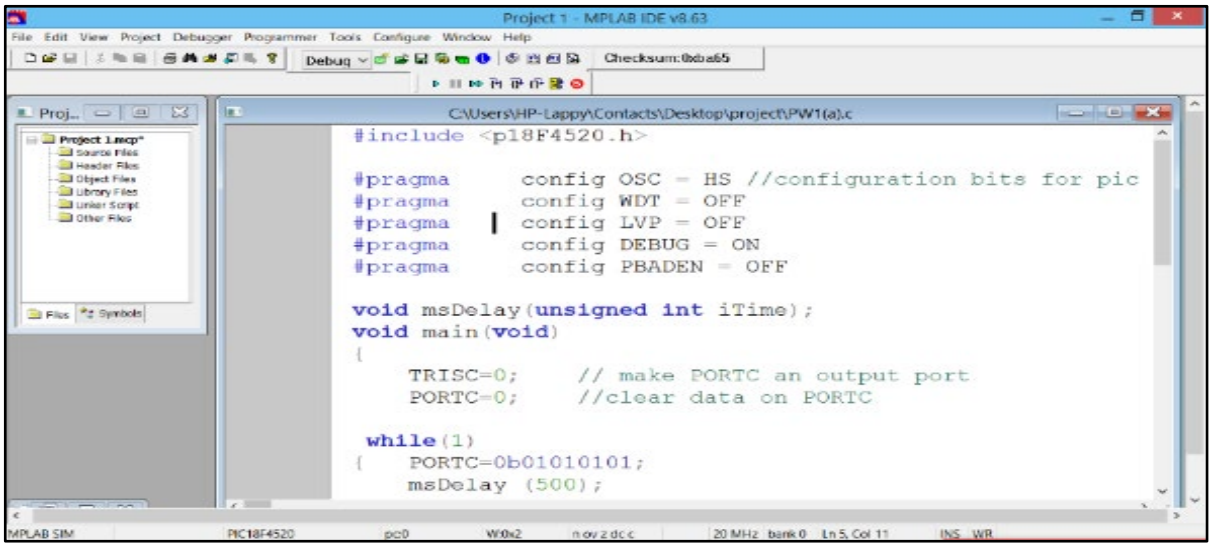


Figure 4: A C program is written in MPLAB

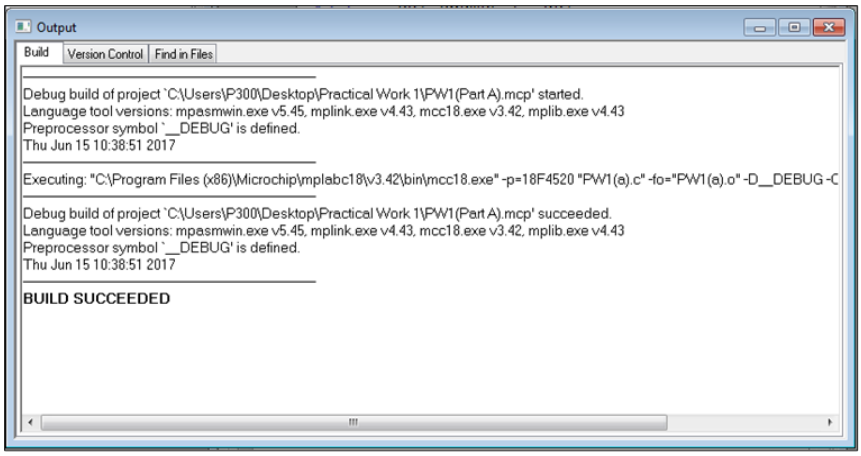


Figure 5: A C program is build succeeded

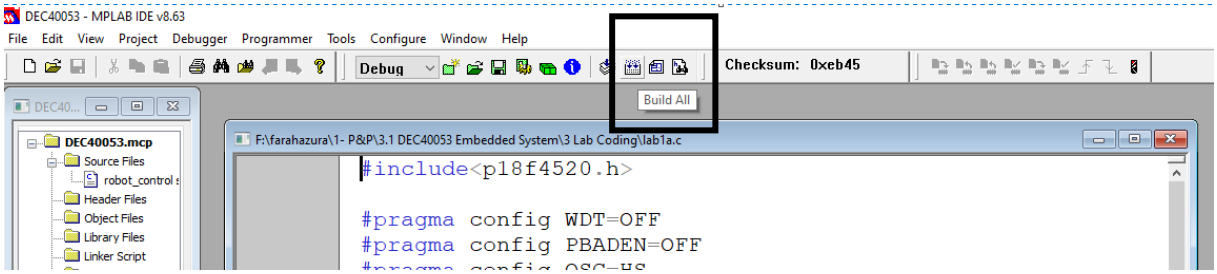


Figure 6: Using the Build All button to generate a .hex file

3.3 Experiments

The list below is the proposed experiments with the microcontroller board using PIC18F4520.

Table 1: List of experiments

Experiment	Topic	Courses
Experiment 1	Time Delay	Embedded System and Application
Experiment 2	Timer as a Counter	
Experiment 3	Interrupt Control	
Experiment 4	Hardware Interfacing	
Experiment 5	Robot Avoidance	Embedded Robotic
Experiment 6	Line Follower Robot	
Experiment 7	Remote Control Robot	

3.4 Details of Experiments

Experiment 1: C Program to create a time delay

This experiment is used to demonstrate LEDs on PORTC toggle continuously with some time delay. The components needed for this experiment is a microcontroller board and LEDs.

Experiment 2: Timer as a counter.

This experiment is used to construct the C program used by Counter0 in 8-bit mode to count and display the state of the TMR0L count on PORTB. PORTB is connected to 8 LEDs. The components needed for this experiment is a microcontroller board and LEDs. The software developed using MPLAB IDE is based on the flowchart in Figure 7.

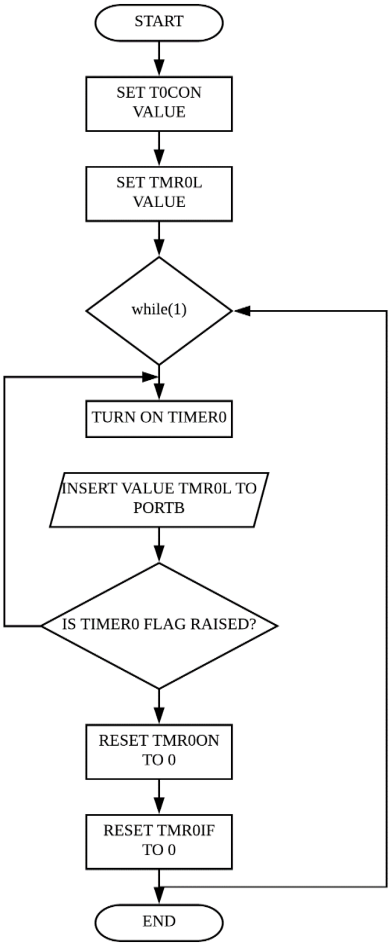


Figure 7: Flow Chart for Counter experiment

Experiment 3: Interrupt Control

This experiment is used to construct the C program to show the example situation while using the INT0 as an external interrupt. The components needed for this experiment are a microcontroller board, push-button, and LEDs. The circuit shown in Figure 8 is already assembled on the board. The software developed using MPLAB IDE is based on the flowchart in Figure 9. In the flow chart, LED1 will toggle and upon activation of a switch (interrupt), LED2 will toggle 10 times.

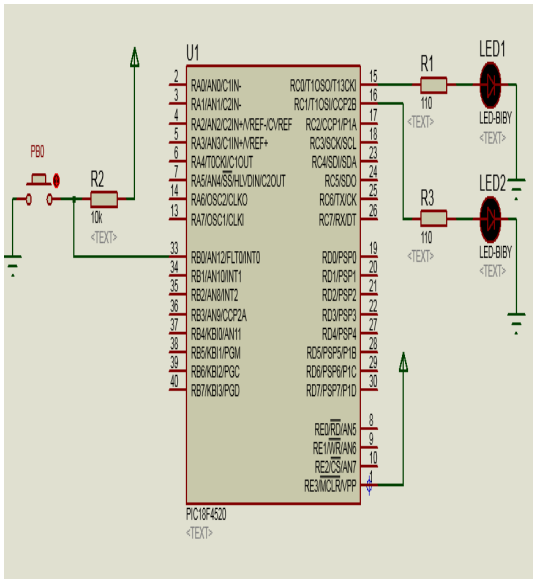


Figure 8: Circuit diagram for interrupt control

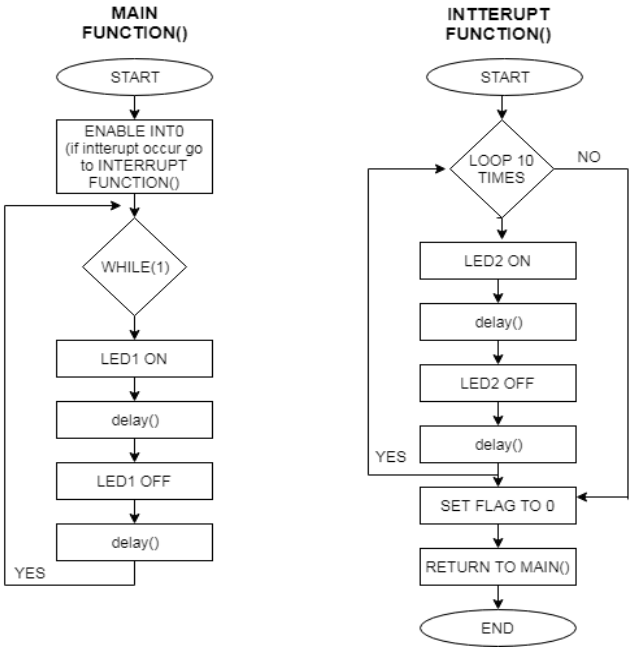


Figure 9: Flowchart for interrupt control

Experiment 4: Hardware Interfacing

a) Switches and LEDs.

The most important feature of the PIC Microcontroller is its input and output pins. The 36 pins allow the microcontroller to sense the outside world and output in different ways. The PIC18F4520's input and output pins are capable of many different functions including analog and digital signal processing. In the beginning, we will treat the input and output pins as simple digital input-output, capable of sensing or outputting binary signals.

This experiment introduces a command that assigns a value of 1 to a bit register. An LED is connected to PORT C (pin RC0, RC1, and RC2) PIC18F4520 IO pin via a current limiting resistor and the push button is connected to PORTB (pin RB0, RB1, RB2). The push-button is an inactive low state.

The circuit shown in Figure 10 is already assembled on the board.

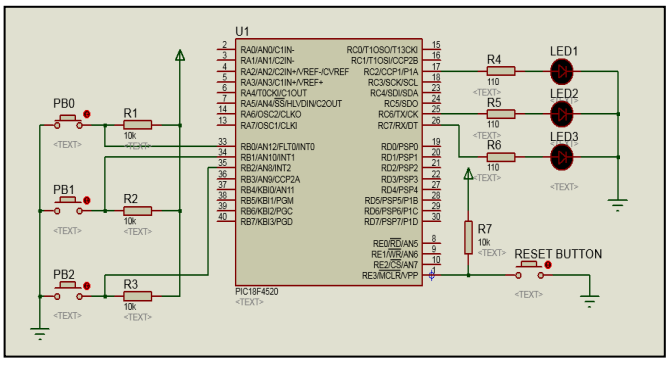


Figure 10: Circuit diagram for switches and LEDs interfacing

b) DC Load Using Relay

This experiment will give a clear explanation of how the relay works. A relay can be interfaced with the microcontroller using the Figure 11 below.

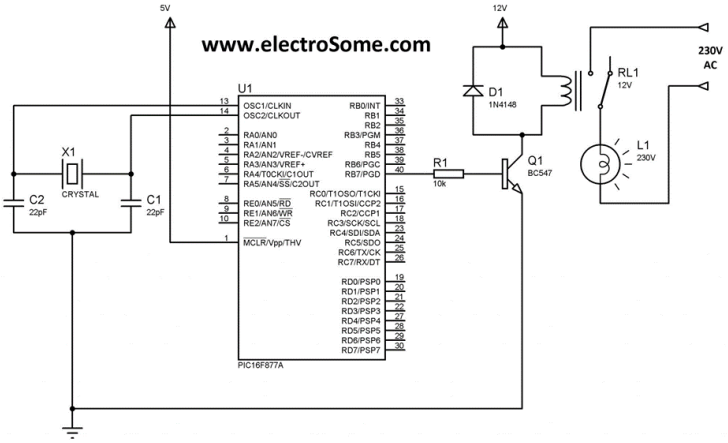


Figure 11: Connection of relay with microcontroller

c) LCD interfacing

Liquid Crystal Display (LCD) can be used to display messages or results. This experiment will concentrate on how to make a connection between LCD and microcontroller. This LCD can display massages in two lines with 16 characters each. Connection of LCD with microcontroller show in Figure 12.

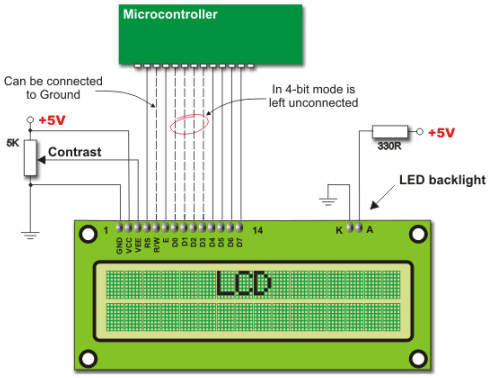


Figure 12: Connection of LCD with microcontroller

d) LM 35 Analogue Sensor

LM 35 is one example of an analog sensor. It will give a voltage that varies directly with the sensed quantity. The output voltage for LM35 is 10 mV per degree centigrade, which means when its output is 300 mV then the temperature is 30 degrees. Microcontrollers are digital and can only differentiate between HIGH or LOW level on input pins. The voltage cannot be measure directly by a microcontroller. To overcome this problem, a microcontroller has an analog to digital converter (ADC) unit to convert a voltage to a number so that it can be processed by microcontroller. This experiment is described using the flowchart in Figure 13.

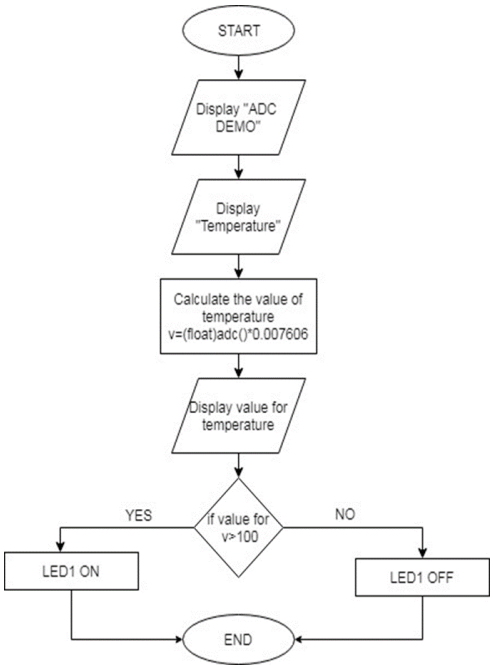


Figure 13: Flowchart for LM35 analogue sensor experiment

Experiment 5: Robot Avoidance

Obstacle avoidance strategy is an algorithm of the mobile robot's action when detecting an obstacle. The purpose of the obstacle avoidance strategy is to prevent the robot from any collision with any object or obstacle which may cause damage to the obstacles and the mobile robot itself. Figure 14 is an example of an avoidance mobile robot using two (2) infrared sensor (IR sensor).

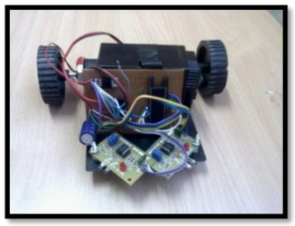


Figure 14: Avoidance mobile robot

Experiment 6: Line Follower Robot

The Line Follower Robot is a basic robot that follows a specific path indicated by a line (usually a black line on a light-coloured surface having some width. This circuit mainly consists of a microcontroller, one or two or more IR sensors, motors, and motor driver IC. The IR sensors are mounted on the front of the robot facing the diodes facing towards Earth. When the robot is placed on the fixed path, it follows the path by detecting the line. The robot direction of motion depends on the outputs of the sensors whether to go forward, turning left or right, and stop. Figure 15 is an example of a line follower robot using one (1) infrared sensor (IR sensor).

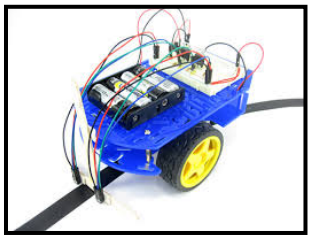


Figure 15: Line Follower Robot

Experiment 7: Remote Control Robot

A robot that is tele operated (operation of a system from a distance) by any transmitting device, which in most cases is remote. These robots are referred to as a remote-controlled robot. There is a direct interaction between the human and the robot here. And mostly, humans have complete control over the robot's actions. The remote-controlled robots are mainly classified into two types; wired remote control and wireless remote control. Students use the built-in push-button for wired robots and Bluetooth devices for a wireless robot.

3.4 Project using Microcontroller Board

Microcontroller board also has been used for others project rather than experiment in class such as: -

a) PPRN project (Onion Peel Machine for the small industry)
b) Smart lamp control in institution library
c) Final year project

4. CONCLUSION

Microcontroller board was designed based on the maneuverability and performance of each component with the minimum cost where the size of the board is smaller than other trainers. This microcontroller board will give many benefits for an educational researcher, high educational kits, and related industries that looking for a microcontroller project using the minimum cost of implementations. A bunch of experiments with the PIC18F4520 microcontroller board will bring the user from beginner to the advanced exploration of the microcontroller. The hands-on experience allows students to design and develop complex embedded systems using PIC18F4520 microcontroller in their final year project.

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SOCIAL RESPONSIBILITY DURING COVID19 PANDEMIC: INNOVATION OF FACE SHIELD USING 3D PRINTER

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Abstract. This paper focused on designing, producing, and optimizing the production of face shield mainframe using 3D printer. It aims to provide a guideline on 3D printing of face shield using a new method to boost production during the coronavirus pandemic. The 3D printing machine model used was Ultimaker 2+ with the application of fused deposition modelling process (FDM) to produce three dimensional products from polylactic acid (PLA) material, a biodegradable polymer from renewable resources. The frame was designed in eleven parts per stack to optimize the production of each part of the face shield. Two stacks of the face shield parts can be printed at once to fully utilise the machine-built plate area. The part stacking design was also constructed to eliminate the use of a support structure which was proposed by the machine slicing software, CURA. This was achieved by adjusting the position of parts, which was designed to minimize the contact area between two parts and manipulating printing parameter setup. Finally, the process of face shield assembly with readymade accessories was presented in detail culminating to a complete product. The printing of the face shield parts in stacking without the use of support structure was successful. The production time and material usage were discussed and compared to the conventional method which was one part per production and requires support structure for stack printing. As a result, there was a huge reduction in production time and material usage when using the new setup.

Keywords: Fused Deposition Modelling (FDM), Polylactic Acid (PLA), 3D Printer, Stacking, Support Structure.

1. INTRODUCTION

The escalating outbreak of Covid-19 pandemic had caused a high shortage of medical personal protection equipment (PPE) among doctors, nurses, and other health workers (Kanyakumari, 2020). This was due to higher daily usage of medical PPEs such as gloves, face masks, and face shields by the frontliners to protect themselves from getting infected from their patients. These PPEs which are in line with the medical standard of operating procedure, must be disposed after each use which resulted in a dramatic shortage of PPEs stock in most hospitals.

Local companies, higher education institutions, volunteers, and individuals have come together and worked to produce and supply various type of PPEs to the frontliners from health sector. While some companies helped to import face masks from various sources overseas, other ground volunteers and individuals took part in various efforts to produce self-made or homemade face masks and shields.



Figure 1: Delivery of Face Shield to Likas Hospital (Dahali, 2020)

Politeknik Kota Kinabalu, a local higher education institution in Kota Kinabalu, Sabah also took part in its social responsibility drive during this difficult time. The Mechanical Engineering Department embarked on an initiative to use their expertise in 3D printing technology to produce face shields for healthcare frontliners. The production of face shields was successful, and more than 1000 units were produced and supplied to local hospitals (Dahali, 2020). Figure 1 shows the top management and staff of Politeknik Kota Kinabalu during the delivery of face shields to Likas Hospital, Sabah.

The objectives of this research are:

i. To design and produce face shield using 3D printing technology
ii. To establish new printing setup to increase face shield production
iii. To share the design and new printing setup of face shield production to 3D printer owners globally

2. LITERATURE REVIEW

2.1 The 3D printer machine

Politeknik Kota Kinabalu has three units of 3D printing machine located in CADCAM Laboratory, Mechanical Engineering Department. This type of rapid prototyping machine uses Fused Deposition Modelling (FDM) technology to produce the part. The production of part begins when thermoplastic materials which are in form of filament are pushed through a hot nozzle. The semi liquid state that comes out from the nozzle is layered continuously onto the built plate until the three-dimensional object is created (Kiran, 2014). Figure 3 illustrates the process of FDM.

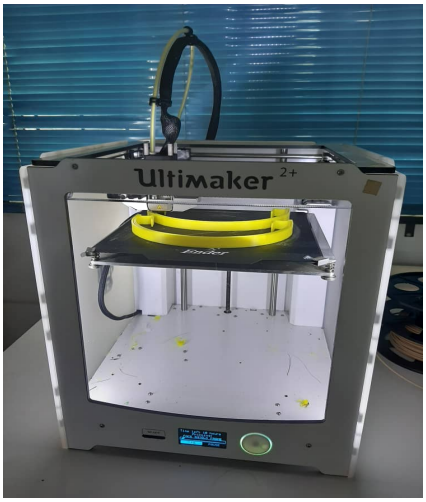


Figure 2: 3D Printer, Ultimaker 2+

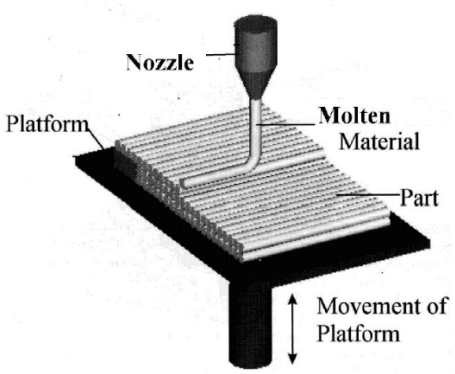


Figure 3: Fused Deposition Modelling Process (Kiran, 2014)

These 3D printers were used to produce the face shield's frame which will be assembled later with other readymade accessories to complete a face shield. With the current pandemic, the challenge is to produce more face shields within a short period time. With the former setup, 3D printing was very low in productivity or required longer time to print a product.

With this challenge in mind, the product design and machine parameter setting were studied thoroughly to optimize the use of 3D printer. With improvisation, thousands of face shields had been delivered to local hospitals in a short period of time.

3. RESEARCH METHODOLOGY

There are three steps of process involved in this technology which are pre-processing, production and post-production. The pre-processing step includes modelling using computer aided design; transfer to stereo lithography (STL) format file to slicing software and to setup printing parameter. Production is the step where it includes the setup of the machine, heating of built plate and nozzle. Next, printing process will start until the product is completed and product is removed from machine built plate. The last step before assembly is the cleaning process to remove excess elements. A source suggested that other finishing works may include sanding, polishing and painting to improve the surface finishing of the part (Pandey, 2006). Figure 4 illustrates the production process flow chart.

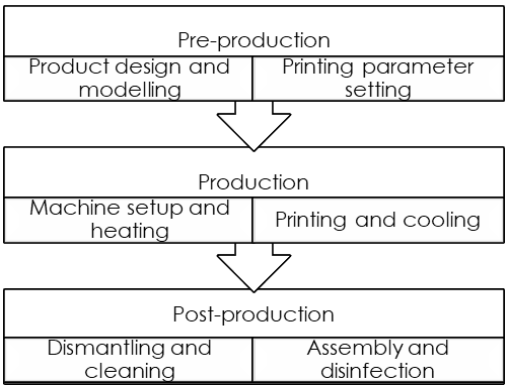


Figure 4: Production Process Flow Chart

3.1 Pre-production

The frame's model of the face shield is designed using computer-aided software CATIA version V5R21 as shown in Figure 5. The part's frame model is then arranged in stack to maximize the production. Figure 5 illustrates the frame design and modelling stage. Once the design is completed, the file is converted to an STL format so the machine slicing software CURA V4.6 can access the file for printing parameters setting. The main printing setup parameters are layer height, wall thickness, infill density, printing speed, printing temperature, infill pattern and nozzle diameter (Pandzic, Hodzic, & Milovanovic, 2019).

The parts stacking design required the use of a support structure as proposed by the machine slicing software, CURA. However, duplicating and arranging the parts in stack causes the upper parts to be in an overhang position. The use of support structure for overhang part is not desirable as it increases the printing time, material usage and time in the post-production step. It also hard to remove from the part and may damage the product (Fazzini, et al., 2019). Fazzini et al. (2019) also proposed a method to print without support but it requires complex calculation and modification of path printing sequences.

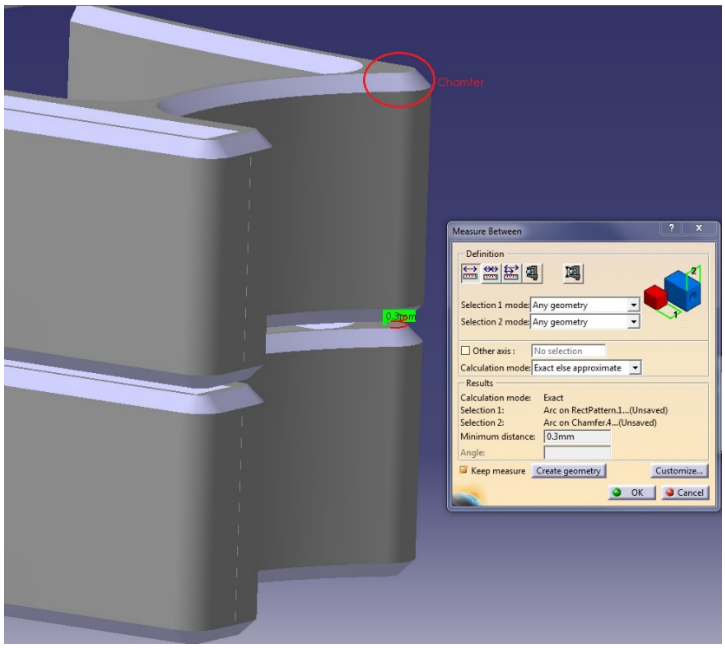


Figure 5: Product Design and using CATIA

During stacking setup, the position of parts in that stack was carefully designed so that printing overhang parts is possible without support structure. The optimum distance between parts is equivalent to layer height selection, which is 0.3 mm as shown in Figure 5. Other than

that, the contact area between parts was minimized during part design process by construction of chamfer on the parts. This is critical to facilitate the dismantling work in post-processing step.

In term of printing parameter setting, wall setup by line count was set instead of main parameter wall thickness as shown in Figure 6. It also shows that the wall thickness setup will automatically be disabled if wall setup by line count is used. Wall count line setups also will prevent the construction of top layer finishing and no infill density is required. As printing the bottom and top layers are done in zig zag pattern, surface between the parts will be meshed and dismantling process is not possible without damaging the parts. Figure 6 shows the full printing parameters include printing time and material usage for stacking without support structure.

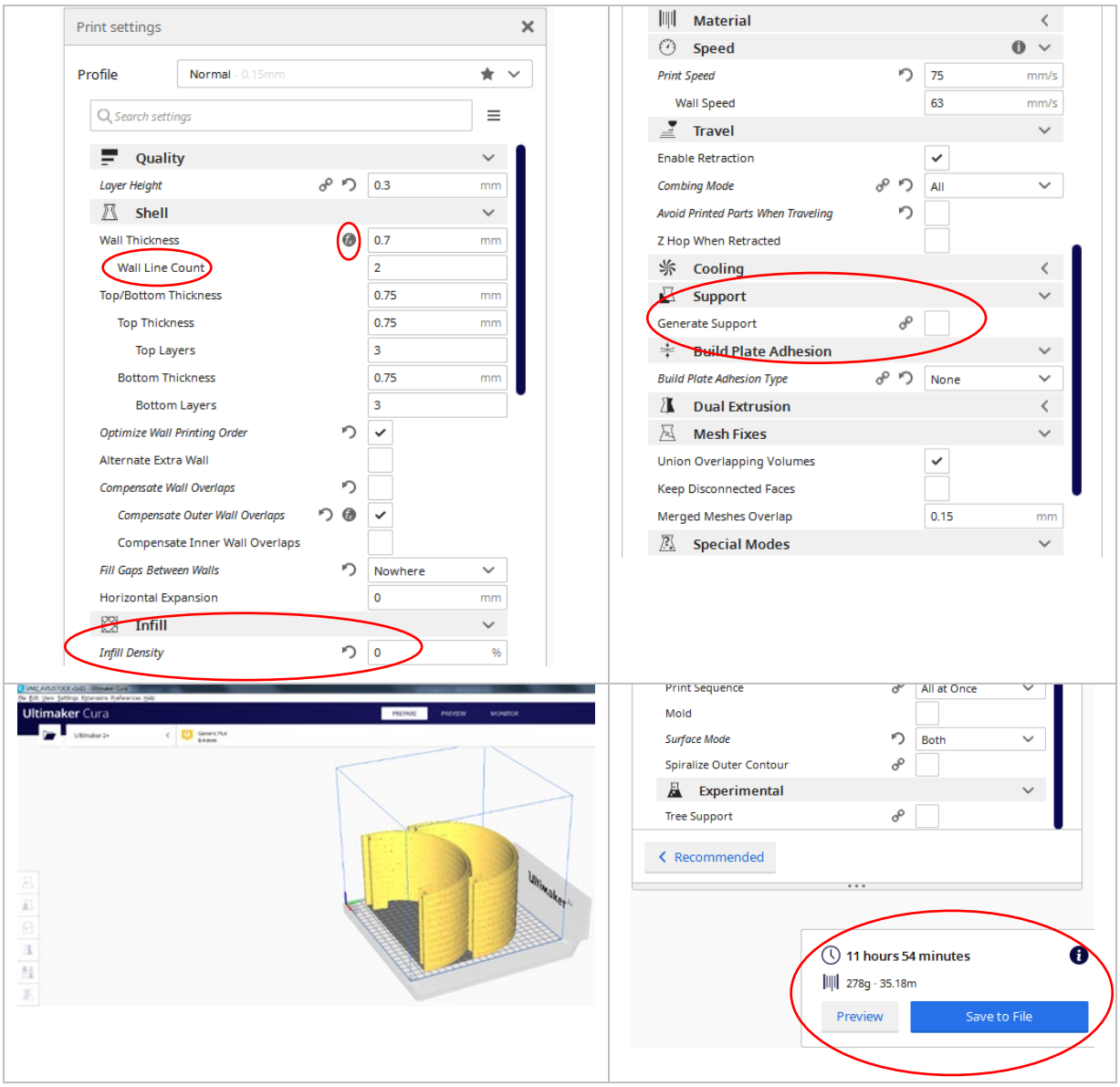


Figure 6: Printing Parameter setting using CURA

To fully utilise not only the area but also the working volume of the machine, intensive trials and errors in model design construction were made. It was then decided that the optimum number of parts per stack is eleven, printed at one time. This was to minimize material waste if

printing error or machine breakdown occurs. Printing errors such as layer separation, print lifting and warping are common due to unstable room temperature (Khau, Lourey, & Napau, 2017). The laboratory was air-conditioned, and the room temperature was at 24 °C.

3.2 Production

The material used for the face shield frame is generic polylactic acid (PLA), a polymer made from biodegradable renewable resources. This type of polymer is mostly produced from corn and sugarcane. PLA material was selected because of its availability, good mechanical properties, low toxicity, and higher flexibility. However, the disadvantages of PLA are brittleness and low thermal stability (Shabana, Santosh, Sarojini, Vikram, & Lakshmi, 2019). The generic PLA filament size is 3.0 mm and 1 kg in weight.

The machines used are Netherland made which is the Ultimaker 2+ model with open source slicing software CURA V4.6 and firmware V1.54. This type of model uses single nozzle of 4.0mm in size. Its main disadvantage is the size of product that can be printed is limited to the machine's working envelope. The machine's build plate area is 210 mm x 210 mm and the height is 195 mm. Therefore, bigger product must be printed in parts and to be assembled thereafter.

The common printing practice is that every finished part requires cooling down before being manually removed from the machine built plate. This repeating process of machine setup every time it restarts the part-by-part printing is a waste of time. For PLA material, machine setup that includes heating the nozzle and build plate to 220 °C and 50 °C requires 5 minutes. After printing, cooling time is 3 minutes before the product could be removed manually. So, to maximize the production time per unit, the number of machine setup has to be minimized. The solution is to print the parts in stack but without support structure. Figure 7 shows the finished printing of two stacks.

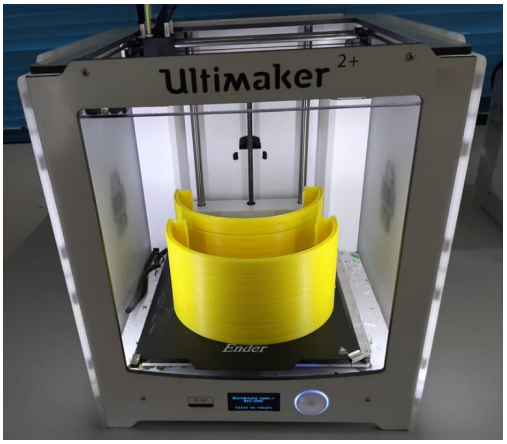


Figure 7: Finished printed product

3.3 Post Production

This step includes dismantling and cleaning each part from its stack. Other accessories required are multipurpose overhead projector (O.H.P) transparency, 1.75 mm plastic filament, rubber string, sponge, and glue. The transparency is used as a visor, assembled with the frame and is tighten using the plastic filament as shown in Figure 8. The sponge is for head protection and comfortability while the minimum of glue is used to strengthen the assembly. The last step is to disinfect the face shield with sanitizer. Finally, the part design file which is in STL format was uploaded at https://www.thingiverse.com/thing:4564492 for public access, especially 3D printer owners.

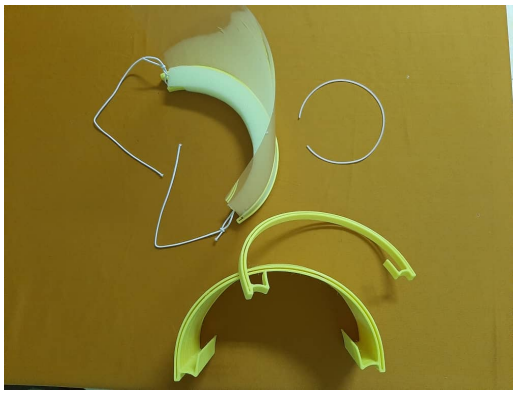




Figure 8: Face Shield Assembly

4. RESULTS AND ANALYSIS

The outcome of the study found that it is possible to print overhang parts without the use of support structure. This was achieved through innovating a new printing setup by adjusting the position of parts, which was designed to minimize the contact area between two parts and manipulating printing parameter setup. This new printing setup was able to reduce huge amount of printing time compare to the conventional methods.

The production time and material usage comparison between the three methods were studied and recorded in Table 1. This data comparison was obtained using the machine slicing software, CURA as shown in Figure 9. The blue colour in the figure shows the support structure generated by the CURA. The total time to produce two stacks of parts without support structure took 722 minutes compare to 1319 minutes when using support structure. It took 66 minutes to produce two parts when using part by part method. Printing the part one by one is not practical as it requires the machine operator to stay more than 13 hours for same amount of production.

Table 1: Comparison of Production Time and Material Usage

Method	Stacking without support structure	Stacking with support structure	Part-by-part
Machine setup (min)	5	5	5
Printing time (min)	714	1311	66
Built plate cooling time (min)	3	3	3
Total time (min)	722	1319	74
Total material usage (g)	278	320	25

The production time and material usage per unit of the face shield frame were then calculated using the given formula and recorded in Table 2. The new stacking method requires 32.81 minutes to produce one unit of part compare to 59.95 minutes when using support structure. This indicates that printing support structure in between parts takes a significant amount of time. In term of material usage, using support structure uses more material which is 14.55 gram per unit. Without support structure and part by part method use 12.64 gram and 12.50 gram per unit, respectively. It suggests that printing without stacking use less material because there is no material wasted as structure between parts.

$$\text{Eq 1: } \textit{Production time per unit } \left(\frac{min}{unit}\right) = \frac{\textit{Total Time}}{\textit{Number of Unit Per Print}}$$

$$\text{Eq 2: } \textit{Material usage per unit } \left(\frac{gram}{unit}\right) = \frac{\textit{Total Material Usage}}{\textit{Number of Unit per Print}}$$

Table 2: Calculation of Production Time and Material Usage per Unit

Method	Stacking without support structure	Stacking with support structure	Part-by-part
Printing time (min/unit)	32.81	59.95	37.00
Material usage (gram/unit)	12.64	14.55	12.50

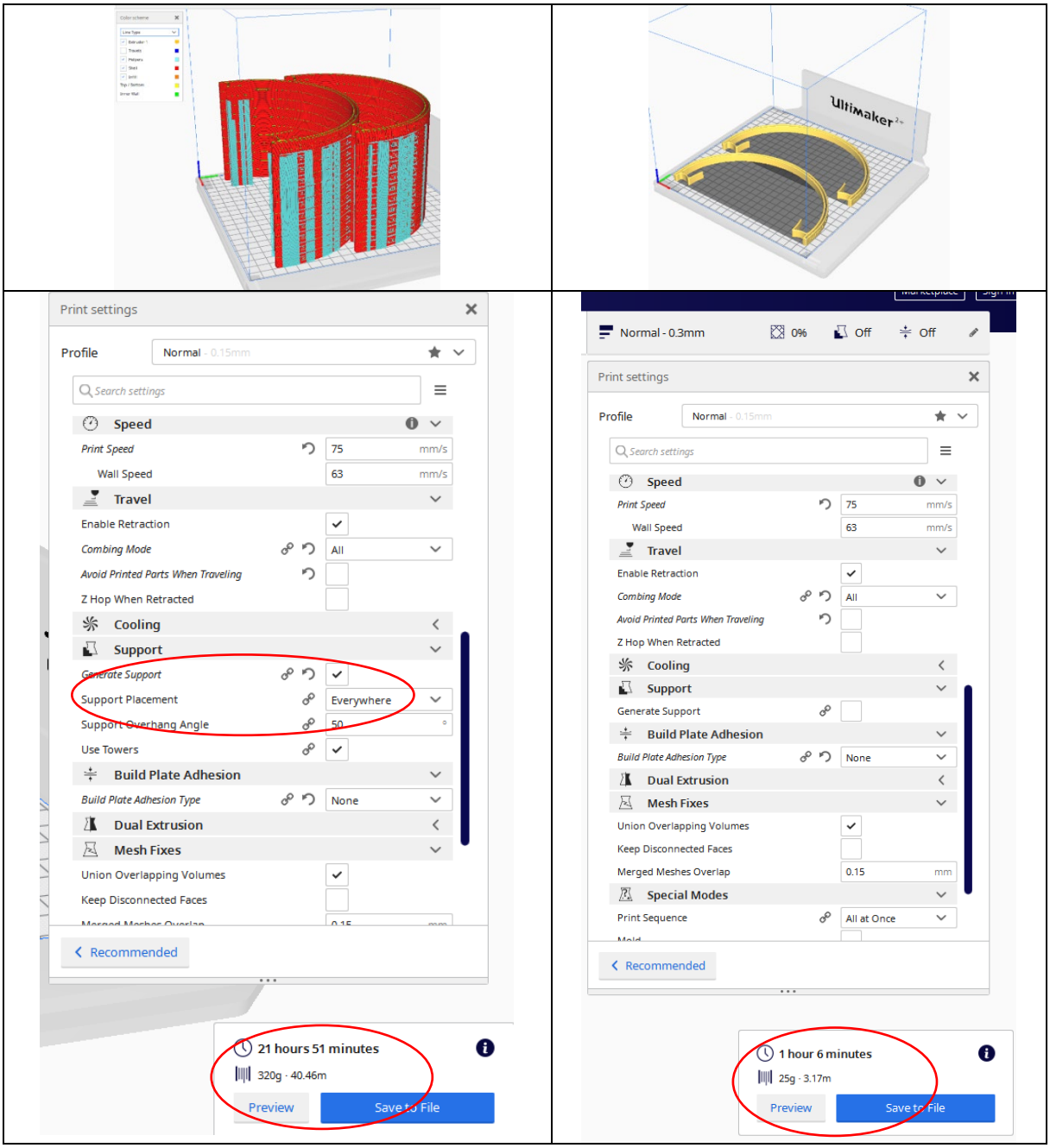


Figure 9: Printing parameter with support structure and part-by-part method

5. CONCLUSION

As Covid-19 pandemic led to high shortage of medical PPE, requiring mask reuse or improvisation (Garcia Godoy, Jones, & Anderson, 2020), the innovation of face shield using 3D printer is at an apt time and has been proven to be successful. With this new printing setup

and parameter manipulation, printing time per unit was significantly reduced, cutting the material usage to 12.64 gram. This also proves that printing parts in stack is possible without the use of support structure which requires higher amount of plastic material thus the longer time to print. By cutting the printing time to almost half, this has allowed Politeknik Kota Kinabalu to effectively produce more than 1000 face shields which were donated to the local hospitals around Kota Kinabalu in just a short period of time.

The design of the face shield which is in STL format is also shared and uploaded to the cloud at https://www.thingiverse.com/thing:4564492 to allow 3D printer owners worldwide an easy access and benefit from the new printing setup. Hopefully, this small contribution will boost the production of face shields during the Covid-19 pandemic around the world or be use in other areas related to 3D printing.

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DESIGN AND DEVELOPMENT FULLY AUTOMATIC HIGH-SPEED COOKIES DEPOSITOR MACHINE (HS-CDM)

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Abstract. The demand for home-made halal cookies has been increasing especially for "*biskut raya*" category, especially in the festive season. Mostly home-made cookies especially "*biskut raya*" have been produced manually by using piping bag decorating kits to get the desired shape. The manual method depends on the skill of the worker, very time consuming, incurs high labor cost, not effective and not economical for the small and medium-size company to produce a bigger volume of cookies in the future. A fully automatic High-Speed Cookies Depositor Machine (HS-CDM) is proposed to produce a consistent shape of cookies within a minimum production time compared to the manual method. This machine consists of six sub-assemblies such as Roller Pump Assembly, Dough Pump Chamber Assembly, Rotating Nozzle Assembly, Conveyor System Assembly, Lifting Table Assembly, and Frame Structures. By using Human Machine Interface (HMI) or touch screen buttons, the dough placed in the hopper will automatically deposit on the tray according to the desired shape. The shape of the nozzle can change according to the desired shape of cookies easily. HS-CDM able to produce about 12-tray of cookies in 1 h production compared to 4 trays only using the manual method. This result shows that the speed of production will be increased to more than 3 times or 300 percent. The machine can also help the companies in terms of time savings or productivity increase and thus will increase product booking and result in high turnover and an increase in profit.

Keywords: *cookies; HS-CDM; production time*

1. INTRODUCTION

"*Biskut Dahlia*", "*Biskut Semperit*" and "*Tat Nenas*" are three common types of cookies that are bought after or very popular among customers during festive Hari Raya season. This type of cookies is produced manually using piping bag decorating kits. This process usually depends on the skill of the worker and a very selected few skillful workers can produce up 5 trays of cookies in 1 hour. During the festive Hari Raya season, the demands for cookies increase up to 100 trays every day. Most biscuit making machines available in the market usually have problems in terms of making time, how to clean the machine itself and is also expensive (Siraj M Tamboli, 2017). This has resulted in the company is facing pressure to produce more cookies because the manual method of producing these cookies is impractical and tedious. Beside, ergonomic problems also increase due to repetitive work done. The traditional manual process is using piping bags and a coupler. The dough is put in the piping bag and is pressed using the finger. The cookies are deposited at the end of the coupler on the tray. The concept idea of automatic cookies depositor machines is the same as manual processes. The piping bag is replaced with the hopper and the coupler is replaced with the nozzle. The process of pressing the dough using the finger is the automation of the roller pump assembly that is powered by an induction motor. The dough that has been put in the hopper is pumped by the roller pump assembly and deposited through the end of the nozzle on a tray. The High-Speed Cookies Depositor Machine consists of six sub-assemblies

such as Roller Pump Assembly, Dough Pump Chamber Assembly, Rotating Nozzle Assembly, Conveyor System Assembly, Lifting Table Assembly, and Frame Structure. An amount of 4 to 5 litre of dough will be put in the hopper. 0.75kW induction motor will pump the dough to the pump assembly chamber. They get the desired shape of cookies, the dough will be squeezed by rotating the nozzle assembly before deposited to the tray. The shape of nozzles can be changed according to the desired shape of cookies easily. The conveyor and linear actuator will move up and down and forward and backward to control the arrangement of the cookies on the tray. By using the latest touch screen technology or Human Machine Interface (HMI) button, the dough that has been put in the hopper will automatically deposit to the tray according to the desired shape.

Nowadays, the cookies, especially "*biskut Raya*" have been produced manually by using homemade piping bag decorating kits to get the desired shape. The worker can only produce 4 to 5 trays in 1 hour. This method depends on the skill of the worker, which is very time-consuming, high labour cost, not effective, and not economical for the company to accommodate in bigger order of cookies in the future especially during the festive season. The objective of this project are:

I. To design and fabricate High Speed Cookies Depositor Machine.
II. To increase the production of cookies.

2. LITERATURE REVIEW

All necessary information on the production and manufacturing process should be gathered following process parameters, principles, and safety obtained by referring to the production Engineering and Technology manual. Basic knowledge of various production technologies to enter the fabrication phase is essential for a product to be successfully developed. The basic operations performed are welding, turning, grinding, drilling, and many more that are important to achieve (Kalpakjian & Schmid, 2014). Cams, gears, belt, and chains are example mechanical elements contain basics of working and principles in Theory of Machines (CE, n.d.).

Nowadays, most of the manual methods are used to produce cookies because it is difficult to get interested employees. This is because the production of these biscuits requires focus and patience.

3. METHODOLOGY

In determining the capabilities of a machine, the design and fabrication process of various components is necessary to determine the strength of function and structure (Pradhan et al., 2017). The High-Speed Cookies Depositor Machine (HS-CDM) is to replace the manual method using piping bags by the worker. The HS-CDM is estimated capable of producing a maximum of 100 trays per day. The automatic method has increased productivity up to a maximum of 3 times or 300 percent compared to the manual baking method. The mechanism of HS-CDM consists of 6 sub-assemblies and is powered by a 1HP induction motor that has integrated with a gearbox. This project will be conducted according to a study on the efficiency and effectiveness of the machinery for the product to be produced. Before starting the process of developing this machine, all problems in producing biscuits are identified by taking information from traditional biscuit entrepreneurs. Information related to processes or methods is collected as a reference to the process of designing machines. Next, the work of sketching the design of the machine shape was performed before being drawn using a computer-aided system (CAD) called Solid Work. Solid work is CAD software that translates ideas into graphic visual forms. After completing the process of designing the machine, the machine is developed according to what has been drawn using the software. The machine that is ready to be developed will be tested for its level of effectiveness and operation. The results are based on the increase in productivity in threefold and the total

number of cookies produced by a machine through an established automated process against manual method.

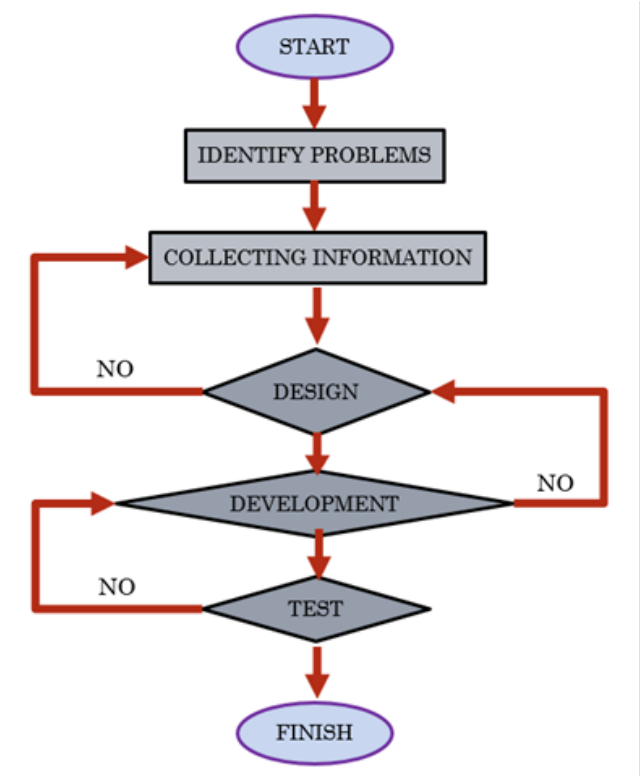


Figure 4: Methodology of the project.

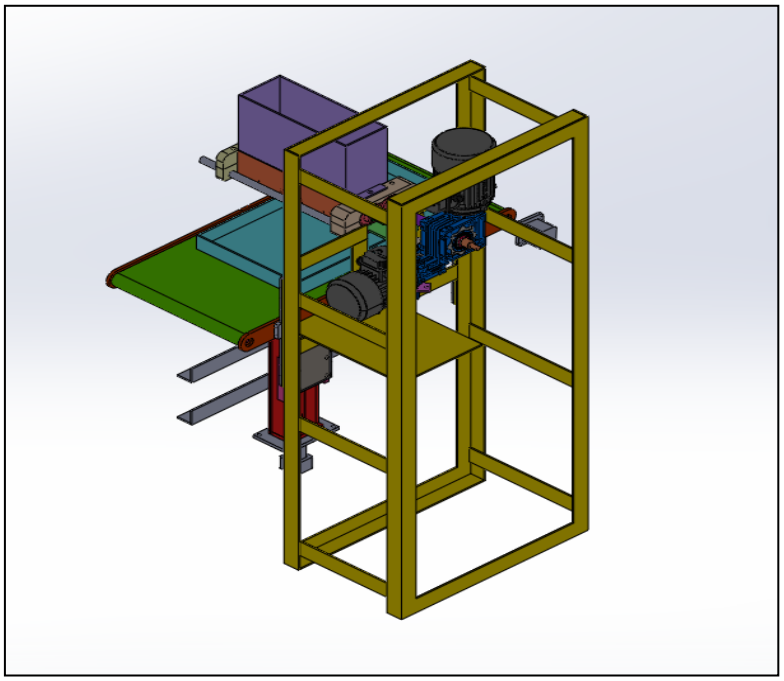


Figure 5: Assembly of Fully automatic High-Speed Cookies Depositor Machine (HS-CDM).

4. RESULTS AND DISCUSSION

After finishing the development of the High-Speed Cookies Depositor Machine (HS-CDM), the machine was operated to evaluate the productivity of cookies produced. The design and productivity results are summarized below in Figure 5 and Table 1.



Figure 6: Fully automatic High-Speed Cookies Depositor Machine (HS-CDM).

The speed of production increases almost 3 times or 300 percent per day compared to manual methods. The company can produce in large quantities within a short period and less labour cost. Worker's job scope can be reduced and combined in one process. Hence, the salary cost can be reduced. Worker's tiredness and exhaustive due to the long period of standing work can be reduced due to a combination in one process as monitoring the machine works.

In the future, this machine can be combined with the dough operation in the mixing process. This way, the process will be faster and easier because the only operator puts the raw material into the machine, and then the machine will process everything to produce biscuits. The machine design can also be designed with a small compact size, but the concept is the same so it can save space in the factory.

Table 1: Description of the state of the art including information on similar product available in the market and existing market size

No	Product name	Features
1.	 **Figure 1: Piping bags and coupler**	a. Mostly used by cookies maker. b. Cheap and available in most bakery shop. c. Time-consuming and high labour cost (manually). d. One cookie per press.
2.	 **Figure 2: Press Gun Biscuit Machine**	a. A new tool to replace piping bags and coupler. b. Cost around RM 50 to RM 200 (depend on Size and brand). c. Time-consuming and high labour cost. d. One cookie per press. e. Better than piping bags and coupler.
3.	 **Figure 3: FALCON Magic Maker (Enon 2016)**	a. A new machine. b. Cost around RM 5000 to RM10000(depend on size and brand). c. Time-consuming (manually). d. One cookie per press.

Table 2: Result of productivity.

No	Description	Machine	Manual
1	Production of Cookies (1 Tray)	3 minutes	10 minutes
2	Production of Cookies (1 Hour)	12 Tray	4 Tray
	Productivity Increase	3 times or 300 %	

5. CONCLUSION

The progressively growing market demand for home-made halal cookies led to many small and medium companies to seek alternative ways to increase their sales by increasing production. This project was undertaken to simplify production and cost savings of the cookie manufacturing. The local halal home-made cookie products will also be able to compete against imported cookies products in the market. The project of HS-CDM is to make the production of cookies become fully-automated and reducing the production cost of the company. This process requires more than one worker mainly in dough filling and compress. The time allocated for each process is longer compared to using the automatic machine. Although the cost to develop this machine is huge worthwhile with the result of the quantity produced, this machine can also last a long time because the material used to produce it consists of aluminium and stainless steel. The concept of HS-CDM is to make the cookie's production process easier and faster. HS-CDM will increase the production rate of cookies, which will also increase the production turn around. The size and thickness of the cookies will become standard.

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FISH CHIPS DRYING MACHINE INNOVATION

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Abstract. The objective of this project is to develop food drying machine that can be operating during monsoon season. This machine is designed to overcome many problems occur during drying process such as a confine space, long drying periods under sunlight, less hygiene and need more manpower. Generally, food drying process using the concept of drying and air circulating control. By using this machine, drying process of the food is done simply by relying in the machine and can be monitored using IoT technology. This food drying machine consist of framework, body and 12 racks made from stainless steel for hygiene purpose. Node MCU is used as a controller to monitor the temperature reading in the machine. Smartphone is used to send the temperature reading using MIT application Wi-Fi or internet connection are required in this project. The temperature inside the machine must be monitor from 40°C to 60°C to make sure the fish chips is dry completely as conventional method. The machine can produce 300kg per day. Overall, this drying machine project may develop and sustained food industry manufacturer manner especially in fish chips industries.

Keywords: Fish chips, IoT, drying machine, MIT application

1. INTRODUCTION

Nowadays, many of manufacturer start to use modern technology in producing fish chips. The usage of 80% modern technology contribute to the sustainability of food industry widely operated in coastal areas in the state of Terengganu, Kelantan, Johor, Kedah and some parts of Pahang. Some of modern technologies are include fish bone separator, frozen meat chopper, fish dough mixer, fish dough roller, fish dough slicer and tossing table (Ahmad Haziq,2015).

In fish chips industry, most of the production process is conducted by semi-automated machine such as mixing and grinding. However, the drying process is still conducted manually. In conventional method, the fish chips are arranged and dried on a board called '*pemidai*'. As shown in Figure 1, the fish chips are placed on '*pemidai*' under the sunlight so that the fish chips are exposed to the heat and wind to be dried. Nowadays, this method is considered the most convenient and practical. Besides, the operating cost is considered cheap. However, this method is exposed to the low level of hygiene and bad weather that can limit the potential of the fish chips to be manufactured in high volume and exported to the other countries (Mohamaddan,2015).



Figure 1: Fish chips drying process using '*pemidai*'

By using the '*pemidai*' the fish chips are contaminated by dust and dirt from air pollution. Besides, the fish chips are exposed to the animals and insects such as birds, mice, flies, etc. During the raining season especially at the east coast area in Malaysia, more time is needed to dry the fish chips. In order to meet the market demand, new method for the drying process need to be invented. However, in general the research on food drying machine is considered limited.

2. LITERATURE REVIEW

Drying is a mass transfer process consisting of the removal of water or another solvent by evaporation from a solid, semi-solid or liquid. This process is often used as a final production step before selling or packaging products [1]. Usually the drying process of the food is done simply by relying on sunlight, weather and wind. When unpredictable weather conditions the drying process takes time, especially during monsoon or rainy season. This has caused demand for the season to be unfulfilled and the economy is sluggish that month. There have three problems are the drying process fully depends on weather and sunlight, when rainy day, the drying process will take a long time and unable to meet the market demand especially on monsoon season. Therefore, it is requiring an innovation machine that can solve the above problem without changing its shape, smell and taste.

Noraien Mansor (2014) found that the reason why fish chips in the past did not last long and dried up easily. This condition is due to the microorganism that came into direct contact from hands that handle the fish chips that was said to be polluted. In the traditional method, fish chips were placed on *pemidai* under direct sunlight which is consider as exposing them to low level of hygiene. Bad weather was also the cause that made the chips could not last longer. Furthermore, improper processing method cause damaged to the product of a good quality fish chips. It began with fresh raw materials that were needed to be processed in a short time at suitable temperature to avoid deteriorating food quality. The method using this machine can reduce time to dry fish chips 3 hours compared to 2 days of drying under the sunlight. By introducing these machines all the problem that mentioned before has been saved without change in the texture, shape, smell taste and quality of fish chips.

3. METHODOLOGY

Usually the drying process of the food is done simply by relying on sunlight, weather and wind. When unpredictable weather conditions the drying process takes time, especially during monsoon or rainy season. This has caused production cannot meet the demand for those months. Therefore, it is requiring an innovation machine that can solve the above problem and can be monitored by phone using IoT technology. One of the ways of solving food drying process is by using the concept of drying and air circulating control. Food is dried using

this machine without changing its shape, smell and taste. This machine operates using 240V power supply with ventilation system. The supply will automatically cut off if the temperature reach 60 °C. The rack will limit to 12 racks (4kg per rack) and will only carry 80kg per serve. Complete drying within 3-4 hours and can be monitored by phone using IoT technology. Using the concept of drying, circulating air and relays can minimized electricity. Figure 2 show the hardware design for Drying Machine.

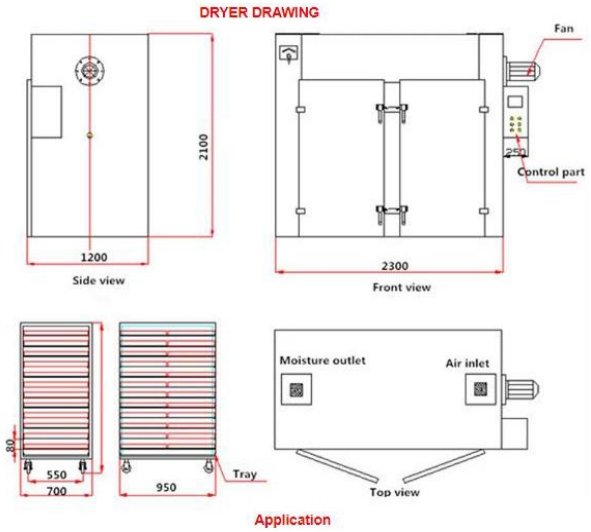


Figure 2: Hardware design for Drying Machine

3.1 Project design

The size of the structure frame in figure 2 is 2000mm length, 1000mm width and 1800mm height. The main material used in the frame design is 2.54 cm x 2.54 cm hollow aluminum square steel because this type of material is a light weight and anti-corrosion. The machine also covered with eight fans to circulate air in the machine with two heater fans to produced heat which 2000W, 50 HZ and 220 Volt for the 45 - 60 °C heat. A pair of the door is also provided to ease the users to load and unload the trays in the drying chamber.

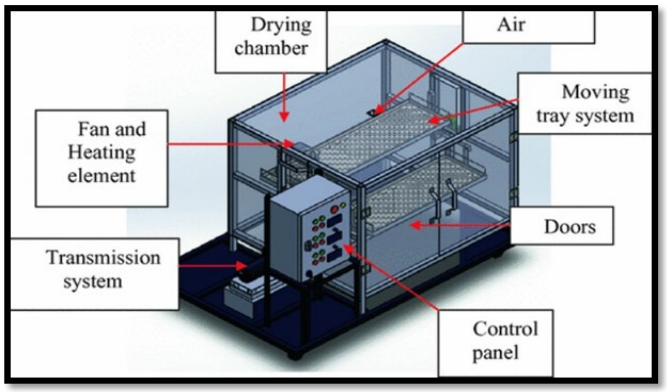


Figure 3 : Interior design Drying Machine

The food drying machine use a power supply to on the system which is Arduino NodeMCU as a controller. Using Arduino, the machine can control on and off monitor the temperature in machine. When the machine is functioning, the fan is spinning, temperature sensor also detected the temperature in machine and the heater fan also evacuate the heat as shown in Figure 4.

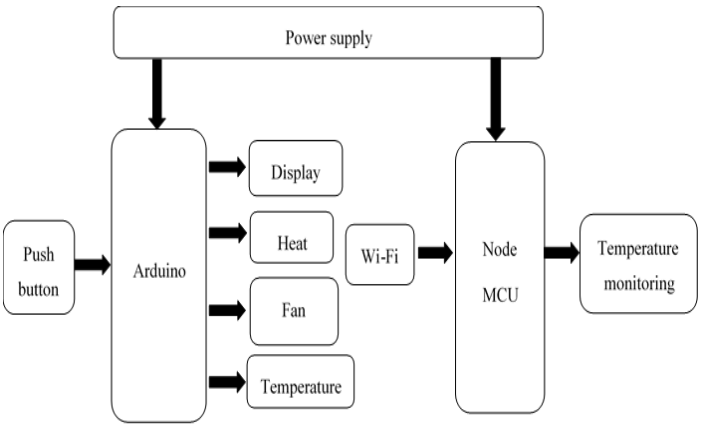


Figure 4: Block Diagram of Drying Machine

Assignment of Inputs and Outputs of the Arduino is assigned to determine the operation of the machine. The controller operational is determined by all the external input and output devices connected to the Arduino must be assigned corresponding to the input and output number. Table 1 shows the assignment of the inputs and outputs specification pin lead to the Arduino.

Table 1: Input -Output table design for Drying Machine

No.	Arduino pin number	Component	Input -output status
1	D6	Start button	input
2	D7	Stop button	input
3	D8	Emergency button	input
4	Rx	Sensor (Temperature DHT 11)	input
5	D0/ D1	Relay 1 (Heater 1)	output
6	D2/D3	Relay 2 (Heater 2)	output
7	D4/D5	Relay 3 (Spare)	output
8	Tx	Buzzer	output

3.2 Drying machine control flow chart

The flow chat used in fish chip drying machine control system technique is shown in Figure 5. The control is programmed in either automatic or IoT controller. When the automatic switch is turned on, the heater and fans start, and the drying process begins. Pilot lamps are utilized as an indicator to represent condition operation.

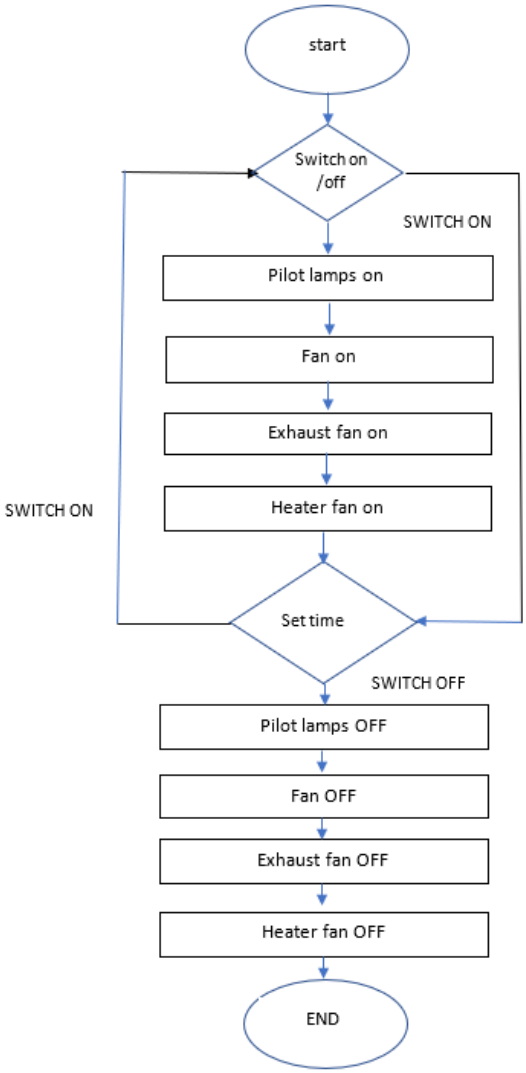


Figure 5. Flow chart for Drying Machine control

4. RESULTS AND DISCUSSION

Drying Machine consists of two part which are hardware and software. Figure 6 show a Drying Machine which can control ON and OFF using IoT application. When the machine is functioning, the fan starts to spin, temperature sensor also ON to detect the temperature in machine and the heater fan also evacuate the heat. After a few minutes, the fish chips will be kept into the machine using NodeMCU as a controller, the temperature can be monitored at the machine using smart phone together with connection to the Wi-Fi. As shown in Figure 7.



Figure 6: Drying Machine

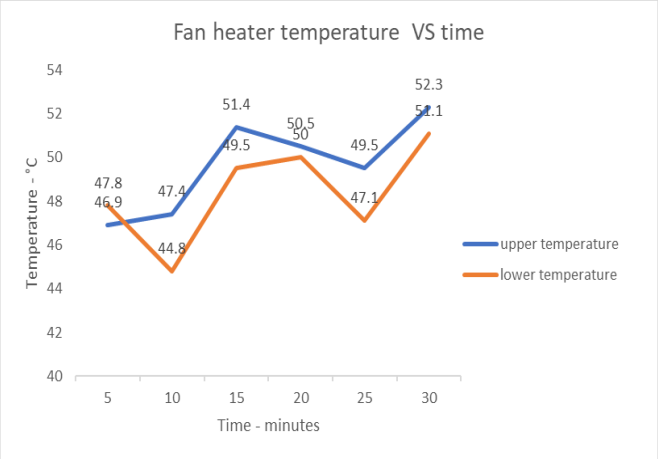


Figure 7: IoT GUI display using MIT software

Drying Machine has a strong mechanism to accommodate 12 racks of food in drying machine within in one time. The heat measurement of the machine was plots lower and upper side of the machine. The reading in Table 2 below shows after 5 minutes the reading is constant both side inside the machine. These can be achieved using eight fans circulated air inside the machine during process.

Table 2: Reading of Drying Machine temperature

Temp Sensor	Time (Min)					
	5	10	15	20	25	30
Upper side (°C)	46.9	47.4	51.4	50.5	49.5	52.3
Lower side (°C)	47.8	44.8	49.5	50.0	47.1	51.1



Graph 1: Fan heater vs temperature (Upper side and Lower side)

4.1 Estimate electricity usage

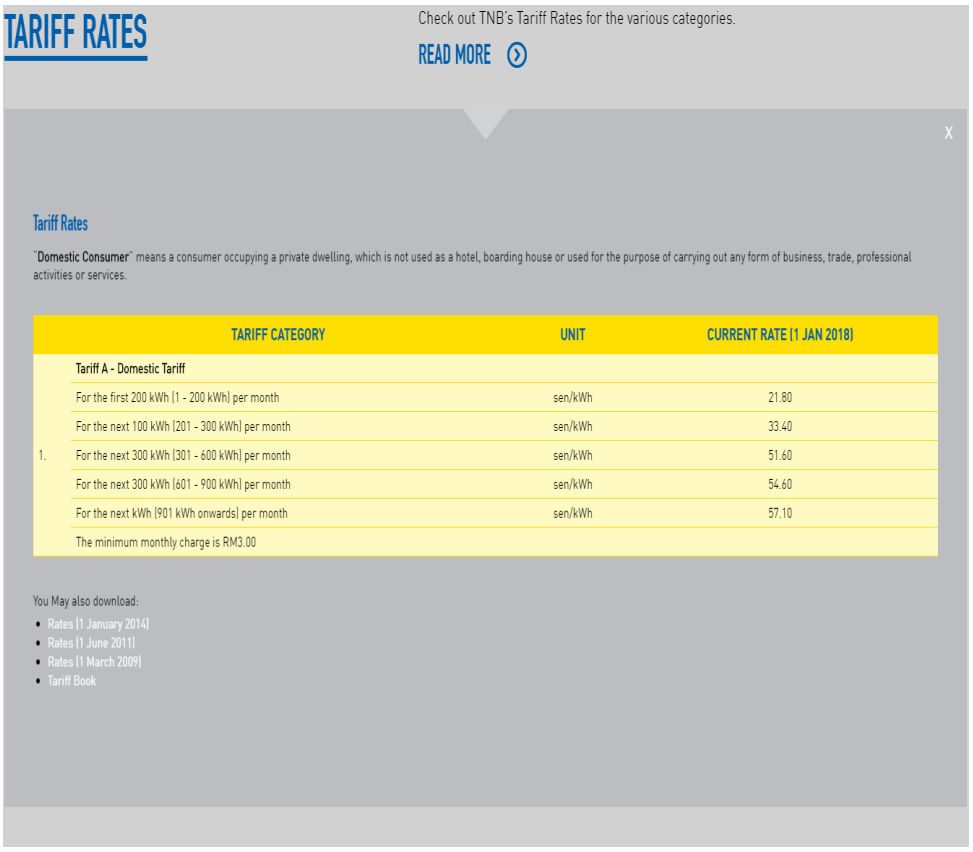


Figure 8: TNB's Tariff rates

Table 3: Estimate electricity power usage per day

Load (KW)	Hour used per day	KWH/day	day in month	KWH/Month
4.5	12	54	30	1620

Table 4: Estimate electricity charge per month

KWH	RATE (RM)	Total (RM)
200	0.218	43.6
100	0.334	33.4
300	0.516	154.8
300	0.546	163.8
720	0.571	411.12
1620		806.72
	Total RM/month	806.72
	Total RM/day	26.89

5. CONCLUSION

This project has been successfully developed and implemented at Fayyad Ventures Enterprise. Previously the conventional method was used where the fish chips was arranged under the sunlight on a board called '*pemidai*'. The method was considered less hygienic since it was exposed to the dirt and dust and less practical especially during the raining season.

Furthermore, by using this drying machine the result showed it can reduce time of drying process and provide clean surrounding during the drying process. Drying Machine also reduced using large spaces. The biggest advantages of these machine are it can monitor using smartphone to on/off the machine. The method using this machine can reduce time to dry fish chips 3 hours compared to 2 days of drying under the sunlight. However, some improvement can be taken as further work.

The recommendations and suggestions for the improvement can be listed as follows;
a) The graphical user interface (GUI) is does not have a special function to control the heat of heater fan. The system will be better if the function is added into the system software.
b) The wiring is too complicated, and the best way is to simplify the components wiring connection.
c) The developed system still has differences readings between control panel and GUI, Some modification needs to be done to the microcontroller to ensure that the GUI reading will be more reliable.

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IoT BASED WASTE MONITORING SYSTEM FOR RECYCLE CONTAINER VIA BLYNK APPS

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Abstract. This paper proposes a design and development of a monitoring system for recycle container via internet of things (IoT) technology. The project focusses on the solution of improper waste management due to the lack of waste monitoring practices that contribute to the waste overflow in recycling container. The ultrasonic sensor is placed on top of the container to measure the distance between sensor and recycle waste from 3cm to 35cm. ESP32 NodeMCU module is performed as a process and control device to read output from the ultrasonic sensor. The Blynk app is an IoT platform which indicates the waste distance in the recycling container from time to time. When the waste reaches 3 cm, the local recycling provider will be informed that the recycling container has reached the maximum storage level and ready to be collected by truck. The LED on the recycling container will turn on to indicate that the recycling container is full and needs emptying. So that, this system able to help local recycling provider to manage waste collection and prevent the recycle waste from overflow.

Keyword: Internet of Things (IoT), Blynk app, ESP32 NodeMCU, Recycling Container

1. INTRODUCTION

Nowadays, the waste disposal issue becomes major problem with the increasing amount of waste. The amount of waste that has been thrown away was not environmentally friendly and bad in ethics (Yahaya, 2003 & Jeremy et al., 2015). It is due to the high number of gigantic growths in Malaysian economy that increases the workforce population. This situation causes the increasing of the waste amount generated the in city (Kathirvale et al., 2004). Sin et al. (2012) found that, there are 37000 tones waste generated daily.

In Malaysia, state of council or private organization for waste collection and landfill management authorize the management of waste. Currently, they manage the waste via fix waste collected schedule based on the area (Sin et al., 2012). The waste was delivered to the landfill for waste disposal purpose. This activity promotes the bad effect on the environment and health due to the improper waste handling. The burning process is one of the cheap and easy solutions to ensure adequate landfill area. This manner encourages the lead of air pollution (Hassan et al., 2018).

Some waste wasn't suitable to be burned, which make landfill as the common method to dispose waste. Proper waste management system was needed to reduce the waste amount that disposed in landfill (Sin et al., 2018). All countries in the world are going green by controlling the human activities that cause damage to the environment. The most popular activity that has been implemented all over the world is recycling activity. Through recycling activity, the country encourages the best way to dispose the recycle waste (Yahaya, 2003 & Jeremy et al., 2015) such as plastics, paper, metal, glass etc.

Recently, the recycle waste was collected by local recycling provider. However, the collection system was not implemented in a proper way which is based on waste collection schedule. Current system was not allowing workers to access the recycle waste level in the recycle container (Patel et al., 2019). This cause the system used was not efficient in term of time and fuel cost (Rashinkar et al., 2017). The IoT based waste monitoring system for recycle container via Blynk apps was developed to allow workers from local recycling provider to access the recycle waste level in real time waste management system. Through this monitoring system, the local recycling provider can manage the recycle waste properly and the waste overflow problem can be solved.

2. LITERATURE REVIEW

In Malaysia, recycling activity was applied to manage the waste regularly and organized by local recycling provider. However, the monitoring of the waste was not efficient and not green (Jeremy et al., 2015). Figure 1 shows the recycling container used and placed in appropriate area with dense of community.



Figure 1: Recycle container as temporary waste storage

Community Recycle for Charity (CRC) has been collaborating their activities with 50 partners. This organization is one of the local recycling providers which is provide recycle waste collection services in community since 2008. The collection will be separated for charity purpose. CRC has been installed 400 containers around Klang Valley and their collection amounts are more than 10461897 tones recycle waste (Introduction CRC, 2017). iCYCLE is another local recycling providers that has been established in 2013. iCYCLE provides more than 200 recycle waste containers around Malaysia. iCYLCE encourage the recycle activities by rewarding recycle point (RP) for those throw the recycle waste in their containers. iCYCLE develops three mobile apps which is iOWT, KitaR3cycle and ThreeHugger that allow community to monitor their recycling activities and track their carbon saving. Besides, the apps help people to interact with community to make a better environment (Our Solutions, 2018).

However, lack of the waste monitoring cause the waste become uncontrollable and unmanageable (Tan et al., 2019). This happens because there is no indicator sent to the local recycling provider to show that the container was full of waste. The local recycling provider collects the waste by truck due to the fix recycle waste collection schedule. This practice brings on the disease on public health. Figure 2 shows the recycle container condition when the container was full of recycle waste.



Figure 2: Recycle container with full of waste

Even though the recycle waste was consisted of the dry waste, a bunch of water can be resulted after rainy. The condition encourages the larva formation by mosquito and cause the dengue disease to spread easily in the community. This unhealthy surrounding may affect the quality of life among the community (Prassanna et al., 2018 & Patole et al., 2018).

To overcome the chain of problem, Internet of Thing (IoT) over internet access was proposed to connect the physical device with the local recycling provider. IoT is an advance communication technologies method through internet with electronic devices. Govindraj et al. (2017) found that IoT helps in development of smart system by allowing people to communicate with other users/devices using appropriate protocols . IoT was contributed a lot in development of a smart home (Bhat et al., 2017), smart cities (Rajab et al., 2018) and others. More than 50 billion devices will be connected via internet by 2020. This matter will alter the life quality, working practice and entertainment approach (Evans et al., 2011).

Nowadays, IoT has been applied to improve the plantation monitoring system. Marcu et al. (2019) found difficulty to maintain and improve the quality and productivity of plant due to weather and natural disaster. IoT monitoring solution has been built to monitor on plant growth, plant diseases, and soil properties. The properties parameter was monitored using Libelium. Libelium is a platform that provides hardware and software used in IoT solution system based on Wifi network. The system was helping to produce healthy plant.

Besides that, IoT technology helping a design of automated parking system in a smart campus. The user waste their time to find a parking lot due to the large number of vehicles. Singh et al. (2018) developed an intelligent parking system which is allowed user to identify location of available parking lot. These systems use IR sensor to detect the present of vehicle in a parking lot and NodeMCU to inform the availability of parking space via MIT Inventor (Zig Bee). When Zig Bee apps receive requirement to park from user, the monitoring system collect the parking status and check the availability of the parking lot. If no parking available, the system will check at the other area around the campus. So user can find out an available parking at that time.

Sultana et al. (2017) conducted project development on IoT based garbage monitoring system. The purpose of the project is to improve the waste management in urban/rural area by allowing a real time waste monitoring access. Wifi IoT module ESP8266 was connected to AT89S52 microcontoller to ensure the waste monitoring system via internet connection. The load cell is used to read the waste weight. This project can detect the waste level in the trash bin via load cell. In this project, load cell act as a sensor which is convert the waste weight into measurable electrical output. When the garbage was filled up, the transmitter sent the waste information to local waste providers for waste collection purpose. The project was succeeded to solve waste overflow in the trash bin.

In this work, a recycling container was proposed by applying the IoT technology, which is enabling solution for smart monitoring system with the combination of electronic sensor and

microcontroller. The blynk application was used as the interface between the waste and the local recycling provider. This solution will increase the work efficiency by the local recycling provider and allow a systematic waste collected based on the needs.

3. RESEARCH METHODOLOGY

This project is an IoT project, which supports green activity by using Blynk Apps to monitor the recycle waste level. Figure 3 shows the block diagram of recycle container system. The project frameworks include the use of ultrasonic sensor as sensing component to measure the distance of recycle waste in the container. ESP32 NodeMCU was used to send the information about the waste level in the recycle storage to the local recycling provider. The red and green LED connected to the output. Green LED shows the waste still can be stored into the container while a red LED shows the waste has reached the limit (minimum distance) and the container almost full to the community.

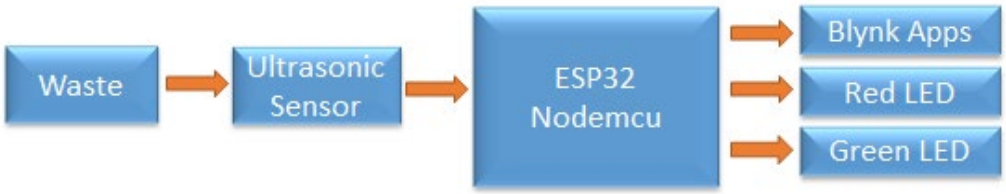


Figure 3: Block diagram of recycle container system

3.1 Ultrasonic Sensor
The ultrasonic sensor is a stable device that used to measure distance accurately. The range of the distance is from 2cm – 400cm. The ultrasound wave will be bouncing back to the sensor at setting distance.

The ultrasonic sensor is consisted of VCC, GND, Trig and Echo pin. VCC and GND will be supplied from port 5V and the GND of the Arduino . Trig and Echo was connected to Arduino digital input pin. Trig act as transmitter while Echo as receiver. Ultrasound signal was generated when Trig pin high for 10us. Then Echo pin was received 8 cycle sonic burst at frequency 40 kHz (Patole et al., 2018).

The sensor operate at 5V supply. The voltage regulator circuit of LM7805 was connected to the sensor to give supply input. The circuitary also consisted of two capacitor in input and output pin. The 9V battery was connected as input voltage to the regulator. Then the output was step down to 5V.

3.2 ESP32 Nodemcu
ESP32 NodeMCU is combination of microcontroller and Wifi module which is open source of IoT Platform. This device comes with dual core 32-bit processor, built-in WiFi and Bluetooth, more RAM and Flash memory, more GPIO, more ADC, and many other peripherals. The ultrasonic sensor was attached to the NodeMCU to detect the maximum recycle waste level in the container. The nodeMCU works at voltage suppy 3V.

3.3 Blynk Apps
Blynk Apps is the applications that can be perform with iOS or Andriod to control Arduino, NodeMCU, Raspberry Pi, etc. The graphic can be easily design by dragging and dropping the widgets as user necessary. In this project, Blynk server was used to forward the notification between NodeMCU and Blynk mobile apps.

3.4 System Flowchart
Figure 4 shows the system flowchart of the project. The system starting when the device connected to internet (Wifi). When the ultrasonic sensor read 3 cm distance, the 'STORAGE

FULL' notification will appear into the smart phone. If the ultrasonic sensor detect distance more than 3 cm, the measured distance will appear on the Widget Blynk Apps.

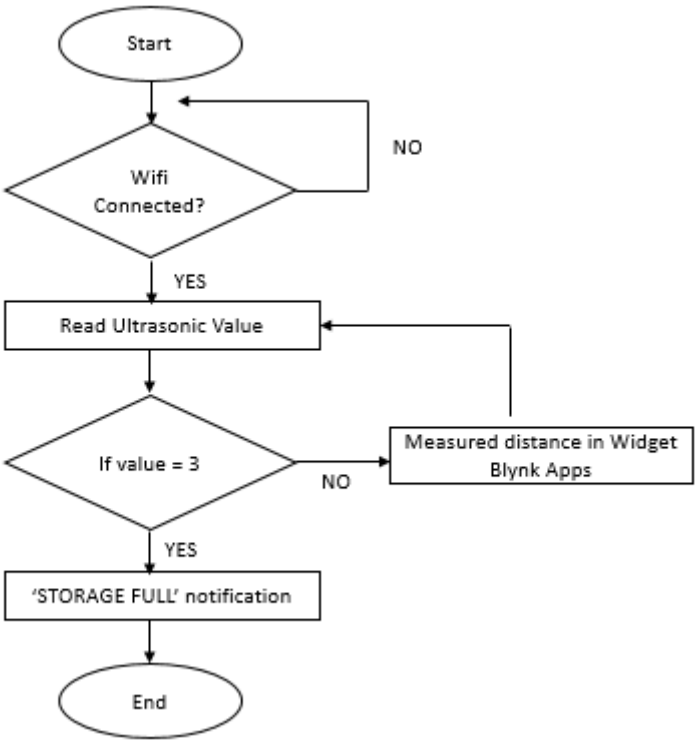


Figure 4 : System flowchart

4. RESULTS AND DISCUSSION

This section discussed on the hardware and software development of the project as a real time application system.

4.1 Hardware Development

The ultrasonic sensor is measuring the recycle waste level in the recycle container with 35 cm maximum distance and 3 cm minimum distance. The measurement started when the user throws the recycle waste into the container. The ESP32 NodeMCU which is acting as a controller of the system will sent measured distance from the ultrasonic sensor.

There are two LED was used as the indicator to the user. Green LED allows user to throw the recycle waste into the container while Red LED alerts user to stop throwing the recycle waste until all waste in the container is collected by local waste provider. Figure 5 shows the prototype of recycled container which attached with ultrasonic sensor. The Green LED was turned on due to the available storage space for recycle waste in the container.

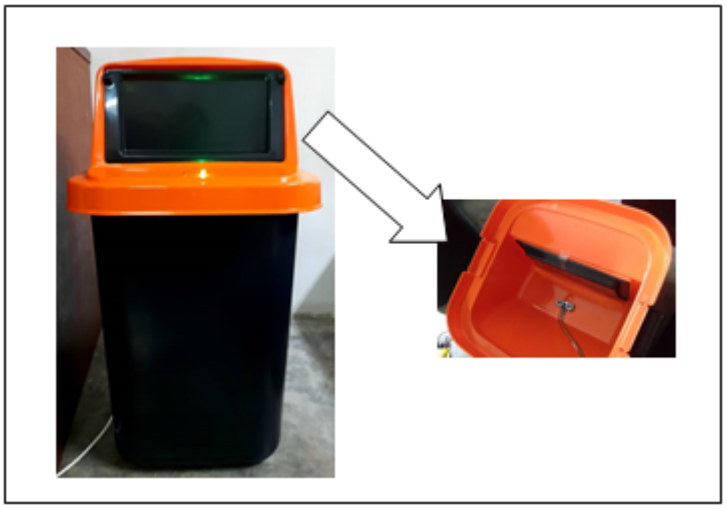


Figure 5 : Prototype of recycle container

4.2 Software Development

The Arduino software (IDE) is used as a platform for coding writing using C language. The coding is uploaded into the ESP32 NodeMCU microcontroller to send the measured distance into Blynk Apps. The microcontroller built-in with the wifi module makes it offers the IoT technology. Figure 6 shows the schematic diagram of the proposed project.

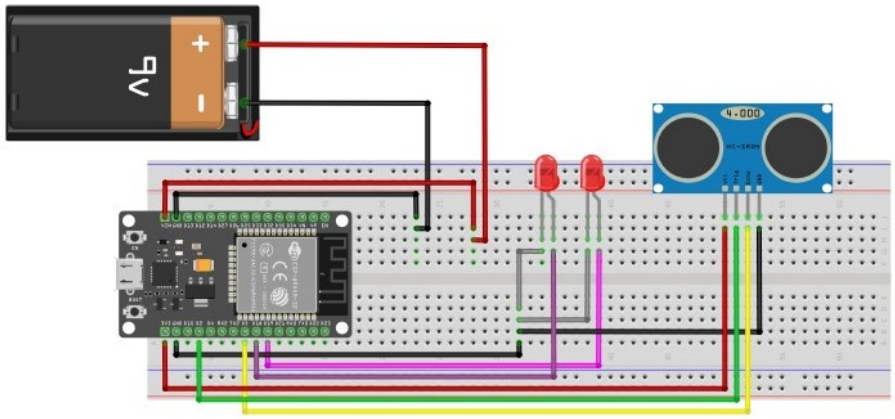


Figure 6 : Schematic diagram of the project

The microcontroller is sent the measured distance from time to time continuously. Figure 7 shows the distance between recycle waste and ultrasonic sensor in the container for local waste provider information via Widget Blynk Apps interface. Figure 7(a) shows the recycle waste in the container with 3 cm distance. Figure 7(b) shows the recycle waste in the container with 18 cm distance. Figure 7(c) shows the 35cm distance between sensor and recycle waste.

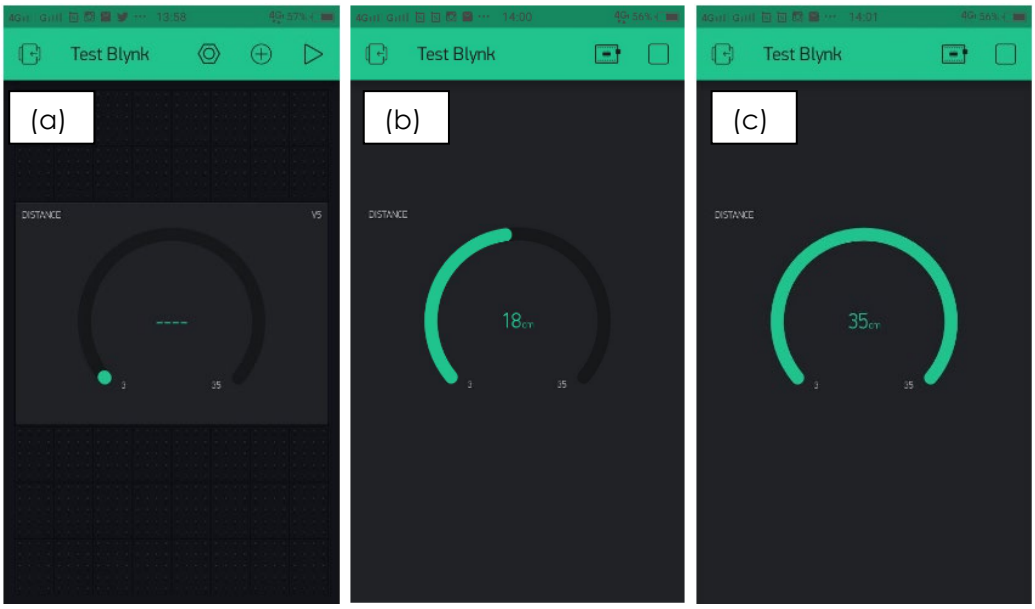


Figure 7 : Blynk Apps Interface for (a) 3cm distance, (b) 18cm distance, (c) 35cm distance

Figure 8 shows the notification received by the local waste provider through a smart phone. The notification will alert the local waste provider to take the further action such as sending truck waste transportation. So that, they can reduce the transportation cost and save the environmental (Rashinkar et al., 2017).

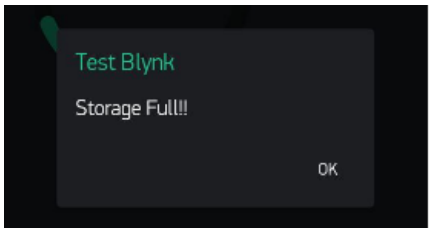


Figure 8 : Notification Sent via Blynk Apps

4.3 Data and Analysis

Table 1 shows the finding on the measured distance between ultrasonic sensor and the recycle waste. When the waste distance at masximum (35 cm), the recycle container was emptied. It shows that no recycle waste has been thrown into the container. At 18 cm distance, half of the recycle container has been filled with the recycle waste. Then the distance between sensor and recycle waste is decreasing into 3 cm. The recycle container was already full with recycled waste.

Table 1: Finding on the sensor and recycle waste distance

Waste Distance	Findings
35 cm	No recycle waste in the container
18 cm	Recycle waste has been thrown until half space of the container
3 cm	Full recycle waste in the container

The proposed project has been tested at a student's hostel in PSAS. The frequency of student's throwing the recycle waste can be identified as shown in Table 2. The analysis of the distances was measured between the ultrasonic sensor and recycle waste in 10 hours. The system starts measuring from 10 am until 7 pm.

Table 2: Analysis of the distance measured in 10 hours

Time	Time (Hour)	Distance (cm)
10:00 am	1	35
11:00 am	2	32
12:00 am	3	29
1:00 pm	4	18
2:00 pm	5	10
3:00 pm	6	8
4:00 pm	7	5
5:00 pm	8	3
6:00 pm	9	3
7:00 pm	10	3

Figure 9 presents the graph of waste distance versus time that has been monitored in 10 hours. At 10.00 am, the storage space in the container was still empty. Students start throwing the recycle waste after 10.00 am. The recycle waste has been thrown frequently at 12.00 am until 2.00 pm due to the highest slope in the graph. At this time, most of the waste is from food packaging, plastic bottles and plastic cups. The graph shows the lowest frequency at 2.00 pm until 3.00 pm. It may due to the students are finishing their break time and starting their online classes. The recycle container was full at 5.00 pm. The recycle waste was remained at 3 cm distance because the waste has not yet been collected.

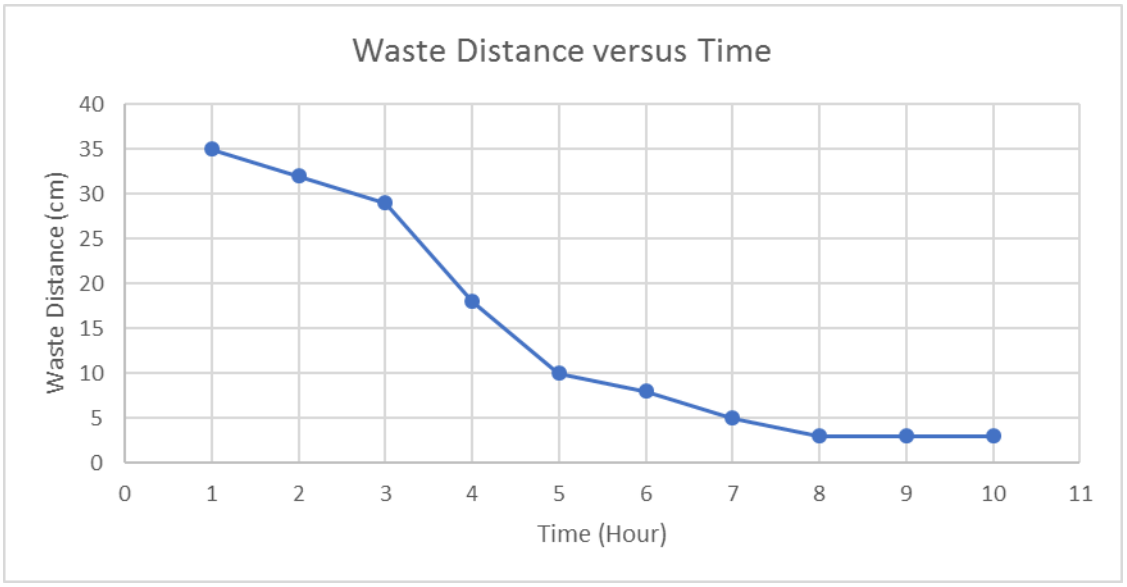


Figure 9 : Graph of waste distance versus time in 10 hours

5. CONCLUSION

The IoT based waste monitoring system for recycle container was successfully designed and developed by applying the IoT technology. The proposed project able to help the local recycling provider to monitor the highest and lowest frequency of the recycle waste disposal by the community. The project also able to help the local recycling provider to manage and monitor the recycle waste level in the container in a real time system. The project may help the local recycling provider to reduce the time collection and fuel cost due to the number of truck routing. Therefore, this project may give solution to increase the work efficiency by the local recycling provider and allow a systematic waste collected based on the needs and avoid waste overflow. The project was tested and proved that the monitoring system can be

applied in a real time. Besides, the implementation of IoT technology by monitoring system can contribute to the development of a smart city.

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FABRICATION OF PROTECTOR FIXTURE TO REDUCE REJECTED PART CAUSE BY WELDING SPATTER

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Abstract. This study aims to develop a welding spatter protector fixture. The fixture would help to reduce the rejected part retainer sub assembly center floor cross member caused by welding spatter. The robotic CO_2 welding was used on the welding process in the assembly part Front Floor Rear and Hanger Exhaust Pipe. The spatter from the welding process caused damage on the parts surface and tread nut. Thus, required additional work or the damaged part or lead for rejection. Rework or parts rejection increase manufacturing cost. The newly developed protector fixture successfully eliminates the rework process and the rejected parts. The study was conducted in the production line (assemble CO_2 welding).

Keyword: welding spatter, protector fixture, assembly parts, reduce rejected part, robotic welding.

1. INTRODUCTION

Today, the world has advanced with technologies that are rapidly developing to facilitate human affairs. With the advent of cutting-edge technology, the automotive industry has also not been left behind in keeping up with the latest technology. The automotive industry is very important in this world as it contributes to the economic growth of the country (Oriental Summit, 2020). Figure 1.1 shows the robotic assembly CO_2 welding at Company O to assembly the part after the stamping process.



Figure 1.1 Robotic assembly CO_2 welding

Company O spatter welding can be observed at the 57055 Retainer Sub Assembly Center Floor Cross Member of the main child part using CO_2 welding robot. The production of the particular part undergoes developmental trial assembly before mass production which will be supplied for customer and Local Part Verification Vehicle (LPVV).

The actual assembly jig without a protector in the assembly line causes the welding spatter to be accumulated on the surface of the part after the CO_2 welding process between the child part Front Floor Rear and Hanger Exhaust Pipe. Figure 1.2 shows a top view of the actual jig assembly without the fixture.

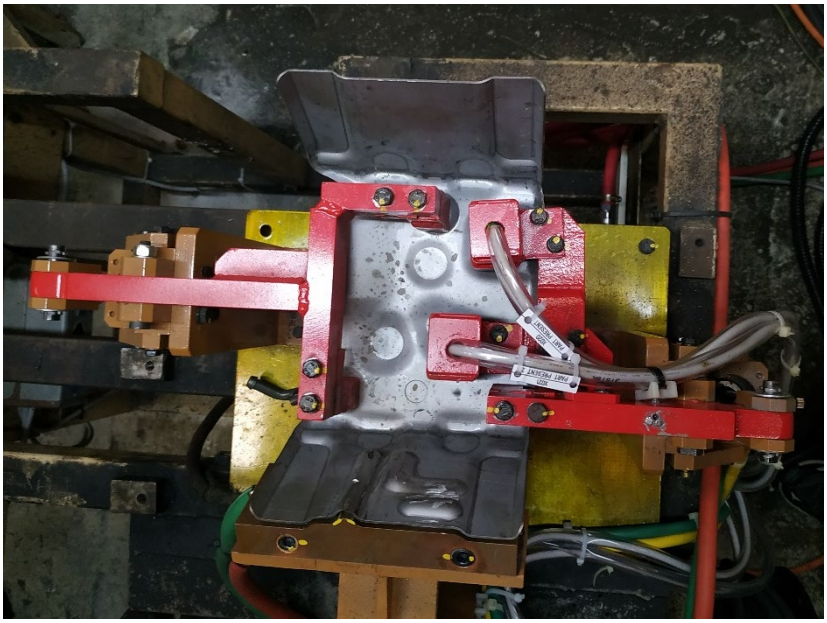


Figure 1.2 Top view of the actual jig assembly without the fixture

The assembly process at Robotic CO_2 welding is that there is spatter welding during the assembly of the child part between Front Floor Rear and Hanger Exhaust Pipe. This welding spatter also enters the thread nuts on part Retainer Sub Assembly Centre Floor Cross Member that may cause the bolts to not be tightened neatly. Figure 1.3 welding spatter enters the thread nuts. On average, 32 pieces rejected parts in a day. Thus, the parts were cannot be used due to the presence of the welding spatter on the nut threads.

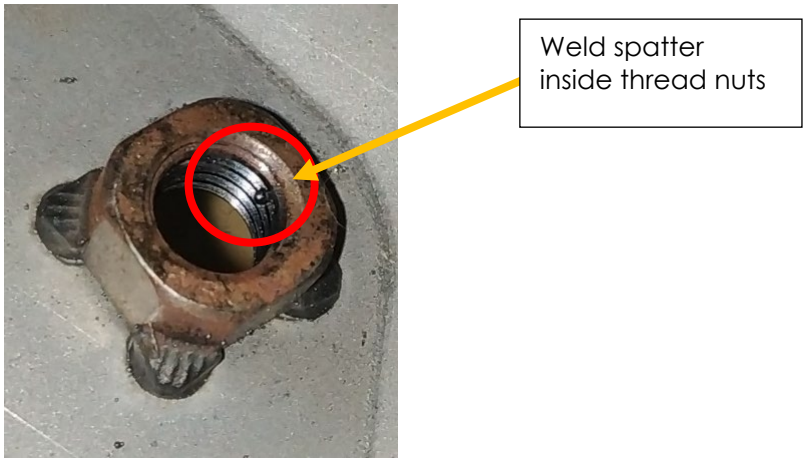


Figure 1.3: Welding spatter enters the thread nuts

2. LITERATURE REVIEW

2.1 Welding Fixture

Jigs or fixtures in welding can influence the cost, quality, and productivity. Besides, jigs or fixtures can decrease the distortion that happens in the welding process. Welding fixtures can also reduce manufacturing lead time for welding, holding parts, and positioning with the reduction of production loss from welding. This could help the worker to finish the welding faster than usual (Makong, 1966).

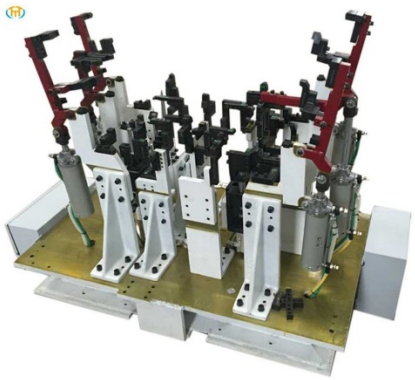


Figure 2.1: Example of Welding Fixture (Makong, 1966)

2.2 Robotic Welding

In the creation and assembling world, quality and efficiency are everything. To stay aggressive, organizations need to search constantly for approaches to build throughput and limit absconds, while likewise minimizing expenses for parts and work. As a rule, going to robotic welding is a way to accomplish those objectives for both the littler activity shop and bigger assembling operation (Tregaskiss, 2020).

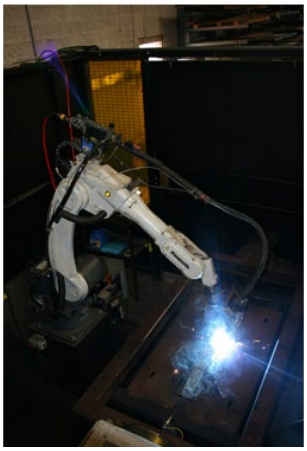


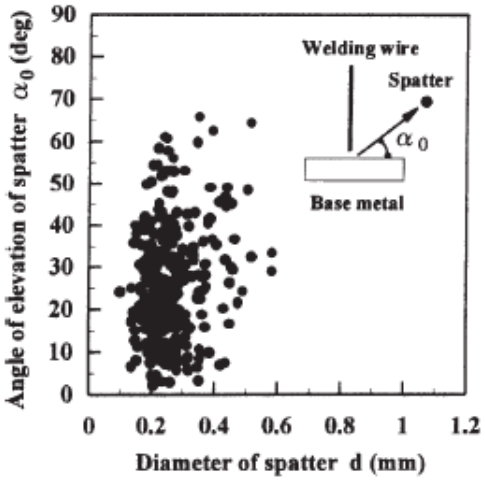
Figure 2.2 Example of robotic welding (Tregaskiss,2020)

2.3 Welding spatter

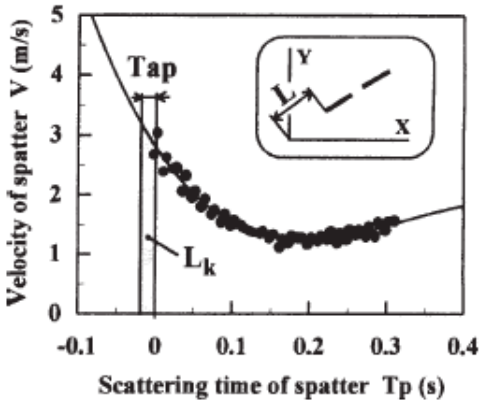
Figure 2.3, 2.4, and 2.5 show the welding spatter cases. Welding spatter is generally caused by the disturbance of the weld pool. These particles are a nuisance to engineering design as they tamper with the surface of the base metal when they stick. They can also cause injuries in the workshop if the welder does not observe safety precautions (Corrosionpedia, 2020).



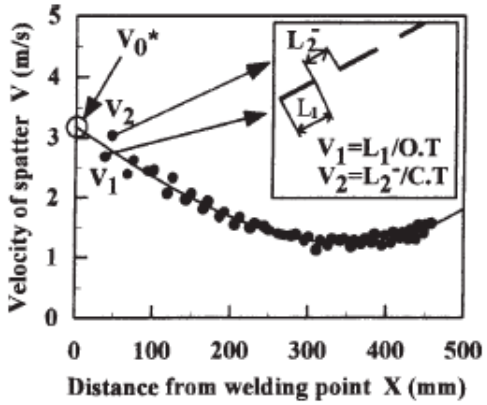
Figure 2.3 Welding spatter on work piece (Corrosionpedia, 2020).



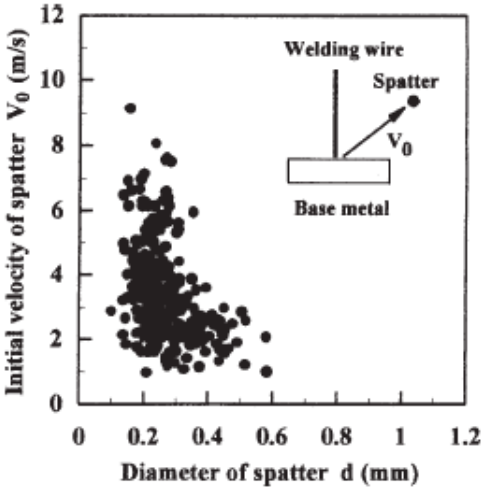
6 *Relationship between the angle of elevation and the diameter of spatter.*



8 *Relationship between the velocity and the scattering time (Tp) of the spatter.*



7 *Relationship between the flight-distance in the X-direction and the velocity of spatter.*



9 *Relationship between the initial velocity and the diameter of spatter.*

Figure 2.4 The factor that affecting the welding spatter Scattering behaviour (Tanaka et al., 2003)

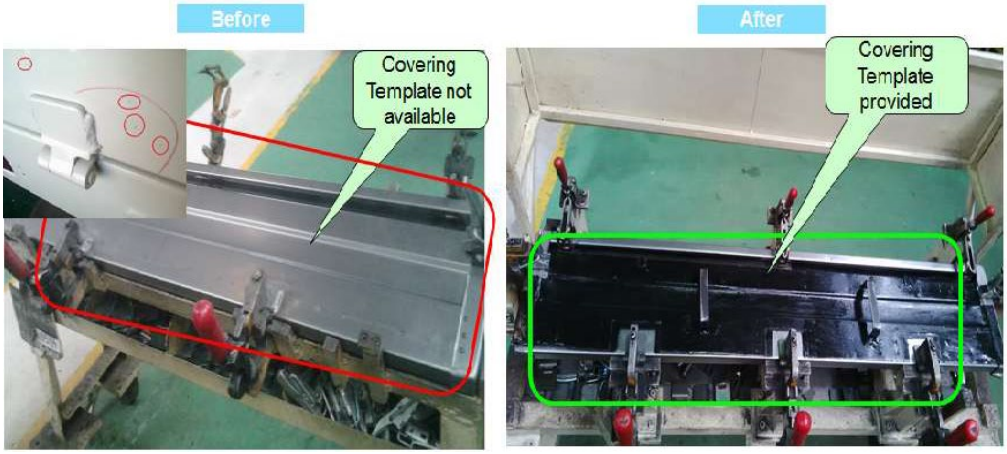


Figure 2.5 CO_2 welding procedure before and after placing the template (Mayur *et al.*, 2020).

2.4 Protector Fixtures Material (Copper)
Copper and copper alloys are important engineering materials because of their good electrical and thermal conductivity, corrosion resistance, metal-to-metal wear resistance and distinctive aesthetic appearance (Indiamart, 2020).

2.4.1 Anti-Spatter Materials
Copper alloys have exceptional mechanical & physical properties as follows:

i. Increased welding spatter resistance which corresponds to fewer maintenance stops during production (Mahale, 2009)
ii. High thermal conductivity of the material cools the welding spatter almost immediately upon contacting the plate
iii. No heat treatment is required – machine it & use it
iv. Higher impact resistance or resistance to distortion.

3. RESEARCH METHODOLOGY

Table 3.1: Fabrication of the Actual Sample Fixture Protector

Fabrication work	Explanation
	Cutting copper plate used band saw machine
	Burring on the copper plate after cutting
	Remove the burring used a grinder machine

	Fitting actual fixture cover on jig assembly CO_2 welding
	Used file on actual fixture protector
	Bending on copper plate follow design jig
 	Side and top view after fitting on assembly jig CO_2 welding

4. RESULTS AND ANALYSIS

4.1 Rejection Before Implementing the Fixture Protector

Figure 4.1 shows the number of parts being rejected before the implementation of the protector fixture. Before improvement was made, 32 pieces parts were rejected and cannot be used due to the presence of the welding spatter on the nut threads.

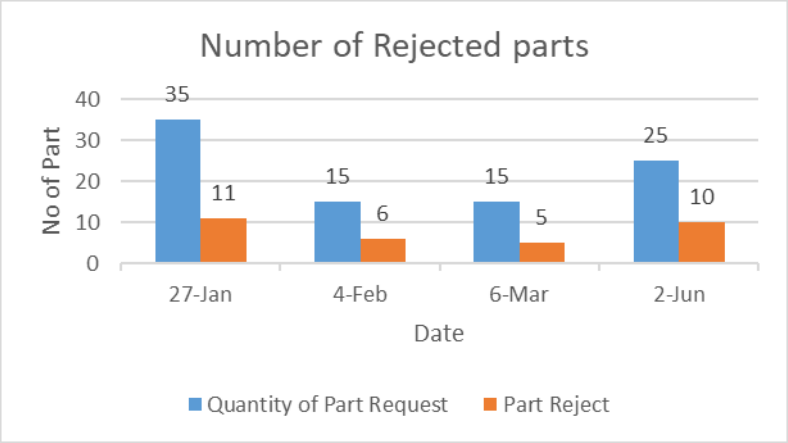


Figure 4.1 Before implementing the protector fixture

4.1 Rejection After Implementing the Fixture Protector

Figure 4.2 above shows that no parts were rejected after the implementation of the newly developed fixture. After improvement using the fixture protector, it was found that 93 pieces of parts did not have any welding spatter inside the nut threads. If welding spatters occur inside the nut threads, it can cause the part to be rejected and no longer be used. After the project was implemented, bolts could be inserted properly inside nuts as no welding spatter was found inside the nut threads, as shown in Figure 4.3.

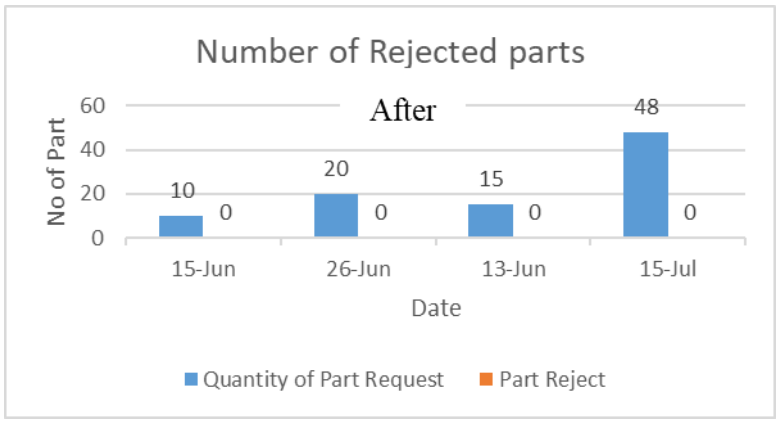


Figure 4.2 Number of rejected parts after improvement

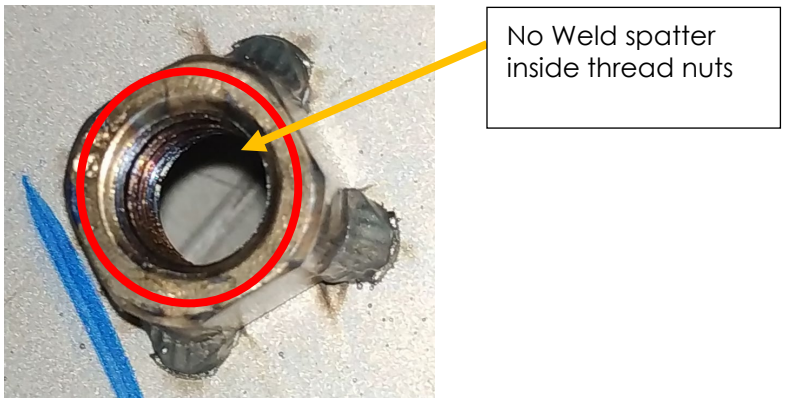


Figure 4.3 Thread nuts without welding spatter

5. CONCLUSION

In the present study, a welding spatter protector fixture was successfully developed, tested, and implemented in the production line. Due to the problems mentioned above, a fixture was fabricated to ensure that the parts are protected from the welding spatter. In designing and fabricating the fixture protector, safety is a crucial factor. From the results of the implementation, it was found that welding spatter was no longer observed on the surface of parts and inside the thread of the nuts. Hence, this indicates that the fixture can be implemented for mass production. After the implementation of the fixture, parts were no longer rejected, which leads to the elimination of the workforce during the rework process. Furthermore, the fixture was also able to reduce the number of rejected parts by 100%, which is a great achievement.

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WOLFRAM ALPHA AS A LEARNING TOOL IN THE TOPIC OF PROPOSITION LOGIC

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Abstract. In this era, the information and communication technologies are growing rapidly. The development of this technology has provided a great influence on the educational system, especially in the learning process. The teaching and learning methods are no longer limited to face-to face learning only, but online learning is also often used among educators and students. In this project, Wolfram Alpha, which is a web tool has been introduced and used as a teaching and learning tool in the topic of Proposition Logic. Proposition Logic is a topic in the subject of Discrete Mathematics. Students can use Wolfram Alpha to improve their knowledge and understanding in this topic. In the last part of this project, the perception of students about the use of Wolfram Alpha in their learning are reviewed. In this study, the questionnaire quantitative method was used to collect the data. Based on the results of the questionnaire showed that majority of students have a positive attitude and motivation to use Wolfram Alpha in their learning. Therefore, the use of Wolfram Alpha can be attracted students to learn Mathematics more deeply. Furthermore, students can develop their potential and knowledge through the use of Wolfram Alpha.

Keywords Wolfram Alpha, Learning Tool, Proposition Logic

1. INTRODUCTION

In this era of information and communication technology, almost everyone has a device or gadget to access the internet. Hence, the education method should make some change so that the teaching and learning techniques are not outdated and keep up with the pace of the time. The educators cannot just use the traditional method, which is face-to-face instruction as their teaching tool anymore. Therefore, many web tools are developed and introduced to help educators diversify their teaching methods. Wolfram Alpha is one of the web tools that is very helpful in teaching and learning. So, the discussion in this chapter focuses on the introduction of Wolfram Alpha, scope, the objective of the study, and the framework of the study. The introduction of Wolfram Alpha provides the exposure about the history and the uses of Wolfram Alpha. The scope of study covers the topics of subject Discrete Mathematics that will be discussed in this study. The objective of the study states the purpose of the review. The framework of the study shows the flowchart on how to carry out this study.

1.1 Introduction of Wolfram Alpha

Wolfram Alpha or Wolfram|Alpha is a computational knowledge engine or answer engine developed by Wolfram Research and released on May 18, 2009. Wolfram Alpha is a web tool which on Wolfram's earlier flagship product Mathematica. Wolfram Alpha has a little bit different approach from a search engine, like Google or Bing, which provides a list of documents or web pages that might contain the answer. Wolfram Alpha is an online website that answers factual queries directly by computing the answer from an external source.

1.2 Scope of Study

This study will focus on the topic of Proposition Logic. A proposition is a declarative sentence that is either true or false, but not both. This research will discuss several compound propositions and the truth table of compound propositions. The topic is included in the

syllabus of Discrete Mathematics, which is a subject offered to students of semester two from the Department of Information Technology and Communication (JTMK), Polytechnic. Therefore, students of semester two from JTMK, Ungku Omar Polytechnic (PUO) who had taken the subject Discrete Mathematics in December 2019 Session are the population in this study.

1.3 Objective of Study

Nowadays, information technologies are developing rapidly and play an important role in many fields, including in the field of education. Many different types of web tools are developed and introduced as a teaching and learning methods in any subjects. Wolfram Alpha, which also is known as an answer engine, is one of a type of web tools that is being used and reviewed in this study. The objectives of this study are:

(i) Exploring the uses of Wolfram Alpha as a teaching and learning tool in the topic of Proposition Logic

(ii) Reviewing the perception of students about the uses of Wolfram Alpha as a teaching and learning tool in the topic of Proposition Logic and also in other subjects of Mathematics.

1.4 Framework of Study

In December 2019 Session, the Department of Information Technology and Communication had divided the students of semester two into six course sections. From the six course sections, only one course section, which is DDTP2A was selected to explore the uses of Wolfram Alpha in the topic of Proposition Logic. After the exploration, students were required to answer the questionnaire.

2. LITERATURE REVIEW

The introduction of new technologies has brought many changes in contents, strategies, and attitudes in education: the computer can be used as a complementary tool for educational training as well as a learning tool on its own. This means that technology can play as a fundamental role in the process of teaching children and adolescents (Sammy, 2018). In the era of information technology, many online web tools are introduced as teaching and learning tools. Online tools and resources have made it easier for teachers to instruct students, and for students to collaborate with those teachers and with other students. Besides, computer softwares which are designed especially for mathematics are used mainly to solve complicated and large-size problems in various areas of mathematics. When one studies a mathematical problem nowadays, tools such as calculators and computers are available for students and teachers. Students can be actively engaged in reasoning, communicating, problem solving, and making connections with mathematics and other disciplines. Technology brings to students and teachers the opportunity to individualize learning, to generate illustrative examples, to follow interesting topics to the desired depth, to choose their own problems and then gather the tools for solving them. Nurlygul (2016) proposed that there can be a huge benefit if teachers and students use ICT in their teaching and learning. The low motivation and the lack of willingness to educate themselves among the students is one of the problems that educators met often nowadays. Students are more interested in using web tools in learning rather than working with a textbook.

Wolfram Alpha is a new product of Mathematica in the information age, which has useful online applications for those who do mathematics using computer. Wolfram Alpha can be an excellent web tool to help students in the way to find the answers for solving mathematics problems. Wolfram Alpha assists students in understanding the steps that are used to obtain a solution for mathematics problems. Wolfram Alpha can be a useful resource to compliment the class work while no replacement class for face-to-face instruction. Besides, Wolfram Alpha also is very useful for students who like to solve through the problems by themselves or those who may be reluctant to ask for help (Grantham, 2014).

There is less resources relevant with the use of Wolfram Alpha in Discrete Mathematics that can be found. Discrete mathematics is the study of mathematical structures that are

fundamentally discrete rather than continuous. Discrete mathematics has been introduced in the 1980s, initially as the computer science support course. The research in discrete mathematics increased in the latter half of the twentieth century partly due to the development of digital computers which operate in discrete steps and store data in discrete bits. Among the fields covered by discrete mathematics are theoretical computer science, information theory, logic, set theory, combinatorics, graph theory, discrete probability, number theory, algebra, discrete calculus, geometry, topology, operations research, game theory, decision theory, utility theory, social choice theory, discretization, discrete analogues of continuous mathematics, hybrid discrete and continuous mathematics. The Wolfram Language has been used to make many important discoveries in discrete mathematics over the past two decades. Its integration of highly efficient and often original algorithms and together with its high level symbolic language has made it a unique environment for the exploration, development, and application of discrete mathematics.

A lot of researches have been conducted to examine the motivation and attitudes of students in learning mathematics. Most of the results of the studies show the positive relation between the motivation of students and their achievement in Mathematics. An article by Davis (2015) shown that students who self-assess their work become top students. Wolfram Alpha is an excellent tool for those interested in self-assess learning method. This is because Wolfram Alpha has the step-by-step instructions which can help students in learning mathematics. The immediate feedback from Wolfram Alpha helps students teach and learn by themselves. The feedback time for mathematics problems should be as close as zero as possible. By using Wolfram Alpha, the motivation of students can be improved. Students was attracted to learn Mathematics more deeply. Furthermore, students can develop their potential and knowledge through the use of Wolfram Alpha.

3. METHODOLOGY

In this study, two hours class session was conducted for the students of DDTP2A on the use of Wolfram Alpha in the topic of Proposition Logic. To use Wolfram Alpha as a teaching and learning tool in this topic, students just need to enter the website address: http://www.wolframalpha.com/. Figure 1 shows the website of Wolfram Alpha.

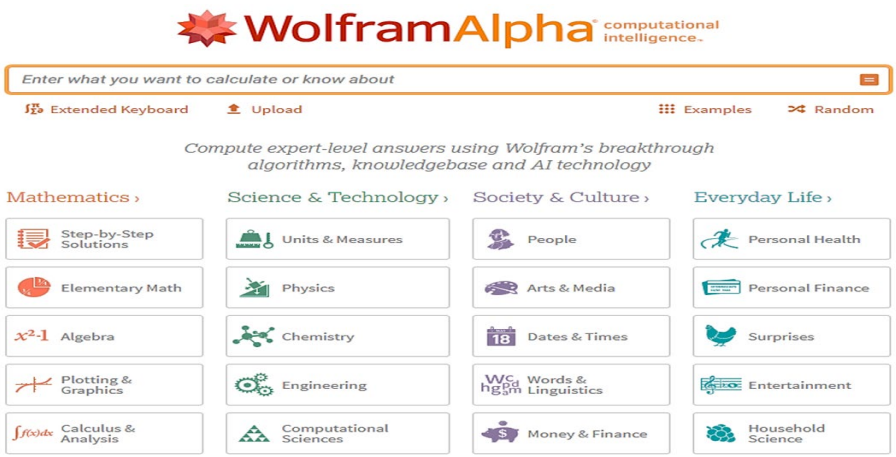


Figure 1: The website of Wolfram Alpha

3.1 Use Wolfram Alpha as a Teaching Tool in the Topic of Proposition Logic

To search the definition of proposition by using Wolfram Alpha, students just need to type "definition of proposition" and click enter, then they can directly get the result as the Figure 2.

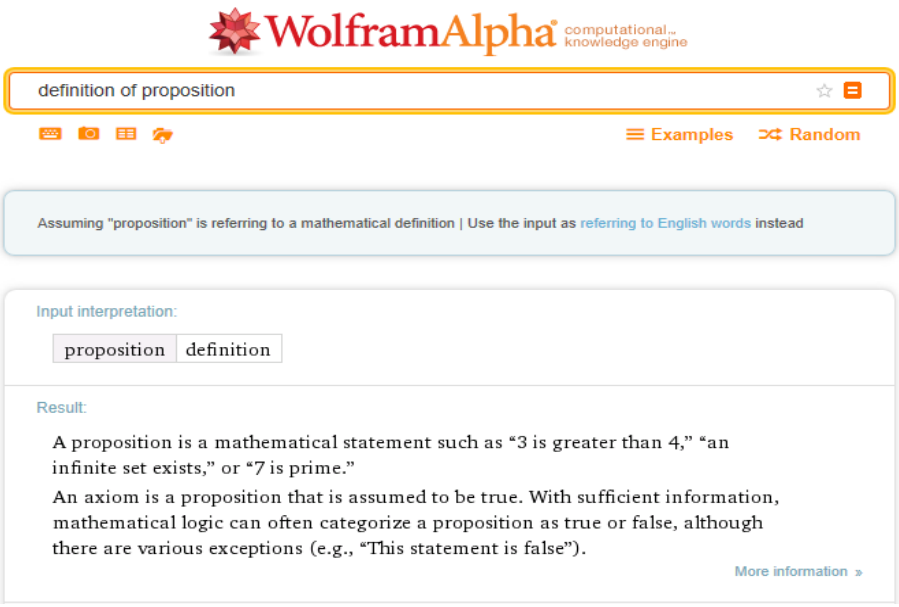


Figure 2: Definition of proposition

There compound propositions in basic logic mean the combination of one or more proposition. The logical operators that use to combine the propositions are negation, conjunction, disjunction, conditional, and biconditional.

In this topic, students must know how to construct a truth table to represent a compound proposition. Wolfram Alpha gives a great help in checking whether the truth table that the students construct is correct or not. For example, if students want to check the truth table of negation, they can follow the command and get the result as in Figure 3.

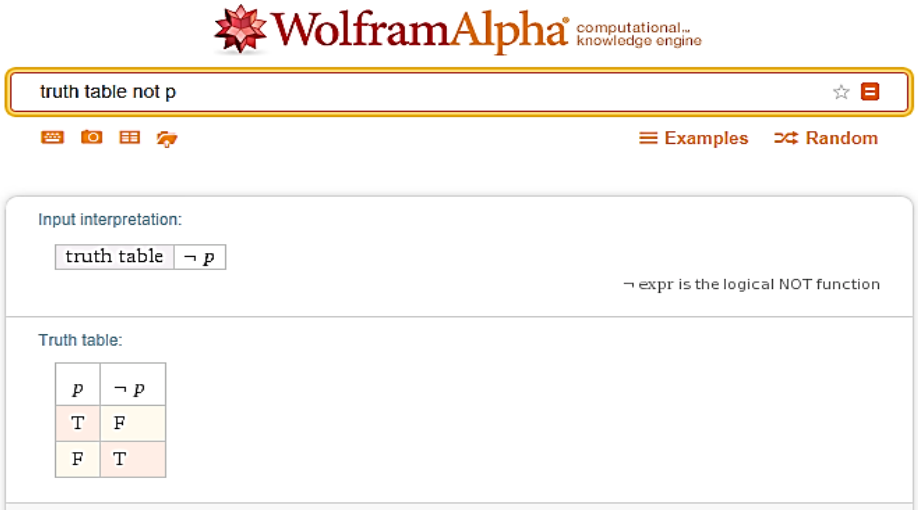


Figure 3: Truth table of negation

One thing that should be noticed by students is that they must give a clear and specific command to get the desired result. For example, if students type "truth table of negation", then they will find another result and unlikely as desired by them. Figure 4 shows the result of "truth table of negation" which does not specify cases that we discuss here.

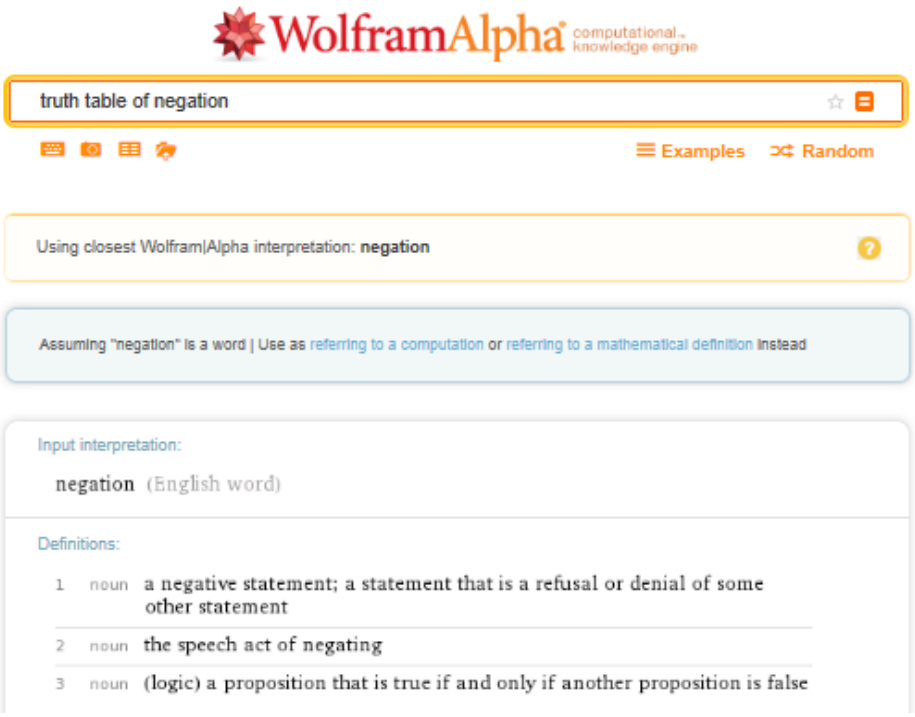


Figure 4: The result of wrong command "truth table of negation"

In Basic Logic, we can use more than one logical operator in a compound proposition. For example, students can check the truth table of the compound proposition $(p \wedge q) \rightarrow \neg p$ by using Wolfram Alpha. However, students can only type the command in symbols if they have purchase the Wolfram Alpha Pro. For Wolfram Alpha, it does not support for this function. So students must know the keyword of the symbols and type the command in words only. To get the truth table of $(p \wedge q) \rightarrow \neg p$, students can use the command as "truth table p and q implies not p" and they can get an answer as shown in Figure 5.

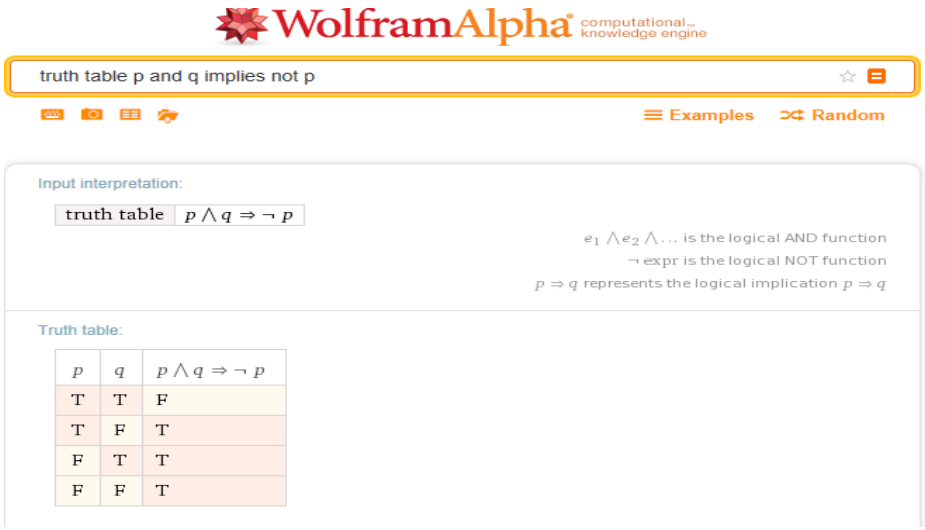
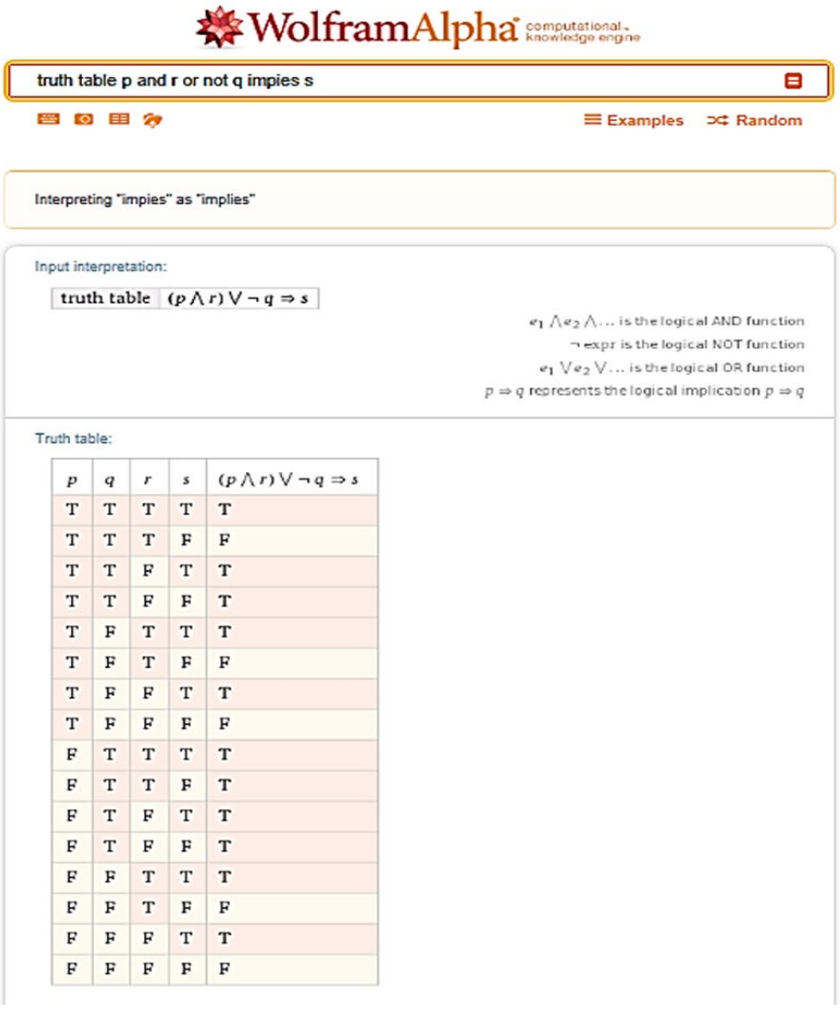


Figure 5: Truth table of compound proposition $(p \wedge q) \rightarrow \neg p$

Now, if students want to construct a truth table for a compound proposition which combine more than three propositions, Wolfram Alpha can also simply provide the result. For an example, students can check the result for the truth table of compound proposition $(p \wedge r) \vee \neg q \rightarrow s$ by following the command as in Figure 6.



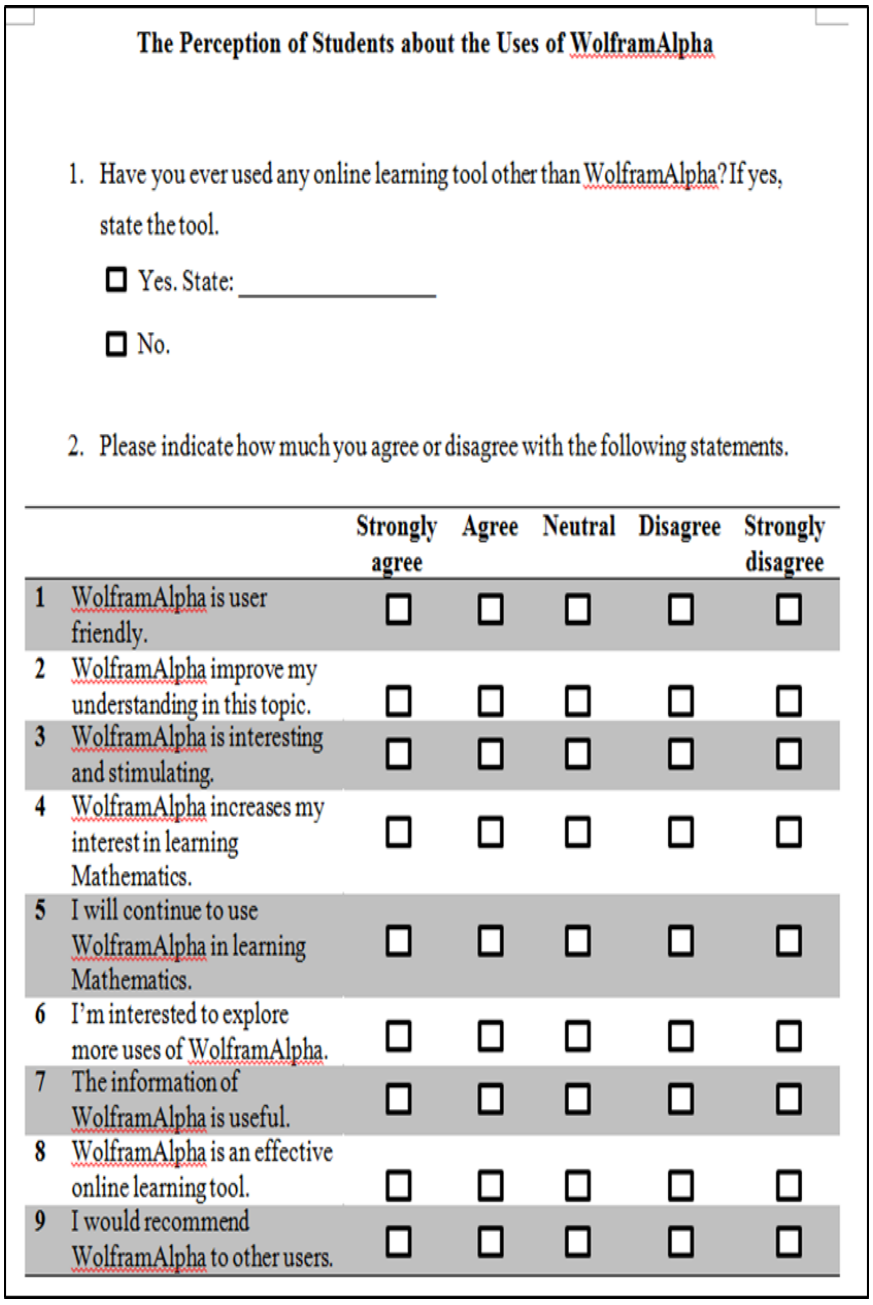
p	q	r	s	$(p \wedge r) \vee \neg q \Rightarrow s$
T	T	T	T	T
T	T	T	F	F
T	T	F	T	T
T	T	F	F	T
T	F	T	T	T
T	F	T	F	F
T	F	F	T	T
T	F	F	F	F
F	T	T	T	T
F	T	T	F	T
F	T	F	T	T
F	T	F	F	T
F	F	T	T	T
F	F	T	F	F
F	F	F	T	T
F	F	F	F	F

Figure 6: Truth table of compound proposition $(p \wedge r) \vee \neg q \rightarrow s$

4. THE ANALYSIS AND THE RESULT OF STUDY

In this research, the questionnaire is used to collect the quantitative data about the perception of the respondents after they have explored the uses of Wolfram Alpha. The questionnaire that is used in this study is quantitative questionnaire. There are two types of questionnaire's questions, open-ended and closed-ended. In this study, closed-ended is chosen as the questionnaire design and two types of closed-ended questions are being the part of the questionnaire design, which are closed-ended Dichotomous questions and closed-ended Likert questions.

In the questionnaire, only one Dichotomous question is being asked to determine whether the respondents have ever used any online teaching tool other than Wolfram Alpha. The other nine questions are Likert questions, which are created to measure the perception of respondents about the uses of Wolfram Alpha as a teaching and learning tool in the topic of Proposition Logic. Figure 7 shows the print screen of the questionnaire that is used in this study.



The Perception of Students about the Uses of WolframAlpha

1. Have you ever used any online learning tool other than WolframAlpha? If yes, state the tool.

   ☐ Yes. State: _____

   ☐ No.

2. Please indicate how much you agree or disagree with the following statements.

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	WolframAlpha is user friendly.	☐	☐	☐	☐	☐
2	WolframAlpha improve my understanding in this topic.	☐	☐	☐	☐	☐
3	WolframAlpha is interesting and stimulating.	☐	☐	☐	☐	☐
4	WolframAlpha increases my interest in learning Mathematics.	☐	☐	☐	☐	☐
5	I will continue to use WolframAlpha in learning Mathematics.	☐	☐	☐	☐	☐
6	I'm interested to explore more uses of WolframAlpha.	☐	☐	☐	☐	☐
7	The information of WolframAlpha is useful.	☐	☐	☐	☐	☐
8	WolframAlpha is an effective online learning tool.	☐	☐	☐	☐	☐
9	I would recommend WolframAlpha to other users.	☐	☐	☐	☐	☐

Figure 7: The questionnaire with the title "The Perception of Students about the Uses of Wolfram Alpha"

The numbers of respondents that take part in the questionnaire are 35 students from class DDTP2A. For the sole Dichotomous question in the questionnaire, 8 respondents answered "yes" and the other 27 respondents answered "no". This means 77% of the sample does not have the experience to use any online learning tool other than Wolfram Alpha. Another 23% of the sample have used an online learning tool other than Wolfram Alpha, which is SYMBOLAB.

Beside the Dichotomous question, there are nine items using the Likert scale in the questionnaire. Each respondent is asked to rate each item on a response scale. For instance, they could rate each item on a 1-to-5 response scale where 1 – Strongly Disagree, 2 – Disagree, 3 – Neutral, 4 – Agree, and 5 – Strongly Agree. Table 1 shows the results obtained from the closed-ended Likert questions questionnaire.

Table 1: The results obtained from the closed-ended Likert questions questionnaire

Number	Items	Scale				
		5	**4**	**3**	**2**	**1**
1	WolframAlpha is user friendly.	23	7	5	0	0
2	WolframAlpha improve my understanding in this topic.	14	14	4	3	0
3	WolframAlpha is interesting and stimulating.	16	13	5	1	0
4	WolframAlpha increases my interest in learning Mathematics.	10	11	9	5	0
5	I will continue to use WolframAlpha in learning Mathematics.	12	13	8	2	0
6	I'm interested to explore more uses of WolframAlpha.	11	14	9	1	0
7	The information of WolframAlpha is useful.	13	13	8	1	0
8	WolframAlpha is an effective online learning tool.	14	13	6	2	0
9	I would recommend WolframAlpha to other users.	15	11	5	4	0

Based on the Table 1, majority of respondents are giving a positive reaction to the uses of Wolfram Alpha as a teaching and learning tool in the topic of Proposition Logic. This can be seen from the responses, 51.4% of students strongly agree that Wolfram Alpha is user friendly and 45.7% of students strongly agree that Wolfram Alpha is interesting and stimulating. Besides, 40% of students strongly agree that Wolfram Alpha improve their understanding in the topic and it is a useful and effective online learning tool. Furthermore, 34.3% of students strongly agree that they will continue to use Wolfram Alpha in learning Mathematics and are interested to explore more use of Wolfram Alpha. In addition, 28.6% of students strongly agree that Wolfram Alpha increases their interest in learning Mathematics and they would recommend Wolfram Alpha to other users.

5. DISCUSSION AND CONCLUSION

The questionnaire that was answered by respondents have shown a positive reaction of the uses of Wolfram Alpha as a teaching and learning tool in the topic of Proposition Logic. An assumption that students will be more interested and motivated in learning Mathematics with the use of Wolfram Alpha can be made since most of students strongly agree the items in questionnaire.

The problem found in this research is the resources which relevant to this study are limited. There are most researches which are focused on Mathematica, but the researches focusing on Wolfram Alpha are not so much. Besides, the researches which relevant with the use of Wolfram Alpha in Discrete Mathematics is also hard to find. Therefore, the lack of resources becomes a limitation in writing the literature review.

Based on the results of the questionnaire showed that the majority of students have a positive attitude and motivation to use Wolfram Alpha in their learning. Therefore, the use of Wolfram Alpha can be attracted students to learn Mathematics more deeply. Furthermore, students can develop their potential and knowledge through the use of Wolfram Alpha. This study might give an implication for students, educators, polytechnic's educational system, and industry. The implication for students is they become more interested in learning Mathematics after exposure to the use of Wolfram Alpha. In addition, this study may also open the minds of educators to focus on the variety of learning techniques. Educators should engage students

to think creatively and always explore some new teaching methods to improve the knowledge of students. With the improvement of students' knowledge, it would also provide useful benefits to outsiders, especially the industry. Employees with higher knowledge will be hired by the industry and might be able to boost the productivity of the industry.

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INVESTIGATION ON THE EFFECT OF DARKNESS LEVEL OF DARKROOM IN DETECTING VEHICLE DEFECT

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Abstract. This study is entitled the Investigation on the effect of portable LED light system in detecting vehicle defect. Visual inspection is one of the methods utilised in Non-Destruction Inspection (NDI). In this study, visual inspection is used as the method to detect the presence of emergent bump or dent on surface of vehicles' body. The current darkroom have been implemented with facilities such as LED lamps as to aid in defects' detection on vehicles' body surface. The lamps' bulbs are covered with green and yellow lumine color in order to create contrast sensitivity between the LED's light and luminance of darkroom. These two aspects play crucial role in revealing the presence of defects on vehicles' body. The objectives of this project are to eliminate the outflow defect of body in the production line by covering all holes in the darkroom to achieved the required darkness level or illuminance (30-50 Lux). By setting up an appropiate darkness level (30-50 Lux), the outflow defects or Defect Per Unit (DPU) data showed a uniform reduction.

Keyword: Lux, Illuminance, Defect per Unit (DPU), Visual Inspection, Bump or Dent.

1. INTRODUCTION

The external appearance and surface of a vehicle are the most crucial significant factors that give impact on viewer's first impression. This component will be hard to change by any arguments heard in the ensuing negotiations.

Figure 1.1 shows the shell parts of the product which include the front door, rear door, hood, back panel, side outer, front pillar, center pillar, and lower pillar.



Figure 1.1 Product's shell parts side view

These part will be visually checked and inspected for dent, scratch and bump on the surface in order to get rid of the defects on the shell body's surface. The visual inspection has been used in the maintenance of facilities, which means the inspection of equipment and structures. Based on Beyerer et. al (2016), visual inspection is an inspecting method by looking and observing. Therefore, there is a dark and confined space or workstation called the darkroom that has been facilitated with LED lamps where the bulbs were covered with

lumine plastic colored in green and yellow to allow the color contrast between the product's surface in order to detect any dents or bumps. These features of the facilities provided in the darkroom are utilized as to aid in visually inspection and detection of dents or bumps (Figure 1.2).



Figure 1.2 Darkroom in surface detection workstation (Darkroom)

Plus, there is an issue about the darkness level in the darkroom. The darkroom has an inappropriate darkness level (100 lux) that was supplied in the current situation. This darkness level is not appropriate for defects (bumps and dents) visual inspection especially for identifying fine dents and bumps. The darkness level affects the revealing and visualizing of the defects where the darker darkroom will provide a better view for team members to inspect the defects visually. Figure 1.3 below shows the current darkroom's darkness level.



Figure 1.3 Current darkroom's darkness level

This issue have caused misdetection of defects (dent or bumps) which lead to outflow defects in the production where over processing work happen and it is considered as waste or Muda as stated in Bodek (2006). Figure 1.4 below shows data of misdetection of defects or Defect per Unit (DPU) in a October 2019. It shows that the DPU is exceeding the monthly target (1.5 DPU).

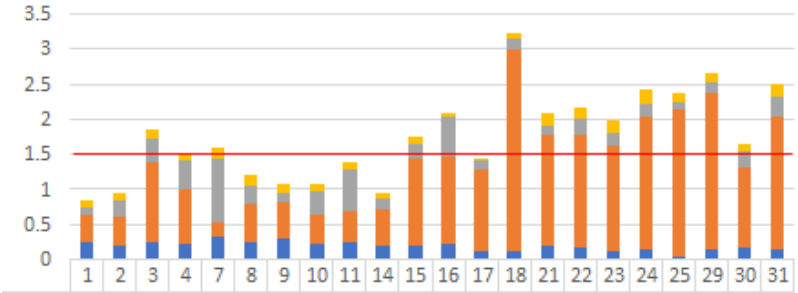


Figure 1.4 Data of misdetection of defects or Defect per Unit (DPU) in October 2019

2. LITERATURE REVIEW

2.1 Visual Inspection

According to Prakash Hiralal Joshi (2010), inspection fixtures is one of the inspection tools that have high accuracy and compatibility in visual checking (Bhavsar 2017) Apart from simply utilizing the assessor's eye, which only investigates general defects or flaws such as that shown in Figure 2.4, simple viewing can detect fine surface defects (Heslehurst, 2014).

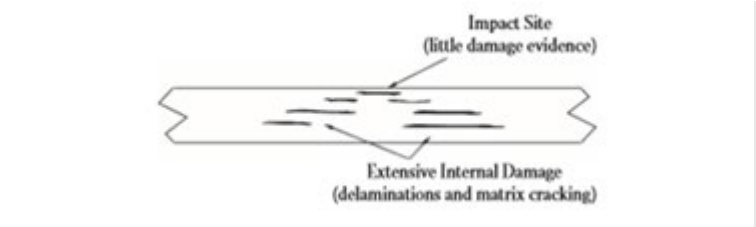


Figure 2.1 Barely visible impact damage (BVID) [4]

2.2 Material Defects

Materials-processing defects occur during the production and preparation of the constituent materials of a prepreg (preimpregnated composite fibers) because of improper storage or quality control and batch certification procedures leading to material variations Heslehurst, (2014). As tabulated in Table 2.1 based on Heslehurst, (2014), dent is one of the composite material defects.

Table 2.1 Types of composite material defect [4]

Bearing surface damage	Blistering	Contamination
Corner crack	Corner/edge splitting	Corner radius delaminations
Cracks	Creep	Crushing
Cuts and scratches	Damaged filaments	Delaminations
Dents	Edge damage	Erosion

2.2.1 Dent

The depth of dent is interpreted as the maximum reduction in the pipe's (object) diameter in contrast to the authentic diameter. This interpretation of dent depth incorporates both the local indentation as well as any difference from the nominal circular cross-section [5]. Flaws or defects such are dents, improper surface finish, large cracks, cavities, and wrong dimensions are suit to be detected and revealed by using visual inspection (Kumar & Mahto, 2013). Figure 2.2 shows on of indentation test (VDI 3198).

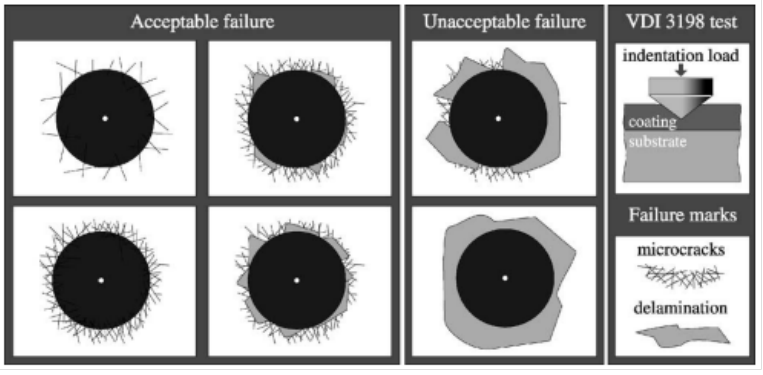


Figure 2.2 The principle of the VDI 3198 indentation test (Vidakis et. al, 2003)

2.3 Light intensity (illuminance), glare and contrast sensitivity
Illuminance is the measurement of the amount of lighting that falls onto (illuminating) and spreads over a given area of surface or parts. Illuminance is also related to the way humans see the brightness of an illuminated region or area. The SI unit for illuminance is lux (lx) and its non-SI unit is foot-candle (DOSCH, 2019).

The vision's glare is the discomfort or impairment of human's vision occuring when parts of the visual fields are experiencing excessive brightness in relation to the general surroundings or environment (DOSCH, 2019). There are two main types of glare that are direct and reflected (or indirect), as shown in Figure 2.3 and Figure 2.4 (Susan Stenson, 2008).



Figure 2.3 Direct glare

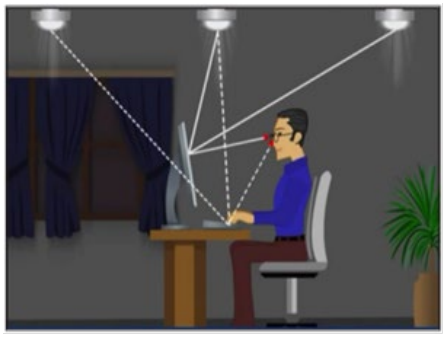


Figure 2.4 Indirect glare

Contrast is a measure of the relative distribution of lighter and darker parts of a visual stimulus (Susan Stenson, 2008). With decreasing contrast, the luminance difference in the grating is reduced until, at some level, the luminance difference is too small to be perceived (Figure 2.5). Based on Maniglia et. al, (2008), the Figure 2.6 below focused on the effect of light condition for no glare, low glare (69 lux), and high glare (228 lux) levels on contrast sensitivity.

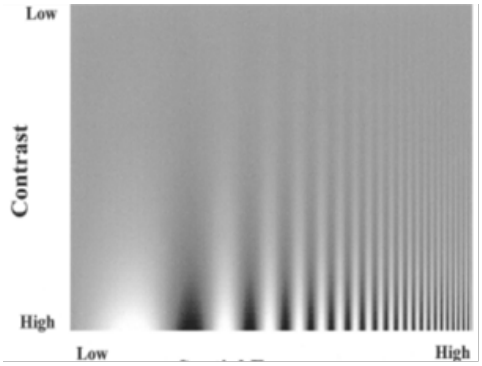


Figure 2.5 Spatial frequency [9]

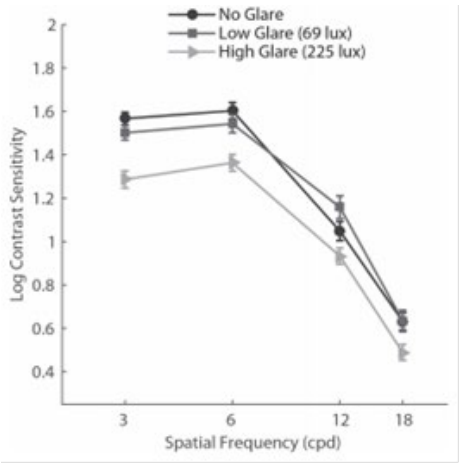


Figure 2.6 Contrast sensitivity function in light condition for no glare, low glare (69 lux), and high glare (228 lux) levels [10]

3. RESEARCH METHODOLOGY

3.1 Data collection on darkness level test
The darkness test is taken five times in the darkroom where four readings are taken in each corner and one reading is taken at the center. These several readings are taken in order to obtain an average darkness level and light intensity of the current darkroom. Figure 3.1 below shows the Lux meter device used to measure darkness level in the darkroom. Figure 3.2 shows

the layout of the current darkroom and areas of interest for the darkness level test (labelled as 1,2,3,4 and 5). Table 3.1 tabulates the result of current darkness level test in each areas of darkroom as labelled in Figure 3.2.



Figure 3.1 Lux meter device

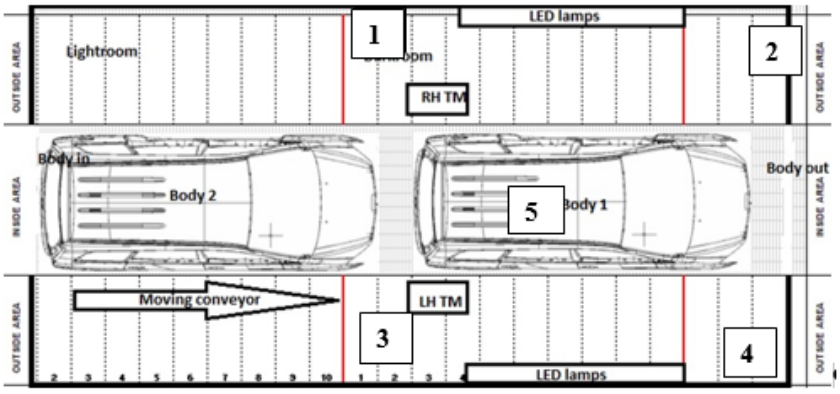


Figure 3.2 Layout of current darkroom and areas of darkness level test

Table 3.1: Current darkness level test data for light intensity in darkroom

AREAS	**DARKNESS LEVEL (LUX)**
Area 1	101 Lux
Area 2	100 Lux
Area 3	99 Lux
Area 4	100 Lux
Area 5	98 Lux
Total Lux	498 Lux
Average Lux	$\frac{101 + 100 + 99 + 100 + 98}{5}$ = **99.6 Lux / 100 Lux**

3.2 Reducing darkness level in darkroom

The black colored Damura boards are attached to the wall and roof of the darkroom especially on the area where the holes are present (Figure 3.3). These holes in the darkroom are unnecessary for the process of surface defects' detection because they allow direct and reflected light glare into the darkroom. Then, all the SOP check sheet and other papers that

are attached on the darkroom's wall are removed (Figure 3.4). This is because the check sheets are laminated and have a shiny kind of surface where it can provide reflected light glare that will affect the darkness level. Attached a black painted plastic to both sides of the exit way of the darkroom (Figure 3.5) to avoid major light source that will emit from the outsource light and affect the light intensity.



Figure 3.3 Covering holes



Figure 3.4 Removing SOP sheet

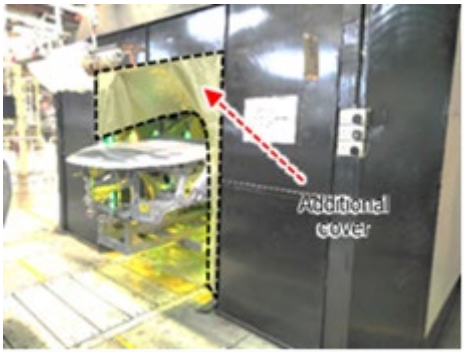
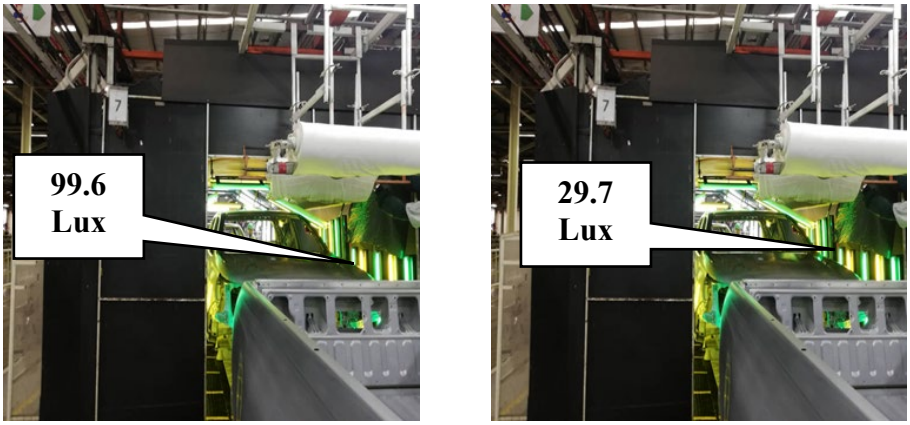


Figure 3.5 Attached a black painted plastic

4. RESULTS AND ANALYSIS

4.1 Darkness Level

Figure 4.1 below shows the darkness level of the darkroom before and after covering holes in the darkroom.



(a) (b)

Figure 4.1 Darkness level of darkroom (a) before and (b) after modification and improvement

4.2 Data of Defect per Unit (DPU)
After the modification and improvements are implemented where the darkroom's darkness level was reduced from from 99.6 Lux to 28.7 Lux, the Defect per Unit data is reduced drastically from beyond the 1.50 DPU in October 2019 to below 1.50 DPU in November 2019 until March 2020 (Figure 4.2)

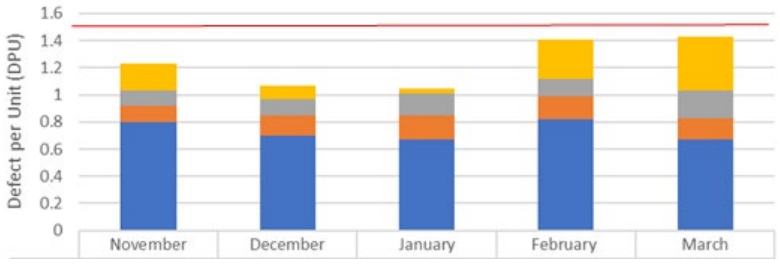


Figure 4.2 Data of Defect per Unit in November 2019 until March 2020

5. CONCLUSION

The reduction of darkness level is required to prevent glare during the visual inspection and the defects (bump and dent) also can be easily detected. The reduction of darkness level or illuminance of the darkroom from 99.6 Lux to 29.7 Lux clearly have improving the visual inspection of the defects on product's surface where the data of DPU or misdetection of defect reduced from exceeding 1.5 to lower than that.

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