



BEAM VOL 2
SPECIAL ISSUE TECHON 2023

INTERNATIONAL JOURNAL BORNEO ENGINEERING & ADVANCED MULTIDISCIPLINARY (BEAM)



eISSN 2948-4049



9 772 948 404 004

**BORNEO ENGINEERING & ADVANCED
MULTIDISCIPLINARY INTERNATIONAL JOURNAL
(BEAM)**



POLITEKNIK MUKAH SARAWAK

BORNEO ENGINEERING & ADVANCED MULTIDISCIPLINARY INTERNATIONAL JOURNAL (BEAM)

Fourth Edition 2023 | Special Issue TECHON 2023 30 September 2023
First Printed 2022

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Published by,

Politeknik Mukah,
KM 7.5, Jalan Oya,
96400 Mukah, Sarawak
Telephone No: 084-874001
Fax No: 084-874005

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PREFACE

Borneo Engineering & Advanced Multidisciplinary International Journal (BEAM) is a peer-reviewed journal that publishes original theoretical and applied papers on all aspects of Engineering, Management, Business, Accounting, educations, IT and Linguistics to publish high-quality papers and references. The topics to be covered include, but are not limited to quantitative, qualitative, and hybrid research on new approaches to using technology to improve learning, design, and educational results. Articles on applied theory in educational practice, as well as practical applications of research, current policy initiatives and research evaluations, theoretical, pedagogical, and methodological challenges relating to educational technology, are all welcome. This journal is an open access journal that provides an online publication (published twice a year). I would also like to congratulate and thanks all individuals exclusively to technical and editorial boards for their interest and strong support to this publication.

Best wishes,

Dr. Habsah binti Mohamad Sabli

Chief Editor, **BEAM International Journal**

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Aafiyat Employees' Knowledge, Attitudes, Barriers and Clinical Practices of Tocotrienols 70 Mg Softgel Consumption

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Abstract

The goal of this study was to learn more about the staff at Aafiyat's current levels of clinical practices, attitudes, and knowledge. It also sought to determine the association between certain demographic factors and consumption of Olive House Tocotrienols 70 mg softgels. Olive House has developed a pharmaceutical product called Tocotrienols 70 mg softgel. This product has a MAL number and has been registered with the NPRA. Three groups of respondents were used in this study: the control group, the case 1 beauty concern group, and the case 2 NCD concern group. There were 30 respondents in total, with 10 in each group, for this survey. To learn more about their concerns, respondents were given health surveys. For a month, the case group must take a dose of 140 mg of tocotrienols daily in the form of a 70 mg softgel. Before and after they take the softgel, a health examination will be done to assess its effectiveness. Following that, respondents are required to respond to survey questions about their views and prior knowledge of vitamin E. According to the research, vitamin E consumption caused systolic blood pressure readings to drop by 13–16% after a month of consumption. Similarly, there was a nearly 30% decrease in diastolic pressure readings. Blood sugar measurements also showed a nearly 6% decrease. This indicates that taking Tocotrienols softgels is very effective in treating NCD because he demonstrated a significant decrease in recurrence after taking them. Additionally, nearly 50% of respondents said getting enough vitamin E helps prevent scars and skin conditions. Six out of ten (60%) of the questions in the knowledge section were correctly answered by the respondents. This suggests that the respondents are knowledgeable about vitamin E. The results of the study showed that taking tocotrienols in the amount of 70 mg softgel had a significant impact on changes in blood pressure (both diastolic and systolic) and blood sugar levels. Additionally, Aafiyat staff members are knowledgeable about vitamin E derivative Tocotrienols consumption. The same can be said for employees who don't care whether they consume enough tocotrienols or vitamin E in their diet.

Keywords: Knowledge; attitudes, clinical practises, Tocotrienols, Vitamin E 70 mg softgel

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1. Introduction

Red palm oil from Sime Darby Oil Sdn Bhd was used in the innovative product Tocotrienols 70 mg softgel, which was created especially for Olive House. Tocotrienols, a form of vitamin E derived from red palm oil, are 70 mg in each softgel capsule. Additionally, this softgel product is capsuled with the consideration that it comes from plants and is Halal. Depending on where the

methyl groups are in their chemical structures, tocotrienols are divided into α , β , γ , δ and isomers (Sailo et al., 2018). Although the characteristics of each of these isomers vary slightly, antioxidant actions are the most well-researched and have a greater antioxidant capacity than tocopherols (Albrahim et al., 2022).

The best sources of these vitamin E forms are vegetable oils, especially rice bran oil and palm oil, which have higher tocotrienol concentrations (Fairus et al., 2020). Oats, hazelnuts, maize, olive oil, buckthorn berry,

rye, flax seed, poppy seed, and sunflower oil are additional sources of tocotrienols (Ji et al., 2021). Tocotrienols, in contrast to tocopherols, are unsaturated and have an isoprenoid side chain. Vitamin E is a necessary vitamin that the body cannot produce on its own and must be obtained from food. Palm fruit is one of the best sources of tocopherols and tocotrienols, along with rice and annatto seed. The source of tocotrienols that is most abundant among all vegetable oils is palm fruit. (Okuyama et al., 2021). In palm oil, tocotrienols account for nearly 70% of the vitamin E, with tocopherols making up the remaining 30% (Xia & Mo, 2016).

Tocotrienols have properties that are frequently different from those of tocopherols, including neuroprotective, antioxidant, anticancer, and cholesterol-lowering abilities (Fairus et al., 2020). Tocotrienol can effectively penetrate tissues with saturated fatty layers, like the brain and liver, because its chain is unsaturated (Chandan K. Sen, Cameron Rink, 2011). Recent mechanistic studies have demonstrated that tocopherol's anti-chronic disease antioxidant and anti-inflammatory properties fall short of those of other forms of vitamin E, such as γ -T, δ -T and γ -T3. Tocotrienols can be found in plasma at detectable levels after supplements. Biodistribution studies have shown that tocotrienols accumulate in the body's vital organs, but the amount of information on the plasma concentrations of tocotrienols required to demonstrate a significant physiological effect is lacking. The current state of knowledge warrants further research into this less well-known form of vitamin E because tocotrienols have a wide range of potential health benefits against some common human ailments (Che Idris et al., 2014).

In fact, there aren't many studies that have looked at the efficacy and consumer acceptance of taking tocotrienol supplements. The goal of the current study is to investigate the Aafiyat ecosystems' knowledge, attitudes, barriers, and clinical practises. We suggest that in the Aafiyat ecosystem, palm tocotrienol may reduce blood pressure and blood sugar levels.

2. Literature Review

In contrast to tocopherols, tocotrienols have potent neuroprotective, antioxidant, anti-cancer, and cholesterol-lowering properties. Micromolar doses of tocotrienol inhibit HMG-CoA reductase, the hepatic enzyme in charge of cholesterol synthesis. It's possible that tocotrienols are stronger antioxidants than tocopherol. In tissues with saturated fatty layers, like the brain and liver, tocotrienol's unsaturated side chain allows for greater penetration (Frank et al., 2012).

Based on previous study, they found that tocotrienols significantly reduced TBARS levels in subjects. Meanwhile, some study found no significant change in TBARS levels with tocotrienol supplementation although the tocotrienols group had a marginally lower trend in TBARS levels compared to the placebo group at the 4th month. To summaries, taking tocotrienol supplements has

numerous advantages, particularly for human health. Tocotrienol supplements are non-toxic and have a positive impact on human health (Patel et al., 2012).

Several studies have been conducted on the use of tocotrienol supplements in the daily diet. The Tocotrienols Rich Fraction (TRF) has immunostimulatory effects as well as potential clinical benefits for enhancing immune reaction to vaccines, according to a study by Mahalingam et al. (2011). The clinical trial of TRF supplementation significantly increased the total vitamin E level in the plasma of TRF-supplemented volunteers compared to the placebo group, indicating overall compliance, based on the study's findings. When compared to the control group, volunteers supplemented with TRF produced significantly more interferon- γ interleukin (IL)-4 by mitogen or TT-stimulated leukocytes. When compared to the placebo group, volunteers in the TRF group produced significantly ($P < 0.05$) less of IL-6. Anti-TT IgG production was also increased (Xia & Mo, 2016).

Furthermore, there are indications from other studies that supplementation tocotrienols at the dosage of 400 mg per day for 14 days did not induce haematotoxicity and hepatotoxicity in subjects with metabolic syndrome (Lin et al., 2016). In these studies, they are indicating that the subjects were supplemented with tocotrienols-rich fraction 200 mg or placebo capsules twice daily for two weeks followed by a post-intervention visit (Fairus et al., 2020). Results showed that tocotrienols supplementation had no significant adverse effect on the red blood cell (RBC), white blood cell (WBC) and platelet counts between TRF and placebo interventions (Ghazali et al., 2022).

Another study aims to determine the variables influencing consumers' preferences-based willingness to pay for palm vitamin E tocotrienols. The health advantages of palm vitamin E tocotrienols were found to be poorly understood by 419 vitamin users in Peninsular Malaysia (Sadikan et al., 2022). According to the study, these compounds in flavoured chewable tablets are valuable to consumers. the probability that consumers will buy tocotrienols. If these compounds were offered as chewable, flavored tablets instead of capsules, the likelihood that consumers would buy them would rise by 67.5%. Additionally, they were willing to pay an extra RM23.30 per bottle for tocotrienols in a flavor-enhanced chewable tablet, which is 19.0% more than the cost of tocotrienols in a capsule. They did anticipate a sizable price reduction of RM48.89 (41%), though, if the tocotrienols were sold online. The results of this study may serve as a guide for future research into the development of palm vitamin E tocotrienol products that are suitable for consumer needs and preferences (Chong et al., 2022).

In this study, the KAP model was used to examine the knowledge, attitudes, and adheres of the Aafiyat staff (measurements of blood pressure, glucose levels, and body mass index (BMI) before and after supplement intake). The core elements of a behavior change model

are knowledge, attitudes, and practices. The definition of knowledge is the conscious, non-symbolic perception of meaning. There are four different kinds of knowledge: scientific and social scientific knowledge, local knowledge, tacit knowledge, and self-reflective knowledge (Liao et al., 2022). Regular activities that are influenced by widely held social norms and beliefs are referred to as practises. The learning theory and the diffusion of innovation theory are the sources of the KAP model processing (Jensen, 2017).

3. Methods

3.1 Experimental Design

The case-control study design was used for the Aafiyatgroup study. Aafiyatgroup was split into three groups, the control group, case group 1 (which was concerned with beauty), and case group 2 (which was concerned with non-communicable disease). The corporate office and warehouse of Ampang Business Centre served as the site of this study. With regard to receiving vitamin E (supplements containing tocotrienols), each population has a list of 30 respondents. The months of February and March 2022 were used to carry out this study.

3.2 Survey and Measuring Instruments

The knowledge, attitude, and practise (KAPP) model were the foundation for the questionnaire designed for this study (Orr et al., 2018). Fig. 1 shows the five sections of the questionnaire:

Section I: Sociodemographic data about the participant, such as hospital level, age, years of employment, education level, current employment position, administrative title, and experience in programmes or courses related to nutrition.

Section II: Understanding of vitamin E. Ten multiple-choice questions in this section covered topics like caloric assessment, basic knowledge, and nutrition support. These questions also covered administration routes and nutrition support. The score for a correct response was 1, while a false response received a score of 0. All 10 questions, with scores ranging from 0 to 10, were added together to determine the final score. The level of knowledge was indicated by a higher score.

Section III: Perceptions of the use of supplements. 11 items made up this section, which evaluated respondents' attitudes towards nutrition support. A 5-point Likert scale was used to grade the responses (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The scores in this section were based on the mean average of all the items. A higher score demonstrated a more optimistic outlook.

Questionnaire and Measurements	
Section I	Sociodemographic
Section II	Knowledge of Vitamin E
Section III	Attitudes towards supplement intake
Section IV	Exploring clinical practice of supplement intake and anthropometric measurement
Section V	Participant self-reported barriers to nutrition support practice/vitamin E intake.

Fig. 1. Questionnaire and measurements

Section IV: Investigating the clinical usage of dietary supplement consumption and anthropometric measurement. This section included 4 questions about the current practises for assessing nutritional condition, checking blood sugar levels, providing initial nutrition support, and the actions taken by ED staff for patients who don't receive enough nutrition support.

Section V: A multiple-choice question about the barriers that participants themselves identified to nutrition support behavior or supplement (Vitamin E) consumption.

3.3 Inclusion and Exclusion Criteria for Subjects

Prior to beginning the study, a health checkup was required of each participant. After undergoing a health examination, participants were divided into 3 groups: the control group; case 1, which focused on beauty; and case 2, which focused on non-communicable diseases. It was not necessary for the control group to consume the Tocotrienols 70 mg Softgel. Clinical evaluations of each respondent were performed both before and after taking Tocotrienols 70 mg softgel, but case groups 1 and 2 had to take it for a full month.

3.4 Collection of Data

An organised questionnaire and medical techniques were used to collect the necessary data. The data collected included the sociodemographic details of the respondents as well as their understanding, attitudes, and clinical practices regarding the efficacy of taking supplements containing tocotrienols 70 mg softgels. With all the necessary approvals, the research was able to move forward (Ksiażek et al., 2020).

4. Statistic Evaluation

To conduct the sociodemographic analysis, the percentages for each category were looked at. All statistical evaluations were completed utilising JMP Pro 16.0.

5. Findings and Discussion

38% of respondents are men, according to Table 1, and 63% of respondents are women. A total of 67.6% of respondents are still single, and 55% of respondents are between the ages of 20 and 30.

Table 1: Sociodemographic data

Characteristics	Values (Percentage %)
Gender	
Male	38
Female	63
Age	
41-50	3
31-40	43
20-30	55
Marital status	
Single	67.6
Married/Widowed	32.4
Housing	
Apartment	8.8
House (≤ 3 bedrooms)	32.4
House (> 3 bedrooms)	55.9
2 room terraces	2.9
Education levels	
SRP/PMR/SPM/STPM	3
Certificate/Diploma holder	3
Degree holder	80
Master/PhD holder	15

Sociodemographic information on respondents shows that up to 55.9% of respondents live in homes with four or more bedrooms. This implies that most survey respondents belong to the middle class. In their fields of study, nearly 80% of those polled have a degree or higher. These sociodemographic data reveal that most respondents are highly educated and earn a middle class living.

Most respondents correctly answered six out of ten questions, as shown in Fig. 2. Most respondents, 76.5 percent, claimed to be aware of vitamin E's importance to human health. According to 41.2 percent of respondents, meat is a food low in vitamin E. Eggs, on the other hand, are low in vitamin E. The percentage of respondents who said Aquasol E is a vitamin E supplement was just 20.6%. According to most respondents (41.2%), betacarotene is a vitamin E supplement. Nearly 44.1 percent of those surveyed were also aware that 15 mg of vitamin E is the daily recommended amount. Most survey participants were unaware of the recommended daily allowance of vitamin E for children aged 1-3.

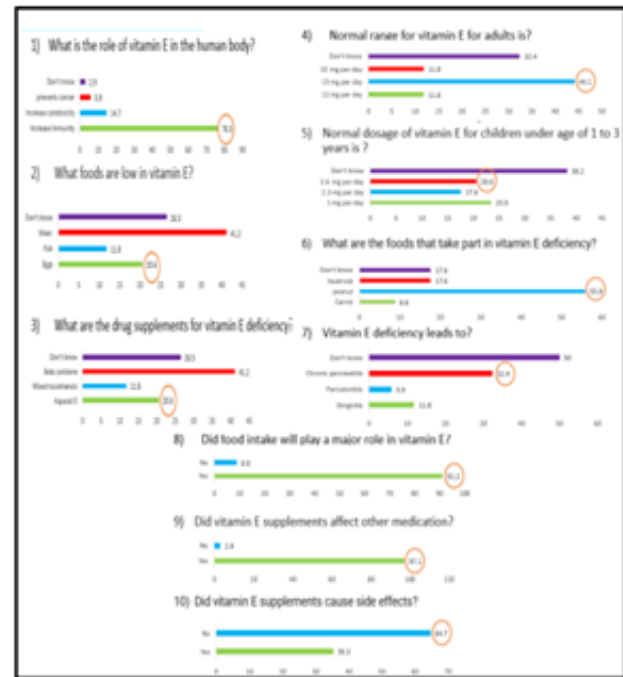


Fig. 2. Knowledge data

The attitudes of the population towards nutritional assistance were assessed using 5 items in this section (Fig. 3). Up to 38.2% of respondents to the survey stated they didn't give their vitamin E intake a second thought. In the survey, nearly 41.2 percent of those who took vitamin E (tocotrienols softgel) for a month reported similar results and changes to their skin.

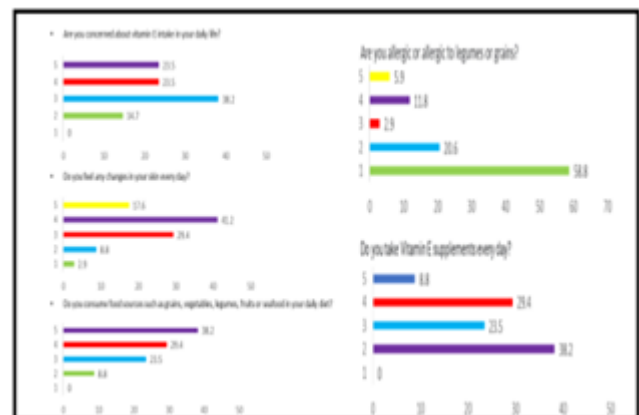


Fig. 3. Attitudes data

38.2% of survey participants firmly agreed that they ought to consume grains, vegetables, legumes, fruits, or seafood each day. Furthermore, most respondents (58.8%) reported that they had no allergies, including allergies to grains or legumes. In addition, 38.2% of them reported never taking vitamin E supplements. According to the study's findings, respondents do not regularly take vitamin E supplements and are unaware of how much vitamin E they are consuming daily.

The study's results, which are displayed in Fig. 4, indicate that 67.6% of respondents did not participate in webinars or talk about the benefits of taking supplements

and eating a healthy diet. Most of them (41%) believe that taking supplements frequently is essential. Most of them (32.4%) failed to take vitamin E supplements as prescribed. Additionally, 64.7 percent of respondents claimed they didn't attend any webinars, seminars, or talks about dietary supplements or nutrition. Unexpectedly, 85.3 percent of those polled claimed to be familiar with vitamin E supplements.



Fig. 4. Data barriers

Fig. 5 depicts the reduction in systolic blood pressure that occurred after a month of vitamin E consumption, which was between 13 and 16 percent. Similarly, there was a nearly 30% decrease in diastolic pressure readings. Readings of blood sugar also revealed a nearly 6% decrease. He showed a significant reduction in recurrence following vitamin E intake, proving that vitamin E intake is very effective in managing NCD. Almost fifty percent of those surveyed also said that getting sufficient vitamin E helps prevent marks and skin-related issues.

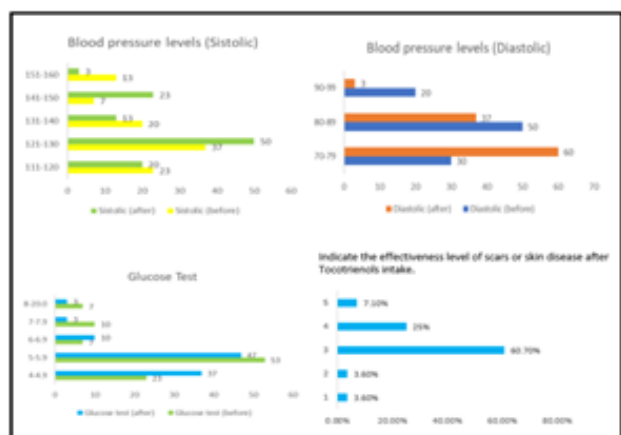


Fig. 5. Clinical practices data

6. Conclusion

The findings of this study show that most participants (76.5%) are aware of the importance of vitamin E supplements (tocotrienols) and that 42% either agree with this statement or have experienced changes in their skin because of taking vitamin E. Most participants (38.2%) did not know what vitamin E was and did not regularly consume it. Additionally, 67.6% of the respondents said they did not take part in any webinars, talks, conferences, or other events related to dietary supplements and healthy eating. Most respondents must have been unaware of the importance of including supplements in their diets, we can infer from this. Nevertheless, when Tocotrienols 70 mg Softgel is taken, the clinical methods yield fruitful experimental outcomes. Readings of the respondents' systolic and diastolic blood pressure taken before and after taking this supplement were found to have dropped, as is customary. Both before and following the vitamin supplementation, the blood sugar levels were significantly lower. In addition, a resounding majority of respondents were very satisfied with the product's results in the treatment of scars and skin conditions. Marketing can infer that vitamin E is well-known and that marketing and selling this product will be simple based on the results of this product testing. Most participants, though, are unaware of their daily vitamin E intake.

Acknowledgments

The researchers would like to thank Aafiyat Group Sdn Bhd for their help and the funding they specified to contribute to this research successfully. We also thank Sime Darby Oils Sdn Bhd for formulating red palm oil and resulting in this softgel successfully.

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Analysis of The Scarcity of Fuel Oil on The Economy of The People in Nunukan, Indonesia

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Full Paper

Article history

Received

24 July 2023

Received in revised form

24 July 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

Analysis of the scarcity of fuel oil on the economy of the people in Nunukan, Indonesia. Fuel is one of the driving elements in the economy. Therefore, the scarcity of general fuels, especially gasoline and biodiesel, has a very broad impact on various aspects of life. The phenomenon of fuel scarcity is a big problem that is still a major topic in Indonesia. Especially in Nunukan, North Kalimantan Province. The scarcity of fuel has hampered community activities. This phenomenon triggers traffic jams due to long queues at each gas station stating the availability of fuel, especially Peralite and Biosolar fuels which have been subsidized by the government. Therefore, this study aims to determine the causal factors, and the impact of the scarcity of fuel oil on the economy of the people in Nunukan. The method used in this research is descriptive qualitative analysis method. The results showed that the scarcity of fuel was caused by factors. The scarcity was caused by several factors including delays in the supply of fuel, misuse of subsidized fuel, behavior of retail traders, and setting quotas. As a result of these factors, the scarcity of fuel has an impact on the agricultural sector, Small and Medium Enterprises, the fisheries sector, and the household sector. Based on this research, the authors suggest to the government to take strict action against retail traders, and to gas stations to ensure timely fuel purchases so as not to cause delays in the supply of fuel.

Keywords: - Scarcity, subsidized fuel oil

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1. Introduction

Fuel is a material that can be converted into energy, one form of fuel is fuel oil. Fuel has become a basic need for all groups of people.

Fuel oil is a strategic and vital commodity that controls the lives of many people so that the government is obliged to ensure its smooth distribution throughout the territory of the Unitary State of the Republic of Indonesia. According to the Regulation of the Minister of Energy and Mineral Resources no.16 of 2011 article 10 point 5, dealers can only distribute fuel oil directly to users of land transportation through the facilities of Public Fuel Filling Stations. And according to article 4 point 2, namely dealers carrying out distribution activities for sea transportation, dealers can control the facilities and infrastructure.

Fuel is one of the driving elements in the economy. Therefore, the scarcity of general fuels, especially gasoline and biodiesel, has a very broad impact on various aspects of life. The sector most affected by the impact is the transportation sector.

This scarcity of course occurs due to the influence of various factors including the lack of supervision from the Regional Government. One of the main tasks and functions of the Regional Government is to supervise the running of the government, including overseeing the parties agreed to be the management of gas stations.

The phenomenon of fuel scarcity is a big problem that is still a major topic in Indonesia. Especially in Nunukan district, North Kalimantan Province. The scarcity of fuel has hampered community activities, especially fishermen and the Nunukan community who use private two-wheeled and four-wheeled vehicles. This phenomenon also triggers

traffic jams due to long queues at each gas station stating the availability of fuel, especially Peralite and Biosolar fuels which have been subsidized by the government.

1.2 Problem Formulation

Based on the background described above, the researcher formulates the problem as follows:

1. What are the causes of the scarcity of subsidized fuel in Nunukan.
2. What is the impact of the scarcity of subsidized fuel on the economic activities of the people in Nunukan.

1.3 Research Objectives

Based on the formulation of the problem above, the objectives of this study are as follows:

1. To find out the causes of the scarcity of subsidized fuel in Nunukan District.
2. To find out the impact of the scarcity of subsidized fuel on the economic activities of the people in Nunukan District.

2. Literature Review

2.1 Scarcity Theory

According to Badudu, scarcity is a condition in which the item is difficult to obtain due to a limited amount (Big Indonesian Dictionary, 1926). Scarcity is the gap between limited economic resources and unlimited necessities of life. Scarcity arises because human needs continue to increase. As a result, the existing resources are not enough to meet the needs of life.

The concept of scarcity is defined as a situation where the number of means of satisfying needs is less than the number of needs for these means of satisfaction. This situation encourages people to make choices among the most profitable alternatives. In addition, humans must be wise and rational in allocating economic resources. To produce various goods and services as a means of satisfying needs various resources are needed. Some of these resources are Natural Resources, Human Resources and Capital Resources.

2.2 Economic Theory (Demand and Supply)

Supply comes from the manufacturer. Supply is several goods or services offered by sellers at various price levels and within a certain time, for example per day, per month, and per year. The quantity of the commodity to be sold by the seller is called the quantity supplied which is a continuous flow per unit time. The amount offered can be different from the amount sold. It is possible that the amount offered is greater than the amount sold.

The law of supply is "the higher the price of an item, the greater the quantity of that item will be offered by sellers. Conversely, the lower the price of an item, the smaller the quantity of that item supplied. From the law of

supply above, we can describe the supply curve as a curve that shows the relationship between the price of a particular good and the quantity of that item supplied.

The concept of demand is a very important study material in economics. In economics, demand is the amount of product that consumers want and can buy at various price levels in a certain period by assuming the factors that influence it are constant or fixed. While the demand function is a function that shows the condition of demand for goods demanded by consumers for goods produced by producers. In the law of demand, the size of the quantity demanded for an item depends heavily on the price level of the item, if other conditions are considered constant (*ceteris paribus*), such as for consumer tastes, the ratio of other goods, consumer income and so on, then assuming that the level of people's income is considered fixed, while on the other hand the price of goods rises, this will of course cause a decrease in the number of requests for goods (Andi Supangat, 2006: 128).

2.3 Fuel Oil

Fuel oil is a type of fuel (fuel) produced from refining (refining) crude oil (crude oil). Crude oil from the bowels of the earth is processed in refineries first to produce oil products, which include fuel. Apart from producing fuel, crude oil refineries produce various other products, ranging from gas to products such as naphtha, light sulfur wax residue (LSWR) and asphalt. The use of fuel will continue to increase in line with Indonesia's national economic growth (Daryanto, 2007) and will decrease from time to time in accordance with Indonesia's national reserves/supplies unless new sources of reserves or use of new renewable energy are found.

Fuel subsidies, as can be understood from the draft RAPBN and Financial Notes every year, are "payments made by the Government of Indonesia to Pertamina in a situation where Pertamina's income from the task of providing fuel in the country is lower than the costs it incurs to provide the fuel. In this case a positive value, as has often been experienced, the figure is called Net Oil Profit.

Subsidized fuel prices in Indonesia are the same price set by the government and apply equally in all regions of Indonesia. Basically, the government together with the DPR determines the price of fuel after considering the basic costs of providing fuel provided by Pertamina/other Business Entities and the level of ability (willingness to pay) of the community. The types of fuel that are generally used in Indonesia are Avgas, Avtur, Premium gasoline (RON 88), Pertalite, Pertamax (RON 92) and Permax Plus (RON 95), kerosene, diesel oil (HSD), diesel oil (MDF), Fuel Oil, Biodiesel, and Pertamax DEX.

3. Methodology

This study uses a qualitative method. Data collection was carried out by means of observation and interviews with research informants. Sampling using purposive sampling method. The research sample consisted of the

operational manager of the Rafti Indah gas station, and 5 informants who represented some sectors of the economy that use subsidized fuel, including servants, motorbike users, business owners and housewives.

Data analysis techniques in the form of data reduction, data presentation to draw conclusions. The author describes this writing in a descriptive way (describing) which can be interpreted as a problem-solving procedure that is surrounded by describing or describing the current situation or subject or object of research (a person, institution, community, etc.) based on visible facts or as it is.

4. Result and Discussion

4.1 Fuel Scarcity Factors

a) Delay in Fuel Supply

Nunukan District has three gas stations, one of which is a gas station managed by PT Rafti Indah. Based on the author's observation, the Rafti Indah gas station is often closed due to a lack of fuel supply. One of the causes of the scarcity of fuel supply was due to delays in the supply of fuel caused by problems on the SPOB (Self-Propelled Oil Barger) ship carrying oil cargo. The delay can be caused by damage to the fuel carrier vessel.

b) Misuse of Subsidized Fuel

The second factor that often occurs is the misuse of subsidized fuel which should only be for the lower middle class but used by the upper middle class.

c) Behavior of Retailers

The third factor found by researchers is the misuse or sale of illegal fuel. Many people who buy subsidized fuel use jerry cans for resale (retail). It is very easy to find retail sales of subsidized fuel along the roads in Nunukan sub-district. They are willing to go back and forth in line and then resell it at a higher price. These retail sales can reap profits by increasing prices by up to 20%. The activity of reselling fuel (retail) should not be allowed by the local government because based on the law, reselling subsidized fuel violates Presidential Regulation No. 15 of 2012 regarding Retail Selling Prices and Consumers Using Certain Types of Fuel.

d) Quota Determination

Scarcity occurs when demand is greater than supply. The demand here means the consumer of the fuel itself, while the supply is the fuel quota prepared by PT Rafti Indah at the Nunukan Regency General Fuel Filling Station. Scarcity or vacancies will not occur if the supply is greater than the demand. The demand is inseparable from the large number of consumers who use Premium Materials, in this case, users of motorized vehicles, both 2-wheeled motorized vehicles and 4-wheeled motorized

vehicles. The following table shows the number of motorized vehicles in Nunukan Regency from 2019 to 2021.

Table 1 shows an increase in the number of both two-wheeled and four-wheeled vehicles from year to year. The increase in the number of motorized vehicles automatically increases the demand for Oil Materials as well. But the obstacle is that the fuel oil quota has not increased, only 81,000 liters per month.

Table 1. Number of vehicles in Nunukan

No	Type Vehicle	Year		
		2019	2020	2021
1	Car Passenger	2.677	2.776	2.967
2	Bus	25	27	30
3	Trucks	2.272	2.405	2.617
4	Bikes Motor	60.551	62.919	66.227
	Amount	65.525	68.127	71.841

4.2 Impact of Fuel Scarcity

Fuel shortages only occur in Peralite and Biosolar fuels, which are subsidized fuels. The scarcity of these two types of fuel has a negative impact on the people's economy. Apart from disrupting transportation needs, it also triggers long queues which can have an impact on road congestion. Fuel scarcity also affects businesses in every sector of the economy.

The following is the impact on the economic sectors in Nunukan District:

1. The agricultural, textile and industrial sectors are not affected by fuel scarcity because they use non-subsidized fuels, namely Dextlite and Pertamina, except for small-scale agriculture which can use Peralite and Biosolar.
2. The SME sector (Small and Medium Enterprises) is not affected by the fuel shortage because it has a letter of recommendation from the Trade Office that can help SMEs deal with incidents like this.
3. In the fisheries sector, relatively less impact is felt because fishermen have access to floating gas stations specifically for ships and boats. The Fisherman's Certificate also gives leeway to fishermen regarding the amount of fuel purchased so they can prepare themselves during a fuel shortage.
4. The household sector is affected by the scarcity of subsidized fuel. The limited subsidized fuel, which is crucial in economic activities for the lower middle-class households, will have an impact on reducing the role of the household sector as consumers and providers of services and products.

5. Conclusion

Referring to the results of the author's research, the scarcity that occurred was caused by several factors including delays in the supply of fuel, abuse of subsidized fuel, behavior of retail traders, and setting quotas.

As a result of these factors, the scarcity of fuel has an impact on the agricultural sector, SMEs (small and medium enterprises), the fisheries sector, and the household sector. Based on this research, the authors suggest to the government to take strict action against retail traders, and to gas stations to ensure timely fuel purchases so as not to cause delays in the supply of fuel.

Acknowledgement

Alhamdulillah, all praise is to Allah who has made it easy. So that researchers can complete this research. Thank you to the Nunukan State Polytechnic for all parties for their participation and support.

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Application Of Earthquake Resistant Standards (SNI 1726: 2019) Against Building in Yogyakarta City

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Full Paper

Article history

Received

3 August 2023

Received in revised form

3 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

The load-bearing structure is made from a Special Moment Bearer Frame Structure. The structure is prepared against earthquake loads in line with the Indonesian National Standard 1726: 2019 (Earthquake Resistance Planning Standards for Building Structures), which is based on an earthquake plan with a return period of 2,500 years. The earthquake load study adopts the response spectrum approach based on the Earthquake Resistance Planning Procedure for Building and Non-Building Structures (Indonesian National Standard 1726: 2012 and Indonesian National Standard 1726: 2019). This study aims are to make a comparison between the two procedures in terms of changes in seismic bottom shear forces, and to examine the performance of the building structure in terms of the inter-level drift that occurs. The results of dynamic analysis obtained using the ETABS v.19.0.0 program showed an increase in seismic bottom shear force by 133%, both in the X direction and in the Y direction. The result directions also compared by using the 2012 Indonesian National Standard. Judging from the terms of deviation between levels, the building structure does not exceed the provisions, either according to the 2012 or 2019 Indonesian National Standard. The City Hall Tower building structure is still in a stable condition when the stability of the building and the P-Delta effect are checked in the subsequent control study.

Keywords: - Earthquake Resistant Standards, Yogyakarta city

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1. Introduction

Use Yogyakarta is an area prone to earthquakes. Failure of building structures can be caused, among others, by miscalculations in planning, inadequate planning with the implementation of work in the field, changes in building functions, natural disasters such as strong earthquakes and others. Evaluation of the performance of building structure can be done by analyzing the performance of ultimate limits and the performance of the service limits based on the Indonesian National Standard, earthquake loads based on the Indonesian National Standard (SNI) 1726: 2012 and the Indonesian National Standard 1726: 2019 which contains guidelines for earthquake resistance planning procedures

for building structures. and non-building which is a revision of the Indonesian National Standard 1726: 2012.

The Indonesian National Standard Guidelines 1726: 2019 have used the latest earthquake history maps since 2017 so that buildings built before 2017 need a structural evaluation to determine the safety of the structure according to the new standard. Differences in building planning guidelines for earthquake resistance The Indonesian National Standard 1726: 2012 and the Indonesian National Standard 1726: 2019, namely the design of the earthquake spectral acceleration of the Indonesian National Standard 1726: 2019 in several regions of Indonesia experienced an increase in site class types of medium soil and hard soil and a decrease in a type of soft ground site class. The building that will be the

object of research in this study is a building that has 8 floors using a concrete structure (Hardianto W, 2014). The purpose of this study is to determine the performance of the building with story drift/deviation between levels and the story shear of the building. The calculation of the structure is based on the earthquake loading of the Indonesian National Standard 1726: 2012 and the Indonesian National Standard 1726: 2019. The building is located on medium and hard ground areas.

2. Methodology

The design response spectrum (S_a) in Indonesian National Earthquake Standard

2.1 Response Spectrum of the 2012 Indonesian National Standard Design for Earthquake

The design response spectrum (S_a) in the 2012 Indonesian National Earthquake Standard is taken as shown in the Fig. 1 and Fig. 2 (Farlianti S, 2019).

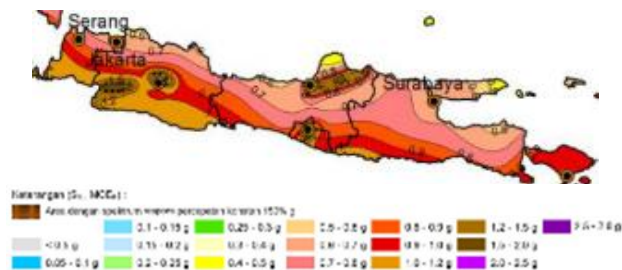


Fig. 1. SS values based on the 1726: 2019 Indonesian National Standard earthquake map

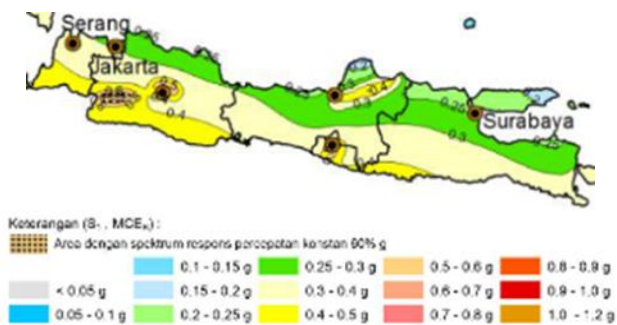


Fig. 2. S1 values based on the 1726: 2019 Indonesian National Standard earthquake map

Data of the design value of the acceleration response spectra obtained, among others: Hard soil, bedrock acceleration value 0.2 seconds (S_s) = 1.306 g, bedrock acceleration 1 second (S_1) = 0.472 g, the acceleration response spectrum in the short period (S_{MS}) = 1.306 g, the acceleration response spectrum for the 1 second period (S_{M1}) = 0.721 g, the design spectral acceleration for the short period (S_{DS}) = 0.871 g, the design spectral acceleration for the 1 second period (S_{D1}) = 0.480 g, Period (T_s) = 0.552 s and Period (T_o) = 0.110 s.

2.2 Response Spectrum for 2019 Earthquake SNI Design

The design response spectrum (S_a) in SNI for Earthquake 2012 is taken as shown in Fig. 3 and Fig. 4.

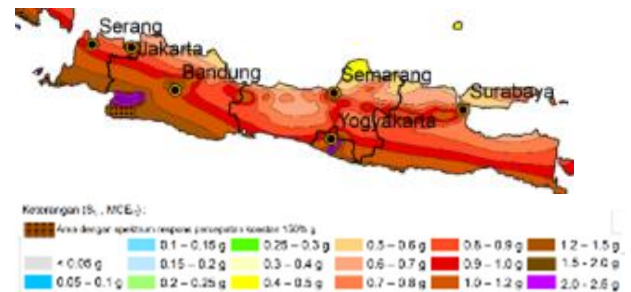


Fig. 3. S1 and SS values based on the SNI 1726: 2019 earthquake map

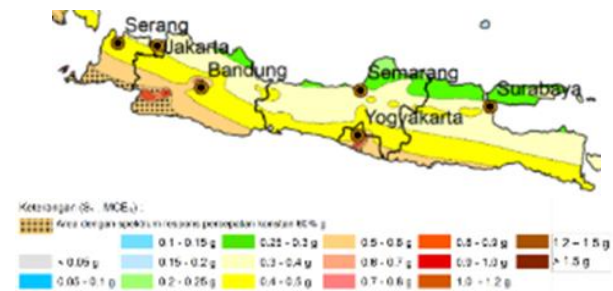


Fig. 4. S1 and SS values based on the SNI 1726: 2019 earthquake map

3. Result and Discussion

3.1 Structural Modeling

Initial modeling was carried out with the ETABS program. The dimensions of the structure are then estimated in determining the initial dimensions which will later get the dimensions of the structure according to the forces that are obtained. Column with dimensions 800 x 800 mm, Beams with dimensions 400 x 800 mm and plate 125 mm. The following are plans and 3D images of the designed building model.

3.2 Dynamic Response Spectra Earthquake Loading

The hard and medium soil spectral parameters of Yogyakarta City based on the Indonesian Spectra Design web are:

Table 1. Spectral parameters

PARAMETER	SNI 2019	SNI 2012
S_s	1.209	1.306
S_1	0.530	0.472
F_a	1.200	1.000
F_v	1.470	1.529
S_{ms}	1.451	1.304
S_{m1}	0.779	0.720
S_{ds}	0.967	0.871

Sd1	0.520	0.480
T0	0.107	0.110
Ts	0.537	0.552
TL	8	8

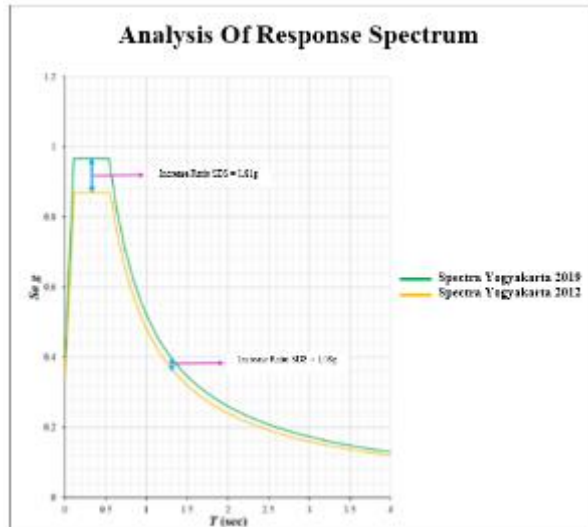


Fig. 5. Comparison of Yogyakarta regional design spectrum curves

Increase in the value of the spectral acceleration (SA) of 1.81g. Data retrieval of SNI 1726:2012 and SNI 1726:2019 coordinate points at Yogyakarta City Hall Yogyakarta city buildings built on hard, soft soil (SC) referring to SNI 1726:2019 will be safer against earthquakes compared to buildings referring to SNI 1726:2012 due to the relatively large difference in SA.

3.3 Relation of Static Earthquake Load – Dynamic

Based on SNI 1726: 2012, the dynamic earthquake load must not be less than 85% of the static earthquake load, or in other words $VDYNAMIC \geq 0.85VSTATIC$, if these conditions are not met then the dynamic earthquake load must be multiplied by a scale factor of. While SNI 1726: 2019 dynamic earthquake load must not be less than 100% static earthquake load, or in other words $VDYNAMIC / VSTATIC$, if these conditions are not met then the dynamic earthquake load must be multiplied by a scale factor of. According to SNI 1726:2012, to determine the scale factor of an earthquake using the formula $(G \times I)/R$, for the x direction and the y direction, the earthquake scale factor is 30% of the x direction.

3.3.1 Sliding Force

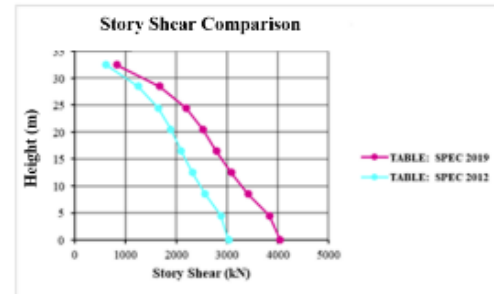


Fig. 6. Story Shear graphics on hard and medium soils

a) Building Lateral Style

The lateral earthquake force of the design of each floor is obtained from the shear force of each floor of the design results of the previous analysis. The earthquake force on a floor is the difference between the shear forces between the floors, so that the respective values can be seen in Fig. 7.

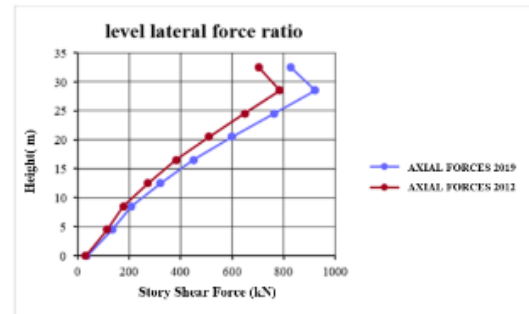


Fig. 7. Lateral force

3.3.2 Image Lateral Force

a) Service Limit Performance Analysis

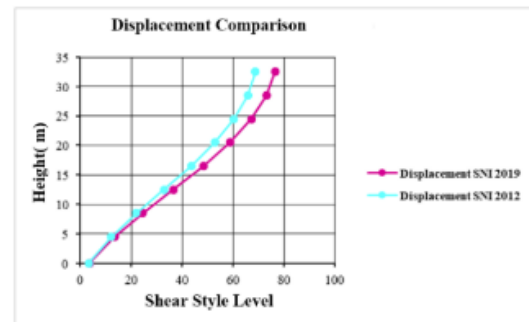


Fig. 8. Displacement

3.4 Design Control

Structural design control is carried out on checking the deviation limits between floors as regulated in articles 7.8.6 and 7.12.1 as well as the stability due to the P-Delta effect regulated in Indonesian article 7.8.7.

3.4.1 Deviation between floors of SNI 1726: 2019

Based on article 7.12.1 table 16 Deviation between floors of SNI 1726: 2012 permit for types of structures that fall into all other types of structures and are in risk category II, the deviation limit between the permit floors is 0.020 hsx. Meanwhile, SNI 1726: 2019 did not change the deviation limit between levels from the previous SNI 2012. Based on the results of the analysis of Etabs v.19.0.0 software, the displacement and deviation between floors in the x direction are obtained as shown in Fig. 9.

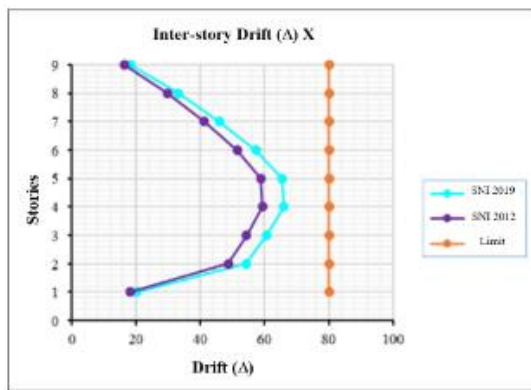


Fig. 9. Allowable deviation between levels

The shear design of the beam is planned based on the maximum flexural strength of the beam (M_{pr}) that occurs in the plastic area of the beam, namely at the critical section with a distance of $2h$ from the edge of the beam. The factor shear force on the face of the load is calculated as follows.

$$V_e \frac{M_{pr1} + M_{pr3}}{l_n} \pm \frac{W_u \times l_n}{2} \quad (1)$$

Where V_e = shear force due to the plastic hinge at the ends of the beam (kN), M_{pr} = the possible bending strength of a structural component (kNm), W_u = factored shear force (kN) and l_n = length of clear span (m).

Based on the calculation results, the main reinforcement for the upper reinforcement in the right pedestal area is 4D19, and for the lower reinforcement, it is 2D19. In the left support area, the top reinforcement uses 4D19, while the lower reinforcement uses 2D19. In the middle span area, the top reinforcement utilizes 2D19, while the lower reinforcement uses 4D19. For the supports, Sengkang D10-100 mm is employed, and for the fields on beam dimensions of 250 mm x 450 mm, D10-150 is utilized. For details on reinforcement can be seen in Fig. 10 and Fig. 11.

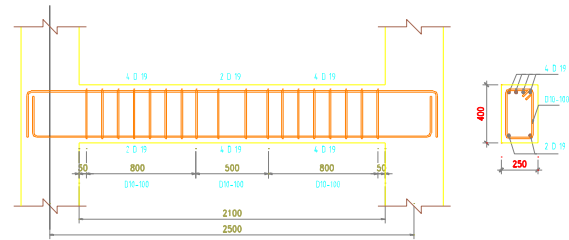


Fig. 10. Main beam reinforcement details

B 250 x 400		
TUMPUAN KIRI	LAPANGAN	TUMPUAN KANAN
250 X 400		
4 D19	4 D19	4 D19
2 D19	2 D19	2 D19
D10-100	D10-100	D10-100
—	—	—

Fig. 11. Main beam reinforcement details

SNI 2847-2013 article 23.4 explains that for structural components in the calculation of the special moment-bearing frame system (SRPMK), which bears the force due to earthquake loads and receives a factored axial load greater than 0.1., the components of the structural elements must meet the following requirements: first, the structural components bear a factored axial compressive force of not less than $0.1.A_g.f_c'$. Second, the dimension of the shortest side is not less than 300 mm (BSN, 2013). And third, the ratio of the dimensions of the shortest section to the perpendicular side is not less than 0.40. The column is planned to be stronger than the beam (strong column weak beam). Columns are viewed against the wobbling or non-swaying portals, as well as for wandering. The flexural strength of the column is calculated based on the design of the strong column weak beam capacity, which is as follows.

$$\sum M_c \geq 1,2 \sum M_g \quad (2)$$

Where $\sum M_c$ = column nominal moment and $\sum M_g$ = nominal moment of block.

SRPMK column shear strength occurs plastic hinge joints at the ends of the beams that meet the column. In column planning, the shear force is obtained by adding the M_{pr} of the upper column with the M_{pr} of the lower column divided by the net height of the column. The shear force does not need to be taken to be greater than the design shear force of the beam-column connection strength based on the M_{pr} of the beam, and cannot be less than the factored shear force from the structural analysis. The column plan shear force diagram can be seen in the

Fig. 12.

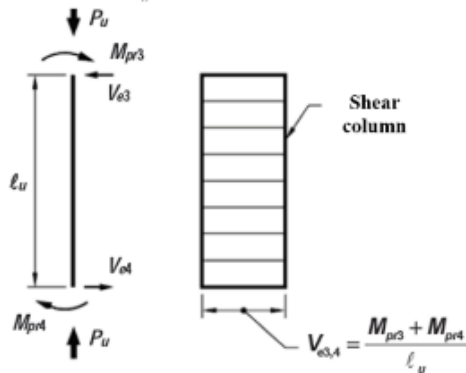


Fig. 12. Column shift style diagram

From the calculations, we get the main reinforcement 36D22 and stirrup 4D10-100 for the support area and 4D10-150 for the field area. Details of column reinforcement can be seen in Fig. 13.

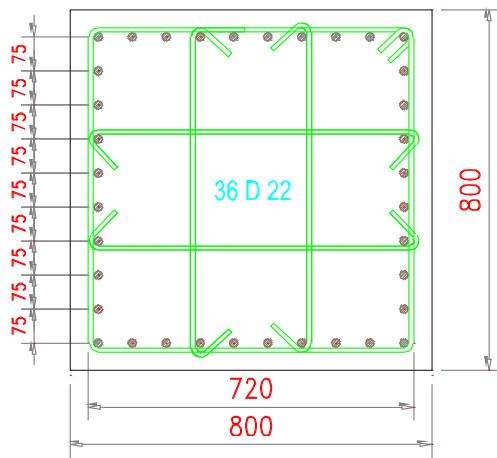


Fig. 13. Column reinforcement details

3.5 Design Control

The beam-column connection or beam-column joint has a very important role in the planning of high-rise building structures with the Special Moment Resisting Frame System (SRPMK). This is because the joints that connect the beam to the column will very often receive the force generated by the beam and column simultaneously. This can cause the joint that connects the beam and column to become weak and collapse quickly. Therefore, restraint reinforcement is needed to be able to accept and distribute the forces generated by beams and columns, so that the SRPMK concept is fulfilled. We can see the freebody diagram of the style in Fig. 14.

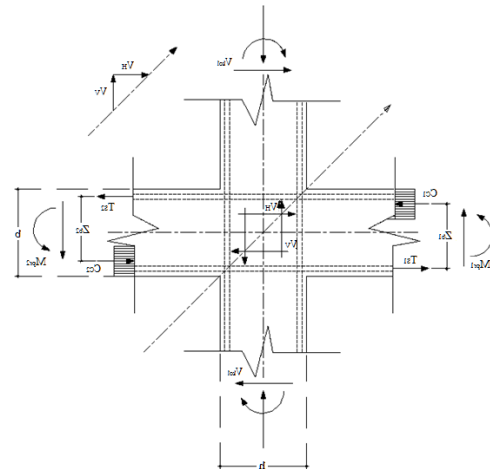


Fig. 14. Forces acting on the beam-column relationship

From the calculation results, the D10-150 count was designed. Details of beam-column reinforcement can be seen in Fig. 15.

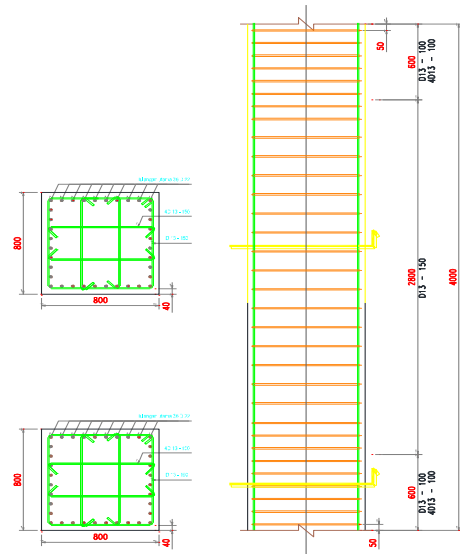


Fig. 15. Forces acting on the beam-column relationship

4. Conclusion

From the results of the review of the City Hall Tower building structure, in terms of the effect of changes in design earthquake loads (changes from SNI 1726: 2012 to SNI 1726: 2019), several conclusions can be drawn as follows: Statically equivalent, the seismic bottom shear force has increased quite significantly, namely 3,572,917 kN (SNI 2012) for the x and y directions, to 4,050.72 kN (SNI 2019), or an increase of 113,373% in the x and y. From the results of dynamic analysis with the analysis method of the 2012 SNI response spectrum, the seismic base shear force is 3,036.98 kN for both x and y directions, while the results of SNI 2019 obtained a seismic base shear force of 4,050,720 kN for the x and y. There was an increase in the basic dynamic shear force of 133.38% in the x and y directions. The results of the

examination of the deviation between floors, both according to SNI 2012 and SNI 2019 regulations, the structure of the Yogyakarta City Hall Tower building still shows a safe level of performance. In the next control analysis, namely checking Stability of the building / P-Delta effect, the structure of the City Hall Tower building is still in stable condition. Acceleration of rocks in the short period in Yogyakarta City has an acceleration decrease of 0.93g. While the acceleration of the rock in a period of 1 second, there was an increase in the acceleration of 1.12g. The design response spectrum between SNI 2012 and the 2017 Earthquake Map in the city of Yogyakarta, there was an acceleration increase ratio of 1.20g. While the acceleration in the period of 1 second, there is also an increase of 1.30g. This shows that the earthquake load of SNI 1726: 2019 is more influential than SNI 1726: 2012.

Acknowledgement

Alhamdulillah, all praises be to Allah that has given all the pleasures. With the gifts and conveniences that Allah gave, so researchers can complete this research. Thanks to master in civil engineering, Faculty of Engineering Sultan Agung Islamic University Semarang and all parties for the participation and support.

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Artificial Intelligence and Machine Learning in Occupational Safety and Health: A Review of Present Status, Opportunities and Challenges

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Full Paper

Article history

Received

21 July 2023

Received in revised form

21 July 2023

Accepted

10 August 2023

Published online

30 September 2023

Abstract

This study aims to investigate the current state of the field of Artificial Intelligence (AI) and Machine Learning (ML) in Occupational Safety and Health (OSH) and to understand how AI and ML can be effectively used to improve workplace safety and health. The findings of this study support the potential of AI and ML in improving workplace safety and health, as well as identifying key challenges such as data privacy and security, ethical considerations, lack of standardization, and integration with existing systems. Overall, this study makes a significant contribution to the field of OSH by providing a comprehensive overview of the current state of the field and by highlighting the potential and challenges of AI and ML in enhancing workplace safety and health.

Keywords: - Artificial intelligence, machine learning & occupational safety and health

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1. Introduction

Workplace accidents and injuries continue to be a significant issue despite advancements in safety regulations and technology (Silva et al., 2020). To address this problem, there has been a growing interest in utilizing Artificial Intelligence (AI) and Machine Learning (ML) in occupational safety and health (Srinivasan et al., 2020). AI and ML can perform various human functions, learn from experience, and adapt to new entries and settings. These emerging technologies can achieve significant contributions and provide better competitive advantages as compared to conventional approaches. These technologies have the potential to predict and prevent hazards (Liu et al., 2020), improve training and education (Srinivasan et al., 2020), and increase the efficiency of safety management systems (Silva et al., 2020).

However, there is a lack of research on the practical applications of AI and ML in occupational safety and health (Silva et al., 2021). For addressing the identified gap, it is important to answer the following research questions:

- What are the areas of AI and ML application in the OSH background?
- What are the future opportunities for AI and ML application in the OSH background?
- What are the challenges to adoption of AI and ML in the OSH?

Therefore, it is crucial to conduct a critical analysis review of AI applications in OSH to comprehend the trends, potential, and challenges. The specific objectives of this study are to:

- Review the existing applications of AI and ML in OSH
- Identify the opportunities for increased applications of AI in the OSH and,
- Identify challenges affecting the adoption of AI in the OSH

Hence, the main motivation for this study is to provide the potential and benefits of how AI and ML can effectively be used to improve workplace safety and health. Additionally, this study aims to provide new knowledge of these emerging technologies that could be used to improve the safety and well-being of workers and to reduce the costs associated with workplace accidents and injuries (Silva et al., 2020).

The scope of this study includes a review of the current state of the field, an analysis of previous research on the use of AI and ML in workplace safety and health, a discussion of the benefits and limitations of using AI and ML in occupational safety and health. The limitations of the study include the focus on potential of AI and ML rather than a comprehensive evaluation.

2. Methodology

To identify the existing applications of artificial intelligence in OSH, an extent review of literature was conducted. Database queries were run on SCOPUS database and validated by data in other databases such as Institute of Electrical and Electronics Engineers (IEEE), Science Direct, WOS and Google Scholar for dates ranging from 2001 to 2023 (2 decades). The intention to comprehend the trends in the decades-long adoption of AI in OSH, as well as to identify the research gaps, opportunities, and obstacles, had an impact on the dates that were selected. The search strategy using keywords chosen of “machine learning” and “expert system” sequentially combining the primary interests of: “occupational safety”, “occupational health” and “work environment”. The combinations were as follows:

“machine learning” AND “occupational health”
“machine learning” AND “occupational safety”
“machine learning” AND “work environment”
“expert system” AND “occupational health”
“expert system” AND “occupational safety”
“expert system” AND “work environment”

The search of using keywords above from the database mentioned had extracted 16,603 articles. After assessing the 16,603 articles, 1690 articles were finally considered relevant and applicable which the articles are non-repetitive, English language and relevant to OSH and AI in construction. The articles were filtered to journal and conference paper. These details were taken from each article: OSH application area, methodology/techniques applied, and findings.

In Table 1, according to Occupational Accident Statistics by Industry Sector 2022, the industrial sector contributes to high number of fatal injuries followed by the agricultural, forestry and fishery sector in Malaysia. While the construction industry hits 148 number of fatal injuries reported to Jabatan Keselamatan dan Kesihatan Pekerjaan, Kementerian Sumber Manusia. Even though the sector of construction only ranked number 6 out of 9 in JKPP statistics website, researcher however interested and keen to look upon for this sector as a preliminary study for a new coming AI project related to construction industry. The search then was restricted to only construction industry and 690 articles were the filtered and finalized accordingly.

Table 1. Statistics fatal injuries (January-November 2022)

Sector	Number of NPD	Number of PD	Number of Death	Total
Hotel & Restaurant	118	1	0	119
Facilities	178	2	9	189
Finance, Insurance, Real Estate & Business Services	345	4	24	373
Construction	87	2	59	148
Transport, Storage & Communication	234	4	10	248
Manufacturing	4273	183	58	4514
Wholesale & Retail Trade	114	3	2	119
Public Service & Statutory Authorities	74	3	0	77
Mining & Quarrying	27	2	8	37
Agriculture, Forestry & Fisheries	856	23	16	895
Total	6306	227	186	6719

Source from JKPP website

Indication:

PD-Permanent Disability

NPD- Not Permanent Disability

3. AI and ML Applications in OSH

One definition of AI is the investigation of an agent that is influenced by data. The process of environmental management, analyzing the data, and acting based on the data analysis. Fig. 1 detailed out the process of data collection to data analysis in AI. The procedure could be initiated with data collected from the environment via sensors. The ML algorithms are employed to analyze the data, and the results are then presented. The process of actuating by the actuators was accordingly to the work environment. Sensors and devices both act as part of the system. The autonomous portion of AI is referred to as AI, while ML is the algorithmic portion of AI.

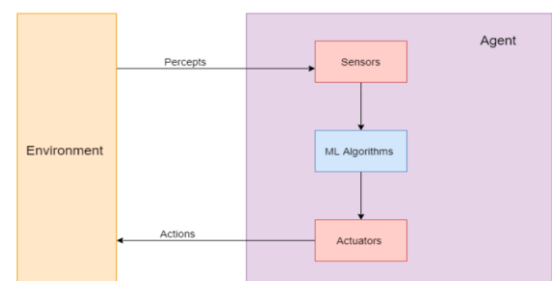


Fig. 1. Components of an AI system

In the 1990s, AI and ML were still in their early stages, with few publications utilizing the techniques. Throughout time the publications of AI and ML in OSH has been the principal area of interest since AI and ML impact on the bottom line is growing. This trend has been increasing rapidly in two years back attributed to the pandemic COVID-19 which hit the world. There were an increased number of OSH-AI & ML research trends in areas of medicine, medical, biomedical and pharmacology and pharmaceuticals as well.

A survey that has been carried out on 2021 by McKinsey & Company indicated findings which the adoption of AI in any backgrounds is steadily rising from 50% in 2020 to 56% in 2022. Since last year the AI adoption has increased in most emerging which includes China, Middle East and North Africa, Indian and followed closely by the Asia-Pacific. The figure steadily rises from 45% of AI adoption in 2020 to 57% in 2022 (McKinsey, 2021).

The survey which involves 39 respondents of adopted AI shown that the function of AI cases mostly used and applied in the area of service-operations optimizations (69%), new AI based enhancement products (56%), contact-center automation (56%), product-feature optimization (51%), predictive service and intervention (46%), customer service analytics (44%), creation of new AI-based products (44%), customer segmentation (41%), risk modelling and analytics (41%) and fraud and debt analytics (36%) (McKinsey, 2021).

The current state of AI and ML in Occupational Safety and Health (OSH) has a lot of potential applications such as in predictive analytics, autonomous systems, training and education, safety management systems, and workplace monitoring. These technologies can help organizations predict potential hazards, develop autonomous systems for dangerous tasks, enhance training and education, improve data analysis and risk management, monitor the workplace for potential hazards, and track worker behavior and performance.

4. Opportunities of AI in OSH

Currently, AI and ML are being used in a variety of ways to enhance occupational safety and health. One of the most common applications of ML is in the construction industry in preventive maintenance or injuries among workers by predicting the risk of injuries. Several machine learning models were developed to identify and prevent and predict the risk. A study from Koc et al., produced a machine learning (ML)-based novel which identifies the most vulnerable body parts of construction workers using a dataset. The study can help safety managers in evaluating susceptible body parts of construction workers prior to accidents. This can help to reduce the risk of injury among construction workers by adopting the utilization plan developed from the analysis of the model (Koc et al., 2023). A study from Zhu et al., developed predictive models of construction fatality

characteristics, including nature of injury, part of body, source of injury and event or exposure among the construction's workers. The ML model developed, benefits most of the construction workers since it able to establish and generate relevant emergency response plans and first aid facilities and services that correspond to the most likely nature of injury, part of body, source of injury and event or exposure among the workers (Zhu et al., 2023). This can allow organizations to take steps to address these risks and improve the overall health and well-being of their workers. In addition, AI and ML are also being used to analyze incidents and accidents that have occurred in the workplace, to identify the root causes and prevent similar incidents from happening in the future.

AI and ML are also being used to monitor human behavior in the workplace, such as identifying workers who may be at risk of developing a particular illness or injury. A researcher reported the ML-based human behavior monitoring can be used to identify and address unsafe behaviors in the workplace, such as not wearing personal protective equipment (Liu et al., 2020). A study from Márquez et al. incorporate the adoption of AI and the Internet of Things (IoT) to provide information of the construction workers by using wearable smartwatch. The wearable smartwatch is able to constantly monitor the worker's health in real-time, through temperature, falls, noise, impacts, or heart rate meters, activating an audible and vibrating alarm when an anomaly is detected. The smartwatches able to correct the unsafe human or workers activity behavior and improve safety working environment in the construction sites (Márquez et al., 2021). After two months, the researcher Márquez et al., then came a crossed a new idea of developing a Smart Personal Protective Equipment (PPE), a wearable technology which information able to reduce the rate of accidents and occupational illness among construction workers. The Smart PPE employs three pieces of: a helmet, a bracelet, and a belt, which process the collected information using artificial intelligence (AI) techniques (Márquez et al., 2021).

A study by Srinivisan et al, reported that AI and ML have the potential to improve workplace safety and health by predicting and preventing hazards, improving training and education, and increasing the efficiency and effectiveness of safety management systems (Srinivasan et al., 2020). For example, AI-based predictive maintenance can be used to identify and predict equipment failures before they occur, reducing the risk of accidents and injuries (Srinivasan et al., 2020).

Another application of AI and ML in OSH is in hazard detection, where the technology is used to identify potential hazards in the workplace or construction area, such as human intrusion judgement in static dangerous areas, the influence of human posture, intrusion direction, and falling from heights. This can help to improve the safety of workers by allowing organizations to take proactive measures to mitigate these hazards. A study from Mei et al., developed a computer vision-based intrusion detection method mainly aimed at static hazardous areas. The proposed method able to effectively address the defects of manual supervision in engineering

safety management, reducing the probability of accident occurrence and enhancing safety at construction sites (Mei et al., 2023). Regarding an accident that considered the most common cases reported in construction industry, falling from heights. A study from Shanti et al., developed a novel system integrating deep learning and drones to monitor workers in real-time when performing at-height activities to protect workers on jobsites from falling (Shanti et al., 2022). A study from Ozcan et al. applied the use of detection systems using wearable devices, e.g., smartphones, and tablets, equipped with cameras and accelerometers to prevent workers from falling from heights. The proposed models can show a significant decrease in the number of falls during daily activities (Ozcan et al., 2016).

Lastly, AI and ML are also being used to monitor the health of workers and to identify and predict the occurrence of occupational illnesses and diseases. For example, a study by Ng et al., produced a ML algorithm to facilitate a productive and efficient healthcare service in the private sector. A reliable and explainable system for predicting sick time and rehabilitation plans named Smart Work Injury Management System (SWIM) able to provides prediction using multi-dimensional data and machine learning approaches. The comprehensive system developed is also able to translate the machine learning result into a human-readable form that can support modern work injury case management (Ng et al., 2023).

Based on the discussion above, it is likely that the information in various digital technologies like IoT sensors, smart algorithms and portable gadgets are employed to prevent and address issues of safety, health and risk injuries among workers. These requirements are inevitably met by the application of advanced AI methods (e.g., the application of ML) to facilitate and promote safety-related prevention. Table 2 mapped the opportunities of AI or ML in construction services which relevance to OSH.

Table 2: Opportunities of AI in construction

Study	AI /ML applied	Tasks	OSH Relevance or Outcome
Koc et al., 2023	Inclusive modelling algorithm	Distinguishes the vulnerable workers' body parts that exposed to injury according to variable of age, working days and number of workers	Help safety managers in evaluating susceptible workers' body parts and reduce the risk of injuries
Zhu et al., 2023	Neural Networks (NN), Support Vector Machines with Linear Kernel (SVMLK), Decision Tree	Identifies 30 explanatory variables that comprehensive related with injuries	Allow organization to take steps to address the risks of injuries

	(DT), Random Forest (RF), Stochastic Gradient Boosting Model (SGBM)		
Liu et al., 2020	Algorithm	Identifies and address unsafe behaviors in the workplace	Reduce the unsafe working behaviors in the working site
Márquez et al., 2021	Smart watch sensor	Identifies and measures the parameters and working environment that contributes to risk of injuries	Valuable for risk prevention and medical-health anticipation among workers
	Smart PPE	Monitoring the state of workers and the working environment to ensure safe conditions	Reduce anomalies in the workplace and provide support for the care of personnel.
Mei et al., 2023	Computer vision-based intrusion detection	Infusion judgement with care of influence human posture and intrusion direction	Detect defects manual supervision in engineering safety management, reducing probability of accident occurrence
Shanti et al., 2022	Drones combine with algorithm	Monitor workers in real-time and protect workers on job-sites from falling	Reduce the severity of falls when performing at-height activities
Ozcan et al., 2016	Smartphone and tablet equipped with camera and accelerometer	Fall Detection system	Reduce the severity of falls by informing other people to deliver help
Ng et.al., 2023	Algorithm	Reduce waiting list for occupational rehabilitation services	Minimal delays in recovery and returning to work and help organization predicting the sick leave and rehabilitation plan

5. Challenges of AI in OSH

The rosy pictures of AI and ML can be imagined from their potential and opportunities. However, it must be realized that due to the complexity of integration AI and ML can also represent many challenges and

ongoing issues. Silva et al (2020), has identified several challenges associated with the use of AI and ML in occupational safety and health. The challenges include data privacy and security, ethical considerations, lack of standardization, and integration with existing systems (Silva, Silva, & Silva, 2020). Additionally, organizations and practitioners may be limited by a lack of knowledge, resources, and expertise in these technologies (Silva, Silva, & Silva, 2021). Hence, to overcome these challenges the government could also establish or develop the standard and legislative guidelines or the best practices (Gomoi and Stoicu-Tivadar, 2010; Bhaduri et al., 2011) to address the ethical considerations and data privacy and security issues associated with AI and ML in OSH. The organizations and practitioners also should consider investing in the development of expertise in AI and ML to take advantage of the opportunities presented by these technologies. The issues regarding privacy protection (Wang et al., 2020; Zhou et al., 2021) on how AI can save, process, edit and share information or data in considerations of permission from the client or user has been brought up by the researcher.

Srinivasan and Kumar (2020), the use of AI-based predictive maintenance can be limited by the availability and quality of data, and the complexity of the equipment being monitored. The key consideration is data privacy and security, as the collection and storage of data can raise concerns about the protection of participants' personal information. Measures such as anonymous data collection and secure storage of data must be implemented to ensure the privacy of participants is protected. Similarly, the study by Liu, Yuan, and Wang (2020) highlights the challenges associated with monitoring human behavior in the workplace, such as privacy concerns and the need for accurate and reliable data.

Furthermore, as highlighted in the study by Silva, Silva, and Silva (2020), the use of AI and ML in OSH raises important ethical, legal, and societal considerations, such as issues of data privacy and security, bias, and accountability. The study recommends that organizations and practitioners should consider these ethical considerations when adopting AI and ML in their safety and health programs. Another important consideration is informed consent, where participants must be informed of the purpose of storage and data collection, their rights as participants, and any potential risks or benefits associated with their participation. They must also give their informed consent to participating. Confidentiality is another important consideration, where participants' information must be kept confidential and not shared with any third party without the participants' consent. Fairness and non-discrimination must also be considered, where it must be conducted in a fair and non-discriminatory manner, and any potential biases in data must be identified and addressed.

6. Conclusion

In conclusion, the research highlights the potential benefits of these technologies in improving workplace safety and health. However, it also identifies key challenges and limitations associated with their use. Organizations and practitioners should consider these challenges and limitations when adopting AI and ML in their safety and health programs. Additionally, more research is needed to fully understand the impact and limitations of AI and ML in OSH, and to develop guidelines and best practices for their use. This research makes a valuable contribution to the field of occupational safety and health by providing a comprehensive overview of the current state of the field, highlighting the potential and challenges of AI and ML in enhancing workplace safety and health, and providing guidance for organizations and practitioners.

Acknowledgement

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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Augmented Reality in Interactive Learning Applications for Hand Tools

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Full Paper

Article history

Received

3 August 2023

Received in revised form

3 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

The advancement of Information and Communication Technology (ICT) is rapidly growing in line with the educational knowledge taught in institutions today. Such technology should be utilized to enhance the quality of teaching and learning (PdP). The conventional methods that are still commonly used by many educators are perceived as less engaging, weak, and fail to stimulate students' interest. This project was developed with the aim of improving students' mastery of the subjects they are studying and creating a conducive learning environment. Interest, dedication, and focus on a particular subject among students are crucial aspects to consider. The methodology chosen to implement this project is using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) and Augmented Reality (AR) technology. The project is developed through a combination of existing and digital materials, utilizing Adobe XD and Artivive applications as the main platforms to connect with other applications. Augmented Reality (AR) technology is used to display virtual simulations of the procedures for using certain hand tools, which are scanned using smartphones. Virtual objects are shown to exist in the user's smartphone camera display. The success of this project can make the teaching and learning process more systematic with the help of educational technology using the internet. Several advantages have been identified, such as increasing students' interest, creating an active learning environment, facilitating understanding and retention through engaging animations and audio, and allowing access regardless of the user's time and location. Therefore, it is hoped that this project will be beneficial to educators, students, and parents alike.

Keywords: - *Augmented Reality, smartphone hand tools, teaching and learning*

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1. Introduction

In the current era of globalization, Malaysia is moving forward with strides, and the advancement of information technology is also rapidly progressing. As such, we can witness the development of education that is becoming more advanced. Various technologies and applications are being used for improvement in education. In line with the 11 shifts of the Malaysia Education Blueprint 2013-2025, the seventh shift emphasizes leveraging ICT to enhance the quality of learning in Malaysia. According to Ghavifekr et al., (2014), the teaching and learning process

will become more engaging and proactive through the use of information, communication, and technology (ICT) as a medium of knowledge delivery to students.

With the advancement of technology in the present time, the teaching process can be carried out anywhere, regardless of the students' location. Therefore, the flipped classroom teaching method can be implemented, where students first explore the topics to be learned based on the resources provided by the instructor within the application. Additionally, the learning environment will become active, and students themselves will seek to understand things they are less familiar with, while the

instructor acts as a facilitator (Siegle, 2014). Fig. 1 illustrates the difference between the conventional teaching method and the flipped classroom. The use of technology in teaching and learning can make students more inclined to comprehend the knowledge being conveyed by the instructor, thereby enhancing their understanding even in challenging courses (Bakar, 2013). Improving student-centered teaching strategies should be further promoted in line with the development of increasingly sophisticated technology.

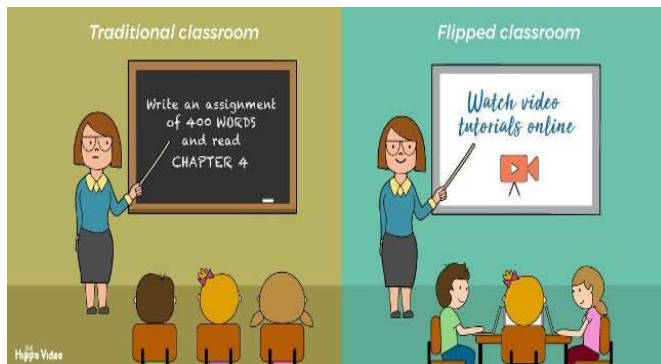


Fig. 1. Comparison of teaching methods

Interest, dedication, and focus on courses involving technical skills among students are seen as crucial aspects that require attention. If this situation is viewed lightly and casually, it will lead to an increased number of students dropping out from this field. This course should not be perceived as something boring, difficult, and suitable only for academically gifted students. On the contrary, it is hoped to create space and opportunities for students who progress more slowly in academics (Mat, 2020). The conventional method or old-fashioned way used today, which mostly involves teaching and rote memorization by teachers, is seen as a situation that students go through. Therefore, it becomes less engaging, weak, boring, and fails to stimulate students' desire and determination to master the subject they are studying.

Furthermore, many students, especially women, are more focused on courses that do not involve technical skills due to factors such as being less proficient in using equipment and not knowing the proper methods of equipment usage. Students also lack sufficient time to learn the correct techniques of using the equipment. Hence, this AR (Augmented Reality) technology is not only capable of transforming traditional modules, program costs, and physical classrooms into online versions, but its implementation can also contribute to a highly flexible teaching and learning environment.

This study was conducted based on several objectives, which are designing the user interface for the learning application and smart card containing information related to hand tools to be displayed to the users. Additionally, developing an interactive learning application using Augmented Reality (AR) technology and testing the functionality of the interactive learning application using Augmented Reality (AR).

The importance found in using this application lies in its ability to facilitate the teaching and learning process while providing enjoyment and expanding students' knowledge. Additionally, the application can enhance students' interest in learning courses involving technical skills more effectively than conventional methods used by instructors, such as traditional classroom teaching and chalk and talk. Teaching and learning processes using this application foster two-way interaction between instructors and students. Students become active participants compared to the one-way interaction in conventional methods where instructors act as facilitators. This makes it difficult for students to absorb and retain information that has been taught. The application also captivates students with engaging visual and audio elements. Indirectly, it stimulates visual, auditory, and kinesthetic senses, making the teaching and learning process more enjoyable than conventional methods.

The concept of pedagogy is increasingly evolving and being utilized in the context of teaching at every educational institution throughout Malaysia, in line with the technological advancements of the present time. Several crucial activities in the teaching process, such as planning, implementation, assessment, and others, need to be further strengthened (Husin & Aziz, 2004). Present-day society is increasingly focused on a reality that aligns with the actual reality. What is referred to as virtual reality (VR) has now become a part of both current habits and many activities carried out during the day. Virtual reality (VR) is also related to the concept of augmented reality (AR) (Arena, Collota, Pau, & Termine, 2022).

AR functions through devices that record the real world and superimpose virtual objects directly in the form of animations, text, data, or sounds visible on the screens of smartphones, tablets, computers, and other display systems (Elmqaddem, 2019). The real world and virtual information are synchronized, adjusting the display based on movements. The use of the flipped classroom model in current teaching and learning activities plays a significant role in the knowledge delivery process (Julia et al., 2020).

According to (Nugraheni, Surjono, & Aji, 2022), the flipped classroom is a blended learning approach that has become popular as a teaching model. The flipped classroom model allows instructors to utilize more opportunities to engage students in applying their knowledge and interacting with both the instructor and peers to share knowledge and ideas, thereby enhancing their higher-order thinking. By implementing the flipped classroom, students can develop critical thinking skills within themselves.

2. Methodology

This application was developed based on the ADDIE model. The ADDIE model consists of five main phases, namely analysis, design, development, implementation, and evaluation. Research findings have proven that the ADDIE model is the most appropriate and systematic approach in developing a learning application (Safitri &

Aziz, 2022). Fig. 2 below illustrates the workflow in the ADDIE model that needs to be followed to develop a quality product that can be marketed.



Fig. 2. ADDIE model

2.1 Analysis Phase

The analysis phase is the initial process of developing a product. This phase involves developers identifying the problems to be addressed. The analysis process is carried out to determine the root causes of the identified problems. The developers of this learning application conduct various needs and technical analyses before developing it.

2.2 Design Phase

The design phase involves the structure, theoretical approach, types of media, and technology to be used. This phase is crucial for planning the strategy in developing this application and the methods to achieve the outlined goals. Fig. 3 below illustrates the design of the PdP card, which will be translated into its content using Augmented Reality (AR) technology.



Fig. 3. Teaching and learning card

2.3 Development Phase

This phase involves building the actual application using all the selected media and technology elements

based on the requirements. Several processes are undertaken by the developers to develop this learning application using Augmented Reality (AR) technology, where Adobe XD and Artivive applications are chosen as the main platforms to facilitate the connection with other applications. Animations and audio are also included to make it easier for users to comprehend the conveyed knowledge more clearly.



Fig. 4. Augmented Reality in learning application

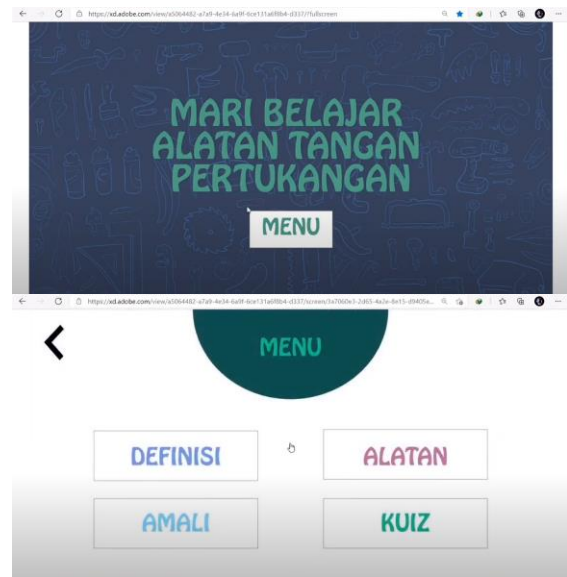


Fig. 5. User interface of the learning application

2.4 Evaluation phase

This phase requires user feedback regarding the functionality of the developed learning application. Questionnaires are distributed to respondents to assess the suitability and effectiveness of this application. The evaluation results are collected to observe the overall average.

3. Result and Discussion

After the questionnaires have been collected again, the summary of respondent distribution is shown in Table 1 below. The overall items assessed for developing this application are presented in Fig. 6, Fig. 7, and Fig. 8.

Table 1. Distribution of respondents

Respondent	Number of Respondent
Educator	10
Student	7
Parent	6

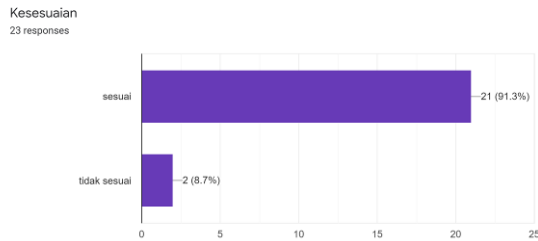


Fig. 6. Factors of product suitability developed



Fig. 7. Factors helping to enhance student's understanding

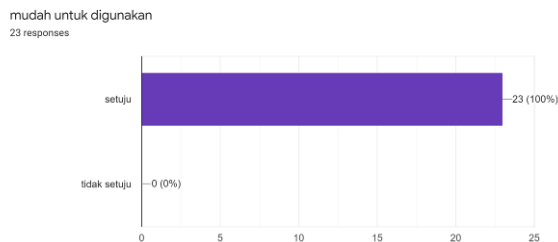


Fig. 8. Factors of user-friendly application usage

Overall, referring to Figures 6, 7, and 8, the development of this interactive learning application using Augmented Reality (AR) technology received positive and encouraging responses. Out of 23 respondents, 21 individuals, representing 91.3%, stated that the application is suitable for use as it helps students comprehend the knowledge presented by the instructor more easily and engagingly. Indirectly, this application can attract the interest of more students, leading them to pay full attention to the subject matter they are studying.

Furthermore, all respondents (100%) agreed that this application can enhance students' understanding of the subjects they are studying, thereby enabling them to achieve high scores in the conducted examinations. Additionally, all respondents (100%) mentioned that this learning application is easy to use and user-friendly. The user interface of the application is also attractive and systematically organized for the users.

However, there are some positive comments provided

by respondents for future improvements. The internet network factor is emphasized to ensure that the application functions well and smoothly, and to increase the presentation of graphic materials.

4. Conclusion

This interactive learning application using Augmented Reality (AR) technology is one of the alternatives capable of increasing students' interest and level of understanding in courses involving technical skills. Overall, this application can also have a positive impact on all target groups. Additionally, the innovation can create an enjoyable learning environment and avoid a passive atmosphere among students. Therefore, students will be more interested in learning courses involving technical skills more effectively. With the resources provided by this learning application, instructors will find it easier to implement the teaching and learning process effectively. Thus, this application can have a positive impact on all educators.

Acknowledgement

The authors would like to express greatest appreciation to Politeknik Mukah Sarawak (PMU) for the permission to carry out this research study work. Last but not least, the authors would like to thank the staff in Department of Electrical Engineering (JKE) and also the staff in Sekolah Kebangsaan Kompleks Sultan Abu Bakar, Johor for supporting this research study to testing the functionality of Augmented Reality in interactive learning applications for hand tools.

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Building Defects and Facility Maintenance Practices

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Full Paper

Article history

Received

26 July 2023

Received in revised form

26 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Cracks, rusty surfaces, missing ceiling panels, and moisture issues are common defects in buildings. Insufficient building maintenance will result in serious defects and more expensive repair work. In Malaysia, buildings are constructed under rigorous supervision and in compliance with British Standards. Unfortunately, the building's maintenance elements are still inadequate. Therefore, the main objective of this research is to identify the building defects and provide solutions to them. This research focused on one block from six blocks in Kampung Siswa (Kamsis). Block V1 was selected to investigate the building defects occurring there. The data were collected through questionnaires to evaluate the building defects. 118 respondents were involved from 172 populations. The finding of this study shows crack is the highest score (4.39) and is considered as the main defect that occurred on the Kamsis building. From the data respondents agreed the recommendation is the management service should be improved (4.38). The building defects that occurred will turn to high maintenance cost. It can be concluded that the most common building defects occurring are cracks.

Keywords: - Building, facility, defects, maintenance, solution

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1. Introduction

In this modern era, most buildings should meet few regulations. According to Vidakovic (2021) stated regulations define the basic requirements for buildings, which ensure the safety and comfort of users. The requirements are intended to protect people's safety and health in and around the buildings. But there are several issues that affect the building performance and have huge negative impact on its own user. According to Kariipanon (2019) reported in flexible learning spaces, students spend more time collaborating and interacting positively with their peers, as well as more time presenting work back to the class. This proves that flexible spaces for learning gives huge impact towards learning and teaching process. The building management should take adequate maintenance of the facility for the benefit of the students to ensure that the location is appropriate for learning and teaching (Poon,

2012). In general, maintenance refers to work carried out to retain and restore the functionality of commercial and residential properties (Gregson et al., 2009). It includes tasks such as cleaning, landscaping, and electrical system maintenance. It aims to preserve safe, functional, and comfortable environments for all users at all times. The success of a building to be used depends on both its buildings and its facilities. A building that is good to operate should cover various aspects such as in terms of safety and comfort of users. Therefore, a study on the effects of building defects and facility maintenance for the Politeknik Merlimau Melaka building was conducted. This study aims to identify the building and facility defects on the building at Politeknik Merlimau Melaka and to find the solution.

The core function of university or any educational institution is to provide education and training for students that will graduate into experts for the best future of the country. Prescilla Palis (2019), mentioned universities have a critical role to play because their core function is the

education and training of students who will graduate into experts that will drive the future of the country to prosperity. Educational buildings also should be good looking on the outside to convince the users that their building is in good condition as it should.

Many studies have been done into building and facility maintenance and found defects as a common phenomenon in construction activity. Yusoff (2020) stated building defects are a common phenomenon in the construction industry which has a negative effect on schools in terms of performance building, health, and safety aspects as well as their overall teaching and learning process. Aulich (2013) stated most of the buildings built will eventually suffer from defects and flaws over time and will leave negative impacts and affect the learning and teaching process. Politeknik Melaka building has been operating for more than 10 years. So, it is necessary for the building to perform function maintenance. This statement also was supported by Saari (2021) who reported that to maintain the viability of old buildings, maintenance of the condition and function must be carried out with the provision of a systematic maintenance management system. Most of the defects were easy to overcome, but what makes it worse is the lack of responsibility and experts to investigate more deeply in maintenance issues. Masrom (2020) found among them are the lack of experts, the difficulty of obtaining equivalent spare parts, and attention among professionals.

2. Methodology

The method used in this study was the quantitative method. The data acquired is from a questionnaire that was distributed to the respondents. Random sampling method was applied in this study. In a simple random method, every member of the population has an equal chance of being selected. Based on Krejcie & Morgan's (1970) table for determining sample size, for a given population of 172, a sample size of 118 would be needed to represent a cross-section of the population. Table 1 shows guidelines of sample needed for population.

3. Result and Discussion

The data was collected from the questionnaire given to the respondents of V1 block residents. The data collected were analyzed using SPSS statistical software. The data were shown in table form.

Table 2 shows the demographic of respondents. All the V1 block residents are 100% male. Respondents' age with the highest percentage is 98.3 for 19 to 25 years old and the rest 1.7% belong to the 26 to 35 years old.

Table 1. Guidelines of sample (Krejcie & Morgan, 1970)

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note.—N is population size.
S is sample size.

Table 2. Demographic of respondents (Krejcie & Morgan, 1970)

Demographic			
Demographic Information.	Sample	Option	Percentage
Respondents Gender	118	Male	100%
		Female	0
Respondents Age	118	19-25	98.3
		26-35	1.70%
		36-45	0%
		46-60	
Respondent Employment status	118	Students	100%
		Staff	0%
		Lecturer	
Respondent's Kamsis Blocks	118	V1	100%
		V2	
		V3	
		V4	0%
		V5	
		V6	
Respondent 's Year Span in the Blocks.	118	<5 Years	100%
		5 Years-10 Years	
		11 Years -15 Years	0%
		16 Years - 20 Years	

Table 3 shows that the cracks defects are the highest in the list. This proves that Politeknik Merlimau Melaka Kamsis building desired maintenance. Concrete cracks commonly happen in buildings due to a lot of factors. Chitte (2018) stated building cracks are the most common type of problem in any type of building. Therefore, it is important to understand the cause and the measures to be taken for prevention. Cracking occurs when shrinkage forces become greater than the strength of the concrete. This is also true for concrete parts cannot deform. Wide cracks in concrete are best patched and sealed with concrete patching compound. Smaller cracks less than 1/4-inch-wide can be repaired with concrete caulk or liquid filler. Patching compounds typically are mixed with water and applied using a trowel. To hide the patch effect, it requires the concrete to be painted with concrete paint or a matching colour with the surface patched.

Table 3. Building defects

Building Defects	Sample	Std.		
		Mean	Deviation	Rank
Cracks	118	4.39	0.785	1
Peeling paint	118	3.93	0.922	2
Roof defects (leaking, cracking)	118	2.84	0.847	3
Corrosion	118	2.80	1.090	4
Rust	118	2.52	0.985	5
Ventilation level	118	2.51	0.922	6
Damage caused by the user	118	2.50	1.107	7
Damaged due to the presence of Wild Animals	118	2.46	0.930	8
Decay	118	2.16	0.952	9
Disruption in electrical supply	118	2.11	0.994	10
Pipeline issues (Broken, Damaged)	118	1.90	0.919	11

Table 4 shows that the number one highest on the rank is the management services that should be improved. This is because of a lot of cases of delay in demand for maintenance for the building. The second rank is using the proper tools and materials for the maintenance process. This is because the previous maintenance services were expected to be done with poor inspection and method. Other than that, the third rank is giving a penalty to the person who committed vandalism. This could prevent vandalism from happening and damaging the building and facility elements. The last on the rank was repairing the design of the

building. This is because the repair took a lot of procedures and costly. Repairing the building design also affects the environment as the building structures will be changed and the need for the materials and equipment will also be crucial to ensure the repairing process was done properly.

Table 4. Building defects solution

	Sample	Std.		
		Mean	Deviation	Rank
Management services should be improved.	118	4.38	0.761	1
Using proper material and equipment during constructions	118	4.18	1.083	2
Giving penalty to the person who committed vandalism	118	4.18	1.129	3
Conduct a maintenance services program as a one of steps as awareness to the user.	118	4.08	1.034	4
Asking for user feedback from the user after using the building.	118	4.08	1.095	5
The need for the intervention of an experienced maintenance engineer.	118	4.08	0.944	6
Inspect the condition of buildings and facilities every month	118	4.07	1.019	7
Give control to the building from bad weather	118	3.87	1.082	8
Add maintenance cost expenses	118	3.66	1.360	9
Control the breeding of wild animals on the building	118	3.54	1.130	10
Repairing the design of the building	118	3.26	1.470	11

4. Conclusion

In conclusion, it is found that the Politeknik Merlimau Melaka Campus suffered from defects that could be reoccur again if there are no proper maintenance method performed. The major and minor defects could be prevented if the management services improve their quality services to upkeep the building from suffering defects that could lead to building failures. In addition, the management must play their part and the building's occupants must help maintain the structure by reporting any flaws found to the relevant unit, such as the development and maintenance unit or via E-Sakups on the Politeknik Merlimau Melaka websites. Because this research has lots of benefits, especially to users and

manager, it is recommended that this study to be further extended to investigate how to improve the quality of the campus services. This is imperative because the building most used by students. A comfortable learning place stimulates the learning process and provides a suitable environment for students to live or carry out their daily activities (Moore & Cooper, 2014). Eventually, it is recommended that the manager of Politeknik Merlimau Melaka to increase the maintenance allocation budget in order to maintain and improve the safety, health and welfare of the users.

Acknowledgement

The authors would like to thank the experts and respondents for giving their opinion on this research and to Politeknik Merlimau which permitted to access the kamsis building which makes this important research viable and effective.

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ChatGPT's Impact: The AI Revolution in EFL Writing

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Full Paper

Article history

Received

31 July 2023

Received in revised form

31 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Artificial Intelligence (AI) has become a potential instrument in the realm of English as a Foreign Language (EFL), presenting considerable prospects for improving language learning and teaching. In recent times, the incorporation of ChatGPT, an advanced AI language model in EFL writing has garnered interest. This article discusses the capabilities, drawbacks, impacts, and strategies of using ChatGPT, an advanced AI language model, in the EFL writing context. This study employed a descriptive qualitative research design using a literature review method. The findings show that ChatGPT offers several advantages, including immediate and personalized feedback, personalized practice, and increased learner engagement and motivation. However, there are also drawbacks to consider, such as overreliance on AI-generated feedback, potential inaccuracies or inappropriate suggestions, and privacy and data security concerns. The use of ChatGPT in EFL writing has both positive and negative impacts. On the positive side, it enhances writing efficiency, improves language accuracy, and increases writing confidence. On the negative side, it may limit creativity and originality, lead to a loss of personal voice, and raise ethical considerations. To overcome the potential drawbacks, a strategy is proposed that involves providing clear guidelines to L2 learners on using ChatGPT as a supportive tool, emphasizing critical thinking and independent expression, and offering teacher guidance and scaffolding.

Keywords: - ChatGPT, artificial intelligence, EFL, writing

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1. Introduction

Artificial Intelligence (AI) refers to the ability of computer systems to perform tasks that normally require human intelligence, such as natural language processing, pattern recognition, decision-making, and learning (Russell & Norvig, 2010). It is related to the simulation of human intelligence in computer systems that are programmed to perform tasks that normally require human cognitive abilities. The goal of AI is to enable machines to think, learn, reason, and problem-solve in ways that mimic human intelligence. The presence of AI changed the systems that run in various sectors, including health, finance, transportation, manufacturing, and education (Yampolskiy, 2018). With advances in machine learning algorithms and data processing capabilities, AI is considered more sophisticated, efficient, and accurate in solving complex problems.

According to Demirbilek & Saka (2021), AI has been widely used in education, revolutionizing the way students learn and teachers instruct. AI in education refers to the use of machine learning algorithms and intelligent systems to enhance the teaching and learning processes. It has been applied extensively, including in the context of learning English as a Foreign Language (EFL). AI technologies can help facilitate language learning by providing personalized and adaptive instruction, automatic assessment and providing real-time feedback. AI-powered language learning media also offer engaging and interactive content, such as games and simulations, that can help L2 learners improve their language skills.

However, AI also poses significant ethical and social challenges in the context of EFL learning, including the misuse of various computer applications to do tasks that are supposed to be done by EFL learners such as translating, writing texts, and summarizing texts. Some

popular examples of AI tools in writing include Grammarly, Google Translate, QuillBot, Turnitin, ProWritingAid, Hemingway Editor, and ChatGPT.

In recent years, the integration of ChatGPT and similar AI language models has gained attention in the field of EFL writing. ChatGPT is an advanced language model developed by OpenAI that recently has garnered significant attention and praise in the field of artificial intelligence. It has demonstrated impressive capabilities in generating human-like text responses and engaging in natural language conversations. It has shown promising results in assisting with language learning tasks, such as providing feedback on writing and answering language-related queries (Kostakis et al., 2022). These capabilities are widely used by L2 learners to make assignments, essays, journal articles, and even theses in EFL contexts.

Therefore, this issue raises the concern of writing this article, which aims to determine 1) the capabilities of ChatGPT in EFL writing, 2) the drawbacks of ChatGPT in EFL writing, 3) the impacts of using ChatGPT in EFL writing, and 4) the strategy in overcoming the impacts of using ChatGPT in EFL writing.

2. Methodology

This study employed a descriptive qualitative research design using a literature review method. Qualitative research includes data collection and analysis through observation, interviews, and other forms of interaction with participants. Qualitative research has certain characteristics (Denzin & Lincoln, 2011; Silverman, 2016), including: 1) Emphasis on meaning and interpretation. It seeks to understand the meanings and interpretations, not simply measure, and quantify them; 2) Flexible and repeatable. It allows researchers to adapt research questions and methods based on emerging findings; 3) In-depth data collection: It involves the collection of rich and detailed data.

A literature review was employed in this study to gather and analyze existing scholarly literature on the topic of ChatGPT's impact on EFL writing to answer the formulated research questions. Literature reviews involve systematically searching, reviewing, and synthesizing relevant published studies, articles, books, and other sources (Grant & Booth, 2020). They serve multiple purposes, including providing an overview of existing knowledge, identifying research gaps, and informing the development of new research studies.

Literature reviews employ a rigorous and systematic approach to ensure the reliability and validity of the gathered information. They critically evaluate the quality and relevance of the selected studies by considering factors such as the research design, methodology, sample size, data collection methods, and potential biases (Cooper et al., 2019). By synthesizing findings from multiple studies, literature reviews provide a broader and more comprehensive perspective on the research topic.

3. Result and Discussion

3.1 Artificial Intelligence in EFL Contexts

Artificial Intelligence (AI) has emerged as a powerful tool in the field of English as a Foreign Language (EFL), offering significant potential for enhancing language learning and instruction. AI technologies, such as natural language processing and machine learning algorithms, enable the development of intelligent language learning systems that can analyze and process vast amounts of linguistic data. These systems have the capacity to provide personalized and adaptive learning experiences, automating tasks like language assessment, feedback provision, and content generation. By leveraging AI, EFL learners can benefit from interactive and immersive learning environments that cater to their individual needs and preferences.

Among the widely used AI tools for writing are ChatGPT, Grammarly, Google Translate, Turnitin, ProWritingAid, and Hemingway Editor. These AI tools perform the following functions:

- a) ChatGPT: ChatGPT, a sophisticated language model created by OpenAI, which is trained to follow instructions in a prompt and provide a detailed response.
- b) Grammarly: Grammarly is a popular AI-powered tool that provides real-time grammar and spell checking, vocabulary enhancement suggestions, and writing style improvements.
- c) Google Translate: Google Translate is an AI-based language translation tool that provides translations between different languages, supporting text, voice, and image translation.
- d) Turnitin: Turnitin is an AI-driven plagiarism detection tool widely used in educational institutions. It compares written content against a vast database to identify potential instances of plagiarism.
- e) ProWritingAid: ProWritingAid offers AI-powered writing assistance, providing grammar and style suggestions, readability analysis, and in-depth reports on various aspects of writing, such as overused words or sentence length.
- f) Hemingway Editor: Hemingway Editor analyzes text for readability, highlighting complex sentences, excessive adverbs, passive voice usage, and suggests simplifications to enhance clarity.

Despite the numerous benefits, the integration of AI in EFL instruction also presents challenges and considerations. One key concern is the potential lack of human interaction and the risk of overreliance on AI systems. While AI tools can provide immediate feedback and assistance, they may not fully substitute human teachers' expertise and the social aspects of language learning (Golonka et al., 2014). Additionally, ethical considerations regarding data privacy, algorithm bias, and the responsible use of AI technologies in language instruction need to be addressed (Amiri & Al-Fedaghi, 2021). Educators and researchers must carefully design

and evaluate AI-driven EFL applications to ensure they align with pedagogical principles and promote meaningful language learning experiences.

3.2 ChatGPT as an AI Language Model

ChatGPT is an advanced language model developed by OpenAI that has garnered significant attention in the field of artificial intelligence. Researchers have highlighted its potential applications in various domains, including language translation, content generation, and customer service (Huang et al., 2019; Radford et al., 2019). Its ability to understand context, respond contextually, and generate coherent text has positioned ChatGPT as a powerful tool in language processing tasks.

While ChatGPT has achieved impressive results, researchers continue to explore ways to improve its limitations, such as reducing bias in generated text and addressing the challenge of ensuring the ethical use of the technology (Bender et al., 2021). Overall, ChatGPT has emerged as a remarkable advancement in natural language processing and continues to evolve, with the potential to revolutionize various applications in the future.

In general, ChatGPT has several capabilities, including:

- a) Natural language understanding: ChatGPT can understand and interpret human language, allowing it to comprehend and respond to user inputs effectively.
- b) Contextual conversations: It can engage in dynamic and contextually aware conversations, maintaining coherence and understanding across multiple exchanges.
- c) Generating text: ChatGPT can generate coherent and contextually appropriate responses in natural language, providing informative and engaging text.
- d) Knowledge retrieval: It can retrieve information from its training data and external sources, enabling it to answer questions and provide relevant information.
- e) Language translation: ChatGPT can translate text from one language to another, facilitating multilingual communication.
- f) Content creation assistance: It can assist in various writing tasks, such as suggesting improvements, generating ideas, or providing creative prompts.
- g) Answering questions: ChatGPT can answer factual questions by drawing from its training and knowledge base.
- h) Sentiment analysis: It can analyze and understand the sentiment expressed in text, allowing it to recognize emotions and respond accordingly.
- i) Text summarization: ChatGPT can summarize long passages of text, condensing the information into concise and coherent summaries.
- j) Personalized interactions: It can adapt its responses and behavior based on user feedback and preferences, enhancing the personalized user experience.

These capabilities make ChatGPT a versatile and powerful tool for a wide range of language-related tasks and interactions.

3.3 EFL Writing in The Age of AI

English as a Foreign Language (EFL) writing plays a crucial role in developing learners' language proficiency and communication skills. It involves the production of written texts in English by non-native speakers. EFL writing instruction aims to foster learners' ability to express ideas, convey meaning accurately, and organize thoughts effectively in written form. The challenges faced by EFL learners in writing are multifaceted. L2 learners often struggle with grammatical accuracy, vocabulary selection, coherence, and cultural nuances in their written production. Instructors employ various strategies to address these challenges, including explicit instruction on grammar and vocabulary, modeling effective writing techniques, and providing meaningful writing tasks that connect to learners' personal experiences and interests (Hyland & Hyland, 2019).

EFL writing instruction has been greatly influenced by the advent of Artificial Intelligence (AI) technologies. AI has introduced innovative approaches and tools that can enhance the teaching and learning of EFL writing. AI-powered writing tools, such as grammar and spell checkers, automated essay scoring systems, and language enhancement software, provide learners with immediate feedback on grammar, vocabulary, and writing style (Lee, 2021). These AI tools offer personalized and targeted assistance, enabling learners to identify and rectify their writing errors more effectively. The integration of AI in EFL writing also allows for the creation of intelligent tutoring systems that offer interactive and adaptive learning experiences. AI-powered virtual writing tutors and chatbots can engage learners in conversation, provide writing prompts, and offer guidance on writing structure and organization (Kobayashi & Rinnert, 2019).

3.4 The Capabilities of ChatGPT in EFL Writing

ChatGPT, an advanced language model based on Artificial Intelligence (AI), offers several capabilities for English as a Foreign Language (EFL) writing instruction. One significant advantage is the availability of immediate and personalized feedback. ChatGPT can analyze learners' written responses, provide suggestions for grammar, vocabulary, and writing style, and offer feedback on the overall coherence and organization of their writing. This real-time feedback allows learners to identify and rectify their writing errors, leading to improved writing skills and greater language proficiency.

Another advantage of ChatGPT in EFL writing is the opportunity for personalized practice and autonomous learning. Learners can engage in interactive writing tasks with ChatGPT, receiving prompt responses and engaging in virtual conversations that simulate real-life writing situations (Wang, Zhu, & Qin, 2021). This personalized practice allows learners to focus on their specific writing needs, such as grammar improvement, vocabulary expansion, or argument development. Moreover, ChatGPT offers a non-intimidating and judgment-free

environment, encouraging learners to take risks, experiment with language, and build their confidence as writers.

ChatGPT can also serve as a valuable tool for promoting learner engagement and motivation in EFL writing. The interactive nature of ChatGPT fosters a sense of collaboration and interactivity, simulating human-like conversations that make the learning experience more engaging and enjoyable (Li, Li, & Wu, 2020). Learners may feel more motivated to write and actively participate in writing tasks when they receive immediate responses and experience a sense of interactivity with the AI system. This increased motivation and engagement can lead to enhanced learning outcomes and a more positive attitude toward writing in the EFL context.

Overall, ChatGPT offers several capabilities for EFL writing instruction. It provides immediate and personalized feedback, enabling learners to improve their writing skills. It also offers personalized practice and autonomous learning opportunities, allowing learners to focus on their specific writing needs. Additionally, ChatGPT enhances learner engagement and motivation through interactive conversations, creating a positive and stimulating learning environment. The integration of ChatGPT in EFL writing instruction has the potential to enhance language learning outcomes and support learners in their writing development.

3.5. The Drawbacks of ChatGPT in EFL Writing

While ChatGPT offers several capabilities for EFL writing instruction, there are also certain drawbacks to consider. One significant drawback is the potential for overreliance on AI-generated feedback. Learners may become overly dependent on ChatGPT's suggestions and corrections, leading to a passive approach to writing and a reduced focus on developing their own critical thinking and problem-solving skills (Evans, 2020). This overreliance on AI-generated feedback can hinder learners' ability to independently analyze and evaluate their writing, limiting their growth as autonomous and proficient writers.

Another drawback of ChatGPT in EFL writing is the potential for inaccurate or inappropriate feedback. As an AI system, ChatGPT may not always provide accurate suggestions or fully understand the nuances of learners' writing intentions (Shi & Lammers, 2020). It may misinterpret context, produce errors, or offer suggestions that do not align with the specific requirements of the writing task. Inaccurate or inappropriate feedback can mislead learners and result in the reinforcement of incorrect language patterns or ineffective writing strategies.

Privacy and data security concerns are also important drawbacks to consider when using ChatGPT in EFL writing instruction. As an AI system, ChatGPT collects and processes learners' written responses, which raises concerns about the privacy and security of learners' personal information (Hong & Lee, 2021). It is crucial to

ensure that proper data protection measures are in place and that learners' personal information is handled securely to maintain their privacy and protect their sensitive data.

Therefore, while ChatGPT offers capabilities for EFL writing instruction, it is important to be aware of the drawbacks. Overreliance on AI-generated feedback may hinder learners' autonomy and critical thinking skills. Inaccurate or inappropriate feedback can mislead learners and reinforce ineffective language patterns. Additionally, privacy and data security concerns need to be addressed to ensure the protection of learners' personal information. These drawbacks highlight the need for a balanced approach, where ChatGPT is used as a supportive tool alongside effective pedagogical strategies and teacher guidance.

3.6. The Impacts of Using ChatGPT in EFL Writing

The use of ChatGPT in EFL writing has had an impact on learners' writing skills, both positively and negatively. On the positive side, the positive impacts of using ChatGPT in EFL writing include:

- a) **Enhanced Writing Efficiency:** ChatGPT can provide immediate feedback and suggestions, allowing L2 learners to address errors and improve their writing more efficiently. This can lead to faster revisions and a reduction in the time taken to produce a written piece.
- b) **Improved Language Accuracy:** ChatGPT's ability to identify grammar and vocabulary errors can help L2 learners enhance their language accuracy (Wang, Zhu, & Qin, 2021). By receiving real-time suggestions, L2 learners can learn from their mistakes and develop a better understanding of correct language usage.
- c) **Increased Writing Confidence:** ChatGPT's non-judgmental and supportive nature can boost L2 learners' confidence in their writing abilities (Li, Li, & Wu, 2020). L2 learners may feel more comfortable experimenting with language and taking risks, leading to greater self-assurance in expressing their ideas.

Meanwhile, using ChatGPT for L2 writing can have certain negative effects, including:

- a) **Limited Creativity and Originality:** There is a risk that L2 learners may rely too heavily on ChatGPT to generate content, potentially limiting their own creativity and originality in writing (Cao & Chong, 2021). Overreliance on AI-generated text can hinder L2 learners' independent thinking and expression.
- b) **Potential Loss of Personal Voice:** ChatGPT's suggestions may lead to a homogenization of writing styles, as L2 learners may adopt the AI's suggestions without considering their own unique voice (Evans, 2020). This can result in a loss of personal expression and individuality in their writing.
- c) **Ethical Considerations:** The use of ChatGPT raises ethical concerns related to transparency, privacy, and

potential biases embedded within the AI system (Rozado et al., 2021). L2 learners need to be aware of the data collection and usage policies and understand how their personal information is handled.

It is important to note that the effects of L2 learners writing using ChatGPT can vary depending on the context, the way the tool is integrated into instruction, and the individual learner's interaction with the system. Careful guidance, appropriate scaffolding, and a balanced approach that encourages independent thinking alongside the use of ChatGPT are necessary to maximize the positive effects and mitigate any potential drawbacks. Proper guidance and scaffolding from teachers are crucial to help L2 learners develop their own writing skills while leveraging the benefits of AI-based tools.

3.7. The Strategy for Overcoming the Impacts of Using ChatGPT in EFL Writing

To mitigate the potential negative impacts of using ChatGPT in EFL writing, an effective strategy is to provide clear guidelines and instructions to L2 learners on how to use the tool as a supportive aid rather than a replacement for their own writing skills. Teachers can emphasize the importance of critical thinking, creativity, and independent expression in writing tasks (Evans, 2020). By setting clear expectations, L2 learners can understand that ChatGPT should be used as a tool for guidance and feedback, while still encouraging them to develop their own ideas and unique writing style.

Another effective strategy is to provide opportunities for reflection and revision after using ChatGPT. L2 learners should be encouraged to critically evaluate the suggestions provided by ChatGPT and make informed decisions about which revisions to accept or reject (Cao & Chong, 2021). By engaging in this reflective process, L2 learners can maintain control over their writing and ensure that their personal voice and individuality are preserved.

Teachers can also incorporate collaborative writing activities or peer feedback sessions to promote peer interaction and discussion about the use of ChatGPT. By engaging in peer discussions, L2 learners can gain different perspectives on the tool's strengths and limitations, fostering critical thinking and awareness of its impact on their writing (Rozado et al., 2021). Peer feedback can also provide an additional layer of evaluation and encourage L2 learners to consider a range of perspectives beyond AI-generated feedback.

By implementing these strategies, educators can ensure that L2 learners view ChatGPT as a helpful tool in their writing process rather than a crutch. These approaches promote critical thinking, reflection, and independent decision-making, enabling L2 learners to strike a balance between leveraging AI technology and nurturing their own writing skills and creativity.

4. Conclusion

This study discusses the capabilities, drawbacks, impacts, and strategies associated with using ChatGPT, an advanced language model developed by OpenAI, in the context of English as a Foreign Language (EFL) writing. The integration of AI technologies, such as ChatGPT, in EFL instruction has the potential to enhance language learning experiences and support learners in improving their writing skills.

The capabilities of ChatGPT in EFL writing include immediate and personalized feedback, personalized practice and autonomous learning opportunities, and increased learner engagement and motivation. ChatGPT can analyze learners' written responses, provide suggestions for grammar, vocabulary, and writing style, and offer feedback on the coherence and organization of their writing. It allows learners to focus on their specific writing needs and offers a non-intimidating environment for experimentation and confidence building.

However, there are also drawbacks to consider. Overreliance on AI-generated feedback may hinder learners' critical thinking and problem-solving skills, while inaccurate or inappropriate feedback can mislead learners and reinforce incorrect language patterns. Privacy and data security concerns also need to be addressed to protect learners' personal information.

The use of ChatGPT in EFL writing has both positive and negative impacts. Positive impacts include enhanced writing efficiency, improved language accuracy, and increased writing confidence. Negative impacts include limited creativity and originality, potential loss of personal voice, and ethical considerations related to transparency, privacy, and biases embedded within the AI system.

To overcome the potential impacts of using ChatGPT in EFL writing, clear guidelines and instructions should be provided to L2 learners on how to use the tool as a supportive aid rather than a replacement for their own writing skills. Teachers should emphasize critical thinking, creativity, and independent expression in writing tasks and provide appropriate guidance and scaffolding to help L2 learners develop their own writing skills while leveraging the benefits of AI-based tools.

Therefore, it is important to ensure that AI-enabled language learning tools are designed and used in an ethical and responsible manner, taking into account the needs and preferences of language learners. As AI continues to evolve, it is important to balance its potential benefits with the need to ensure that its development and application align with the values and interests of EFL educators and learners.

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Curriculum Reform: Assessing the Curriculum Understanding in Developing Effective Teaching and Learning Strategies Among Logistics and Supply Chain Teachers at Polytechnic Malaysia

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Full Paper

Article history

Received

25 July 2023

Received in revised form

25 July 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

Developing teaching and learning strategies is not simple; many factors must be considered, that begins with knowledge and comprehension of the learning curriculum, the use of technology, knowledge of the lesson contents, taxonomy level, and culminating in the classroom environment. The teacher's knowledge and understanding of the curriculum are crucial for them to draft the formula for teaching and learning strategy because the desired outcome is to produce a graduate with holistic characteristics who excel both academically and socially aspect. This quantitative research was conducted by distributing a set of questionnaires to 50 lecturers in the field of logistics and supply chain. Throughout this research, researchers have cited the lecturer's knowledge and comprehension of the Logistics and Supply Chain curriculum as the primary focus of the lecturer's efforts to develop effective teaching and learning strategies. The software Statistical Package for the Social Sciences (SPSS) Version 27 tests mean values, standard deviations, frequencies, percentages, and correlations in this quantitative study. According to the descriptive analysis, the mean value of the lecturer's curriculum knowledge was 4.4554, and the mean value of the lecturer's curriculum comprehension was 4.8888. With a correlation value of 0.81, Pearson's correlation analysis revealed a significant relationship between the variables tested on a very strong scale. Therefore, it is crucial for teachers to really understand the goals and objectives of the curriculum so that they can strategize their teaching and learning activities effectively.

Keywords: - Curriculum, teaching and learning, curriculum understanding, curriculum knowledge

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1. Introduction

A curriculum is a sequence of experiences based on standards in which students practice and achieve proficiency in content and applied learning skills. The curriculum is the primary guide for educators about what is necessary for teaching and learning so that all students can access a rigorous academic experience. The curriculum's structure, organization, and considerations are designed to enhance student learning and facilitate

teaching.

Referring to Education Act 1966, a curriculum must contain the objectives, methods, materials, and assessment necessary to support teaching and learning. In addition, an education program needs to include the curriculum and co-curricular activities that have all knowledge, skills, norms, values, cultural elements, and beliefs to help the development of a student fully in terms of physical, spiritual, mental, and emotional as well as to instil and enhance the desired moral values and to convey

knowledge (Ministry of Education Malaysia, 2023).

As educators, it is vital for them to deeply understand the curriculum documents for them to determine and deliver the contents of the syllabus to the students. A curriculum document contains teaching and learning instructions, goals, content, strategies, measurement, and resources. The curriculum can be interpreted in three different ways: conceptually, practically, and in terms of a specific field of study (Green, 2022). Furthermore, the importance of the curriculum can be understood as it is part of the education system; deficiencies in the education process will occur without the curriculum (Hasmori, Sarju, Norihan, Hamzah, & Saud, 2011).

1.1 Problem Statement

The issues on curriculum and its implementation are not discussed much in the context of teachers' knowledge and understanding. The implementation curriculum should begin with a clear understanding of the philosophy, the goals to be achieved, the design, the content, and the scale of the curriculum itself. Educators should know the subject matter and possess teaching skills, including connecting knowledge, skills, and values (Hassan, Zailaini, & Darussalam, 2020).

The implementation of the curriculum involves more than just simply following what has been outlined and stated in the curriculum's documents. In addition, it must be translated and understood concisely from different angles of perspectives. Before establishing teaching and learning strategies and constructing assessment items for students, curriculum perspectives must be well-translated because the curriculum includes the instructional of the syllabus and taxonomy levels that must be achieved. The curriculum offers ideas and strategies to assess student progress, and it needs to be met for students to advance to the next level; without guidance from the curriculum, the teacher will not be able to ensure students get enough supplies to move to the next level (Patanka & Jadhav, 2013).

The knowledge of the instructors or teachers on the respective curriculum and the construction of teaching and learning strategies will determine the success or failure of student development. Attitudes will determine the amount of effort, perseverance, and the teacher's decision on whether the curriculum is planned and implemented (Salleh, 2003). The context of this study is to identify the level of knowledge, understanding, and correlations between the two variables in the lecturer's efforts to develop effective strategies for developing the teaching and learning agenda.

1.2 Research Objectives

This study was conducted with three main objectives as follows:

1. Identify the level of teachers' knowledge of curriculum reformation content in developing effective teaching

and learning strategies.

2. To identify the level of understanding among teachers in designing effective assessment items based on the curriculum reformation.
3. Identify the relationship between the level of knowledge and understanding of teachers in designing an effective teaching and learning strategy.

1.3 Research Hypothesis

There is no significant relationship between the lecturer's knowledge and their understanding of the curriculum reformation.

2. Literature Review

2.1 Curriculum Reform

Curriculum reform refers to the changes required to attain learning objectives considering the changes that have occurred in the present. Curriculum reform is essential to make the curriculum more integrated in terms of design, structure, and content, as well as implementing the most recent T&L approaches and meeting the Industry 4.0 requirements. The accelerating growth of automation industries indicates that the world's special education programs are in need and their graduates must be adapted for them to remain competent and prepared for the Industrial Revolution. 4.0 with extensive planning (Noorashid, 2019). Based on this fact, a country usually tries to form its educational curriculum based on a deep understanding of its community.

In other words, each nation seeks to create a model uniquely tailored to meet the requirements of its community (Haris, 1992). The curriculum has a significant cultural and political role in a society because it establishes the information and skills that are most important for its citizens and that should be passed on to future generations (Gouëdard, Pont, & Huang, 2020).

2.2 Curriculum

There are various definitions related to the curriculum; the term curriculum comes from the Latin word 'curere,' which means a 'racetrack,' 'path,' or 'trail. According to Glatthorn, Boschee, & Whitehead, (2019), a curriculum can be described either prescriptively or descriptively. Prescriptive specifies the do's and don'ts in the form of a plan and also includes the desired program and expert counterparts. The descriptive definition means that it omits the prescriptive description, which is curriculum-specific and covers the experience.

The Ministry of Higher Education Malaysia (2012) defines curriculum as a term that refers to what is conveyed, such as the integrated curriculum of the primary school and the integrated curriculum of the secondary school, which specify what students should learn. Secondly, the curriculum probably refers to the principles built and becomes a basis for the teaching and

learning approach strategy as contained in the competency-based curriculum (Competency-Based Curriculum).

Third, the curriculum will probably mention what, how, and why instructions should be given. Quoted from the same book, Dewey (1902) interprets the curriculum as a method and a way to promote the cultural experience of a race. He interprets the curriculum as a continuous formation process, the occurrence of a shift from the student's current experience to a new experience offered by the body of knowledge referred to as the field of study.

2.3 Knowledge

Knowledge typically consists of both theoretical notions and ideas and practical understanding based on actual experience completing certain tasks (OECD, 2019). Different fields of study would be a challenge; therefore, it is crucial for the teachers to deeply understand the respective knowledge. It is aligned with Suhairi & Ahmad (2017) where the influence of the teacher's understanding of the subject's content on classroom practice is essential matters. As teachers, it is a must for the teacher to ensure that the students can acquire the knowledge (Indrani, Chrisia, & Janaki, 2018).

The role of the teachers or instructors is to widely spread the curriculum that has been created and will be executed based on the knowledge and skills held can be considered as requiring an understanding of the curriculum. Salleh (2003) clearly states that the main factor that determines the spread of the curriculum is the teacher based on the ideology and knowledge of the spreader himself.

The curriculum objectively states the learning content, achievement grades, percentages, topics, and titles that should be taught in an ordered manner. It also includes the lists of the content, materials, resources, and processes to assess the objectives (Campbell-Phillips, 2020). The ability of the teachers to improve teaching and learning through the curriculum relies on their knowledge and communication skills. Such factors include classroom management, communication skills, and media use (Mat Som & Syed Ali 2011). The teacher's knowledge and skills can also determine the extent to which the content of a subject can be mastered and delivered effectively.

2.4 Understanding

The Merriam-Webster dictionary defines comprehension as a person's ability to understand the meaning or the ability to make an experience comprehensible by using concepts and categories. Understanding the curriculum reflects the formation of knowledge and students' thinking abilities. It is essential to recognize the reference to experience, not only the experience of students with the curriculum but the experience that all stakeholders, including teachers, have with the curriculum's design, implementation, and evaluation (Mitchell, 2016).

From the perspective of understanding the curriculum, the teacher is the primary key player in the implementation and success of the curriculum; the teacher also plays the role of a planner, implements the actual curriculum, and will face challenges in the learning process (Razali, Mohd Yusoff, & Osman, 2017). The relationship between education, curriculum, and society is interdependent because, through the education system and robust curriculum planning, as well as the interaction between teachers, students and parents, and community, it will create a society that can live with the spirit of simplicity and understanding the reason for its existence (Hasmori¹, Sarju, Norihan, Hamzah, & Saud, 2011).

3. Methodology

This research sample comprises teachers from polytechnics that offer a Diploma in Logistics and Supply Chain Management programme. A pilot test questionnaire is developed by referring to the literature review. The sample for the pilot test comes from teachers who are teaching in the same field. Throughout the trial, the researcher can identify issues with the questionnaire. If the questionnaire is not precise, it should be examined and rewritten. Table 1 shows the result of the reliability test. The Cronbach's Alpha value is 0.880, indicating that the questionnaire is good and acceptable.

Table 1. Cronbach's Alpha value

Cronbach's Alpha Value	
	0.880

The questionnaires are distributed by using Google Forms. The questionnaire is divided into three sections. In section A, the questionnaire addresses demographic information such as gender, institution, experience in teaching logistics, and first-degree studies, whereas section B focuses on curricular knowledge. In comparison, Part C is about understanding the curriculum. These sections are based on a self-evaluation ratio on a 5-point Likert scale. Moreover, the questionnaire uses the Likert scale because the reliability level is superior.

Table 2. The number of questionnaire items.

No	Section	Number of Items
1.	A: Demographic	4
2.	B: Knowledge	11
3.	C: Understanding	17
Total Item		42

Descriptive statistics, which involved mean and standard deviation for all items, were used, and the interpretation is based on the mean scores recommended by Moidunny (2009) as shown in Table 3.

Table 3. Level determination

No	Level	Interval Mean Score
1.	Very High	4.21 until 5.00
2.	High	3.21 until 4.20
3.	Medium	2.61 until 3.20
4.	Low	1.81 until 2.60
5.	Very Low	1.00 until 1.80

In this study, the researcher estimated the strength of the correlation between variables based on guidelines by Cohen & Swerdlik (2002) as shown in Table 4.

Table 4. Correlation strength

Negative	Positive	Correlation Strength
-0.50 until -1.00	0.50 until 1.00	Strong
-0.30 until -0.49	0.30 until 0.49	Moderate
-0.01 until -0.29	0.01 until 0.29	Low
0.00	0.00	No Correlation

IR 4.0 is an emerging technology which involves Artificial Intelligence (AI), Big Data Analytics, Internet of Things (IoT), Cloud Computing, Augmented Reality, Simulation, Cyber Security, Systems Integration, Additive Manufacturing, and Robotics & Autonomous Systems by organizations (Othman, 2021). The recent development of IR4.0 technology has further increased the role of PLC use in the automation and manufacturing industry, particularly in developed countries (Khairudin et al., 2019). IOT-based PLC control is widely used to control machine functions automatically and semi-automatically. It is a computerized microprocessor-based controller that implements discrete or sequential logic in an industrial environment. Online PLC control for mechanical relay functions, timers and counters where each function is integrated in one PLC controller unit can be done with internet facilities. It is widely uses in the industry using several programming languages such as ladder diagram (LD), instruction list (IL), sequence function chart (SFC), function block diagram (FBD) and structured text (ST) (Yakimov et al., 2019). The process of uploading the completed program is done online, using the Factory I/O. Once uploaded, the movement simulation can be seen by the students using Arduino and Factory I/O software through the Open Platform Communication (OPC) server. This clearly helps the students to understand better upon seeing the results on the consequences of every command first-hand. Therefore, the use of PLC at an early stage, especially for students, is important before entering the real world of work (Rusimamto et al., 2019). The rapid transition into the IR4.0 combined with advancement of simulation technology have been widely utilized in the military and medicine fields. The success of such implementation proves that the education field can equally benefit from such technology. This will evidently

make teaching and learning interesting and ultimately more effective without involving the purchase of expensive equipment.

4. Result and Discussion

4.1 Level of Teachers' Knowledge

Based on the response, respondents gave the highest response on item B4 which is *Curriculum reformation should include feedback from teachers to ensure the effectiveness of PdP*. The individual mean score and standard deviation for item B4 are 4.66 and 0.479 respectively. Meanwhile, item B10 which is the *Involvement of curriculum stakeholders in giving input for curriculum reformation should be done continuously* and has the lowest mean which is 4.36 and a standard deviation of 0.631. Overall, 11 items indicate that the mean value score on the teachers' knowledge in curriculum reformation stated at the highest level of interval mean score which is 4.5127 with a standard deviation of 0.43878.

4.2 Level of Teachers' Understanding

On the level of teachers understanding aspect, most of the respondents gave the highest response on item C4 which is, *I understand the Course Learning Outcomes (CLO) that have been developed* with a mean value of 4.30 and a standard deviation of 0.544. In contra, item C3, *I understand the mapping of the MQF Cluster to PLO that has been developed* has the lowest mean score with mean value and standard deviation of 3.96 and 0.605 respectively. Overall, 17 items indicate that teachers understanding of curriculum reformation were stated at a high level of interval mean score with a mean value of 4.1156 and a standard deviation of 0.40240.

4.3 Relationship Between the Level Of Knowledge And Understanding Of Teachers

Table 5 shows the results of the Pearson Correlation test for the relationship between teachers' knowledge and understanding. A significant relationship exists between teachers' knowledge and understanding, with a p -value of 0.002. While the r value obtained was as high as 0.426. It shows that there is a strong positive and significant relationship between teachers' knowledge and understanding. This situation means that the higher the teachers' knowledge of curriculum reformation, the higher the teachers' understanding of it. In conclusion, the null hypothesis is rejected at a significant level of 0.01.

Table 5. Pearson Correlation test for the relationship between teachers' knowledge and understanding

		Understanding
Knowledge	Pearson correlation (r)	0.426**
	Sig. (2-Tailed) (p)	0.002

** . Correlation is significant at the 0.01 level (2-tailed).

The findings of the study show that the level of knowledge of teachers on curriculum reform is very high, with a mean of 4.512. These findings align with the results from Jamaludin (2021) who studies teachers' readiness and attitudes towards education changes, which found that enthusiasm for reform and acceptance of a difference by educators is very significant. It is the teachers' willingness to work hard to apply a reform in the educational organization successfully. Teachers' knowledge and skills are vital and are the primary drives for curriculum development (Zohar, Degani, & Vaaknin, 2001). Specifically, teachers must understand curriculum reform. The curriculum modification must include the teachers to give inputs in ensuring the effectiveness of planned teaching and learning strategies. Teachers are crucial in curriculum implementation since they have the knowledge, experience, and abilities to assist in curriculum development (Alsubaie, 2016). Teachers' expertise is vital because they specialize in teaching curriculum content to achieve learning objectives.

Since the teacher should execute the curriculum to fulfil the needs of students, it may be necessary for teachers to develop lesson plans and syllabi within the scope of the supplied curriculum (Carl, 2009). Particularly, teachers can contribute to the curriculum creation process by planning in collaboration with the curriculum development team and subject matter specialists. Necessary confirmation of the university's efforts to generate graduates with relevant knowledge, values, and skills based on Bloom's Taxonomy of learning domains (Laguador & Ramos, 2014) requires the participation of industry partners in curriculum revision.

The involvement of stakeholders in curriculum reform needs core attention. This significance comes from the fact that the curriculum's stakeholders now include the industry and the market rather than just the academic side of universities and colleges (Khayriyyah & Chang, 2022).

The analysis also found that the mean for teachers' level of understanding in designing effective assessment items based on the curriculum reformation is high with a mean value of 4.11. Understanding CLO is necessary for teachers because teachers can build a T&L strategy based on their ideas and creativity through CLO. A well-structured course should demonstrate a precise alignment between the learning outcomes and the assessment criteria employed in the study; this then leads to the design of an assessment that is suited to the evaluation and to deliver the course using the most effective approach to achieve the desired results (Keshavarz, 2011).

Based on the learning outcomes (Learning Outcomes), the teaching context, learning activities, and assessment

systems must be structured so that students may successfully follow and succeed (Mahajan & Singh, 2017). As a teacher, it is a must to promote the development of high-quality learning outcomes in our students, such as a deep approach to learning, comprehension, autonomous learning, critical and creative thinking, problem-solving, and other aspects of lifelong learning (Aziz, Yusof, & Yatim, 2012).

Teachers are responsible for creating the environment and chances for students to engage in profound learning experiences that expose and enhance their abilities. Teachers should be the driver of meaningful learning, not merely the facilitators, and choose from various methods that can be blended and modified to the situation and individual pupils (Caena & Redecker, 2019). During active T&L, teachers are primarily responsible for enrichment, consultations, negotiations, and answering queries (Nur Ayuni, Naziha, & Narina, 2016). The significance of this method lies in the fact that students can regulate their learning and determine whether or not they possess specific knowledge. In conclusion, the primary attribute of active learning is engaging students in learning activities so that they do not learn passively and retain information.

The Malaysian Qualification Framework (MQF) identifies the capabilities to search, evaluate, organize, analyze, synthesize, use, and communicate information as a series of desirable learning outcomes for Malaysian higher education students (Karim, et al., 2010). Therefore, teachers should examine all the capabilities in building their T&L strategies because there is a close relationship between the elements specified by the MQF framework and the elements contained in the PLO.

The significance of the relationship between the lecturer's knowledge and their understanding in establishing a successful teaching and learning strategy must be investigated from various perspectives to be well understood. Proficiency in the field, skills in interpreting and building assessment items, instruction, and learning delivery techniques based on multiple sources and technology platforms, accurate understanding of taxonomy, and so on will significantly impact the construction of this strategy. The curriculum has to support the learning and assessment in developing the students, institutional culture, curriculum design, and learners' final practices while establishing evaluations, feedback, and coaching (Scott, 2019).

5. Conclusion

The results conclude that teachers must understand teaching goals, objectives, and reflections to be free in their different teaching contexts. Education and curricular frameworks are linked, and their mutually beneficial relationship helps both fields grow. When education is built on the foundation of an excellent curriculum, it would receive a great deal of respect. In light of this, teachers should always work to enhance their skills, not only in terms of education but also they provide students

with new information or their professional abilities throughout the learning process.

Acknowledgement

We thank the Curriculum Division: Polyc, the teachers from all the polytechnics involved in this research, and fellow researchers and teammates.

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Full Paper

Article history

Received

28 July 2023

Received in revised form

28 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Design and Development of the EASY MATH Android Application for Interactive Mathematics Learning

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Abstract

The continuous growth of technology has a great impact on society and in the education field. With the technology, the lecturer can perform various activities to ensure the class session is more interactive and students are able to efficiently acquire knowledge. However, the students in the field of mathematical engineering face great challenges, such as boring class sessions, difficulty deriving mathematical functions, and complex calculations. Therefore, in this research study, the EASY MATH android application is designed, developed, and tested for students and lecturers. Rapid Application Development methodology is implemented to ensure that the development of the EASY MATH application stays on track. With the application, students and lecturers can perform various activities such as playing interactive games, viewing notes, and performing specific tutorials. To ensure the application is running as expected and no logic errors occur, a User Acceptance Test is conducted by selecting about 20 respondents. The result from 20 respondents indicate that EASY MATH is fully functioning and ready to be implemented in real-world environment scenarios. Thus, it can be concluded that EASY MATH is fully functioning and can be used by students and lecturers in understanding and delivering engineering mathematics. In future work, The System Usability Scale and Net Promoter Score are planned for implementation to evaluate the application's usability and user satisfaction towards the EASY MATH functionality and accessibility.

Keywords: - Technology, android application, mathematical engineering, user acceptance test, class

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1. Introduction

The continuous growth of technology has a great positive impact on various aspects of society. With technology, people can communicate with each other anywhere and anytime with an internet connection (Wi-Fi, 5G, and 4G) via electronic devices such as smartphones and Personal Computers (PC) (Younes & Al-Zoubi, 2015). According to the (Georgiev, 2022), almost 10 billion mobile devices are being used by all stages of users such as students, lecturers, employers, and employees. With mobile devices, users can perform various activities such as downloading specific

applications, sending emails, making phone calls, and making a video call (Zhao et al., 2022).

The advancement of technology and mobile devices also gives a great advantage to educational institutions. This is to ensure the knowledge can be transferred to the students at the fastest rate and effectively (Wekerle, Daumiller, & Kollar, 2022). For example, during the pandemic Covid-19, all educational activity including the class session via face-to-face methods is prohibited to prevent Covid-19 from spreading. Therefore, all class sessions are conducted online with the lecturer by using a specific platform such as Google Classroom and Microsoft Teams (Pratama et al., 2020; Wea & Kuki,

2021). Students are required to download and install the platform mentioned above onto their electronic device. Then the lecturer will share the class ID or class link with the students. Only then, students able to join the specific online class session with their lecturer (Dash et al., 2022).

Engineering mathematics is one of the necessary subjects that engineering students are required to obtain the attributions to graduate (Tossavainen, Rensaa, & Johansson, 2021). According to City (2021) indicates that most students face a lot of difficulty and challenges in learning in all areas of mathematics concepts. According to the authors, one of the reasons of the reason why students face difficulty in learning mathematics is students feel bored in the theorems and difficult to derive the function and differentiate the mathematical formulas. Other than that, a previous study by Kashefi et al., (2012) mentioned that too many concepts/facts, complex calculations, and poor recall of prior knowledge is the reason why students are not interested in engineering mathematics.

Therefore, effective educational interventions need to be developed to help students in engineering mathematics subject (Meyer & Fang, 2018). It is consistent with the previous study by Rohaeti (2019) mentioned that innovative teaching approaches are more effective compared to the conventional teaching method.

In this research study, the mobile application EASY MATH is designed and developed with the aim to make the class session more interactive and more enjoyable. This application can be used by the lecturer and students who enroll in the subject Engineering Mathematics at a specific educational institution. Students can use this application to help them understand each topic in mathematics. The application consists of various activities and functions related to engineering mathematics that able to help student and lecturer in delivering and understanding engineering mathematics.

The rest of this paper is structured as follows: Section 2 describes the literature review, which includes a comparison of the existing mobile application in the education field based on the recent study within the last 5 years; Section 3 discusses the methodology used in this research study to design, develop and test the mobile apps EASY MATH; Section 4 explain about the implementation of the mobile apps; Section 5 explain about the EASY MATH implementation and testing and section 6 concludes this research study.

2. Literature Review

Many researchers have done their research study to design and develop a mobile application in the education field. For example, a previous study by Jahan et al., (2021) develop an android application called North South University Grade Tracker (NSUGT). NSUGT acts as a tool for the students to track their studies activities and make them more organized. NSUGT also consists of features that implement machine learning to give students a recommended subject for the next semester.

Other than that, Song (2020) developed an android mobile learning system for Ideological and political education. This application was created with the aim to help students study anywhere and anytime related to ideological and political education. This application also makes learning more effective through the combination of intelligent education and mobile learning.

Besides that, Huaynacho and Huaynacho (2020) develop a mobile application for Laboratory Instruction Management. With the application the professor and students can control the management of laboratory instruction effectively.

However, there has no specific android mobile application developed for the subject of engineering mathematics for students in educational institutions. Therefore, this research study will develop a mobile application EASY MATH with the objective to make the teaching and learning lessons more interactive among students and lecturers.

3. Methodology

The methodology can be defined as the systematic, theoretical analysis of the method used to develop, design, validate and maintain a system (Rahman, 2022). In this research study, Rapid Application Development (RAD) is adopted for the development of the mobile application EASY MATH. This is to ensure the application development is on track and can be finished according to the specific time given. RAD consists of 4 stages which are Requirement Planning Phase, User Design Phase, Construction Phase, and Cut-Over Phase as shown in Fig. 1 (Qodim, Busro, & Rahim, 2019).

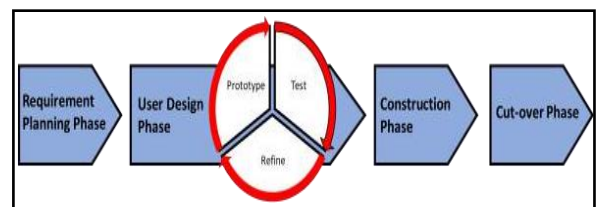


Fig. 1. Rapid Application Development

3.1 Requirement Planning Phase

In this phase, the researcher conducts a comprehensive research study to collect any related data to the mobile application in the education field. This is to identify the strength and weaknesses of the existing research study and collect any useful information that can be used in the next phase.

3.2 User Design Phase

In this phase, a prototype for EASY MATH is designed based on the requirement collected in the previous phase. The prototype of the EASY MATH application is designed using specific tools in order to demonstrate how the application should be functioning. It

should be noted that this phase will be repeated until the prototype application flow of the process is fully designed based on the requirement from the previous phase.

3.3 Construction Phase

In this phase, the EASY MATH application is developed by using a Thunkable platform. Thunkable is a platform that allows the user to develop an application without writing a single line of source code. Thunkable can be accessed by using any web browser (url: <https://thinkable.com/>) and any user with or without basic programming language can use this platform to develop a mobile application. Thunkable is a free and user application can be developed by simply drag and drop components of code and connecting them in blocks (Siegle, 2020).

Besides that, the Graphical User Interface (GUI) is implemented to allow the interaction between the user and the developed EASY MATH application. Other than that, a use case diagram and flow chart are also used to indicate the EASY MATH application flow of process and how the learning process is conducted among students and lecturers.

3.4 Cut-over Phase

In this phase, after the EASY MATH application is fully developed in the previous phase, testing method is implemented. This is to test and validate all the EASY MATH functionality in order to prevent any bug and error. User Acceptance Test (UAT) is used in order to ensure that all the EASY MATH application functionality is functioning as expected. Previous study by Samonte et al., (2018) and Halimah et al., (2010) implemented UAT by selecting between 10 to 15 users to verify all the developed application functionality. According to the authors, the selected user must be among the user who will use the system in the future. Other than that, the selected user must have general knowledge and information about the developed application so that the UAT can be performed more effectively.

4. Application Design and Development

To design and develop an EASY MATH mobile application, application architecture and application design are implemented to demonstrate the application flow of the process. The application architecture is the conceptual modal that represents the flow process of the proposed android application. While the system design is the process of defining the application architecture of the EASY MATH mobile application.

4.1 Application Architecture

EASY MATH consists of two components which are user, teaching, and learning. Fig. 2 illustrates the application architecture of EASY MATH.

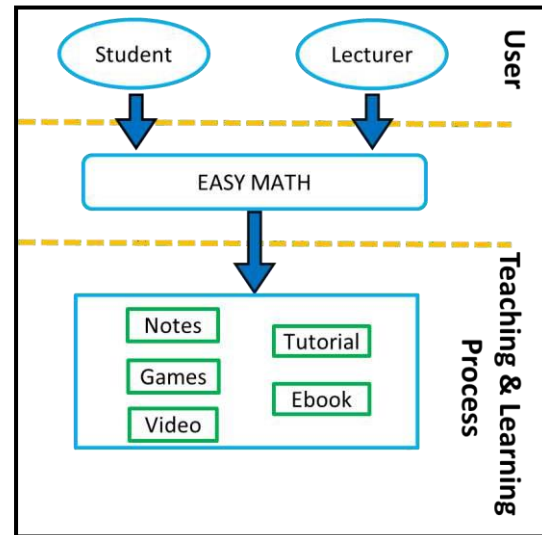


Fig. 2. EASY MATH application architecture

a) User

IPSS can be used by two types of users which is student and lecturer. Each user required to enter an email with the password for the authentication process before able to use all the functions available in the EASY MATH application.

b) Learning Process

This component refers to the function that available and can be used by the lecturer and student. EASY MATH consists of five functions for learning and teaching session which is Notes, Games, Video, Tutorial, and eBook. Therefore, students or lecturers can choose any function for interactive learning and teaching purposes.

4.2 Application Design

To demonstrate the flow of process for EASY MATH, use case diagram and flowchart is implemented. Fig. 3 illustrates the use case diagram to describe the user activity when using the EASY MATH application. Based on Fig. 3, after students and lecturers successfully log in to the EASY MATH application, they can follow various activities such as view notes, playing interactive games, playing videos, viewing eBook, and viewing tutorials/exercises.

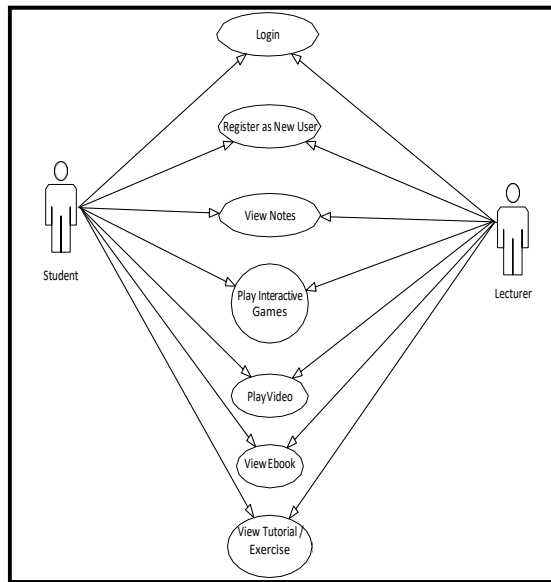


Fig. 3. EASY MATH use case diagram

Fig. 4 demonstrates the flow of the process to gain access to the EASY MATH application. Student and lecturer are required to enter their email and password and then the application will perform the validation process to check whether the user exists in the specific database. If the user credential exists in the database only then the user can log in to the application and access all the functionality provided.

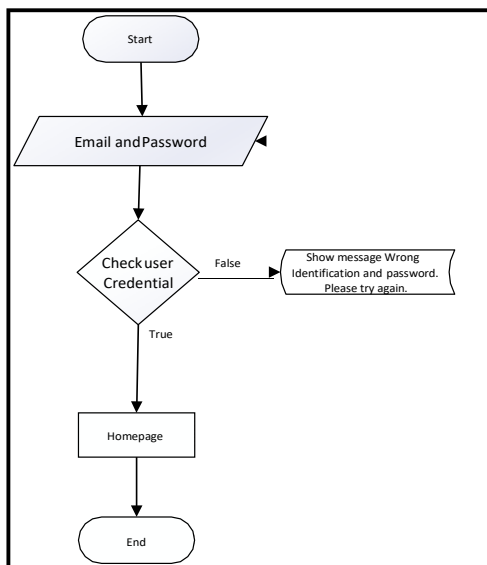


Fig. 4. EASY MATH login flowchart

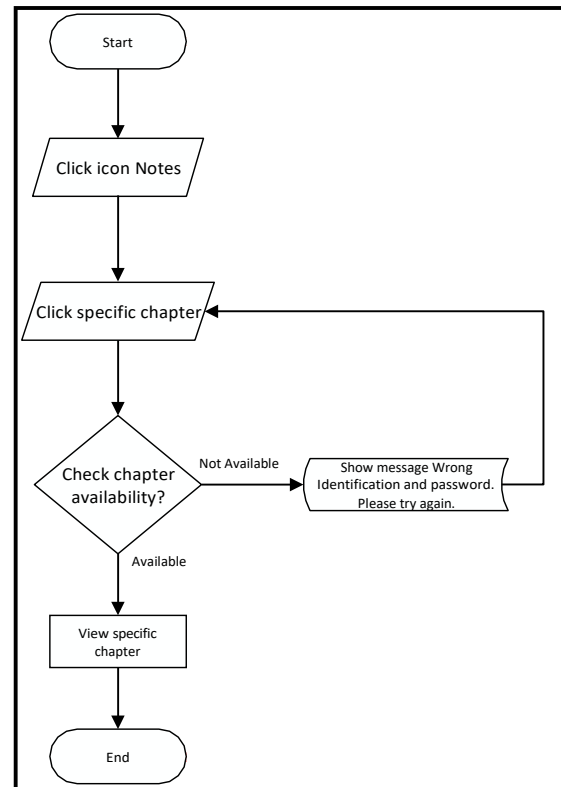


Fig. 5. Select and view specific chapter note flowchart

Fig. 5 shows the flowchart for selecting and viewing specific chapters in the EASY MATH application. Students and lecturers can view specific chapter notes by clicking the icon Notes and then clicking the desired chapter. If the selected chapter file is available only then it will display on the student and lecturer mobile phone. If the selected chapter is unavailable, then the error message is displayed, and the student and lecturer are required to select another chapter.

5. Application Implementation and Testing Result

5.1 EASY MATH Graphical User Interface (GUI)

Graphical User Interface (GUI) is the user interface that allows users (students and lecturers) to interact with the EASY MATH application. Users can perform various activities such as log in, viewing a specific chapter, playing a video, and performing specific tutorials.

Fig. 5 illustrates the GUI for user login to authenticate user credential before can use the EASY MATH functionality. Users are required to enter a registered email with a password then EASY MATH will perform the authentication process. If the authentication process is successful only then EASY MATH will redirect the user to the landing homepage as shown in Fig. 6.



Fig. 5. User login page GUI



Fig. 6. User landing page GUI

Fig. 6 demonstrates the user homepage after successful login to the EASY MATH. Based on Fig. 6, users can select/click various EASY MATH activities such as viewing notes, playing interactive games, playing videos, viewing eBook, and performing tutorials.

For example, if the user clicks notes and user required to select a specific chapter. Then if the chapter file is available only then the EASY MATH application will display the selected chapter (refer to Fig. 5).

5.2 EASY MATH User Acceptance Test (UAT)

After the EASY MATH application is fully designed and developed, User Acceptance Test (UAT) is implemented at the final stage with the aim to ensure the application is fully functioning and satisfy the need of the specific user (Afrianto et al., 2021). In this research study, 20 users are selected among the lecturers and students to test and validate all the EASY MATH functionality.

UAT sessions are conducted at a specific place and each user is required to install EASY MATH through their android electronic device. The UAT session was led by one presenter and one facilitator. User acceptance forms are distributed to each user and users are required to perform each activity available in the EASY MATH. After each user performs all activities, the user is required to fill up the form and tick whether each activity is running as expected or not.

Upon completing the UAT, the results from the testing were gathered. The results were then analyzed to determine the user's expectation towards the EASY MATH functionality. The results collected are presented as shown in Fig. 7.

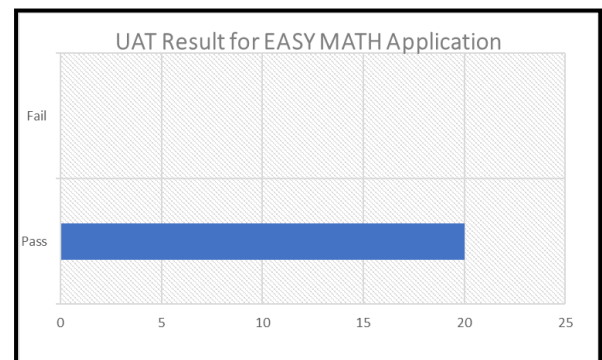


Fig. 7. UAT result for EASY MATH application

Based on Fig. 7, it can be concluded that the EASY MATH has successfully passed the UAT test. The selected users have tested and validated all the EASY MATH functionality and the result indicates that the application is running as expected and no error occurs during the UAT session. Other than that, users also agree that the EASY MATH application can help facilitate the teaching and learning lessons among the students and the lecturer.

6. Conclusion

An android mobile application EASY MATH has been designed, developed, and validated in this study. The Thunkable platform is implemented to develop the EASY MATH user interface and functionality. To ensure all EASY MATH functionality is working as expected and no logic error occurs, User Acceptance Test (UAT) is used. 20 users among the lecturer and students were selected randomly to perform the UAT session. UAT session is conducted at a specific place with the help of the presenter and facilitator.

The result from UAT session indicates that all users agree that EASY MATH are fully functioning, and no errors are recorded during the UAT sessions. Therefore, it can be concluded that EASY MATH is fully functioning and ready to be used in the large-scale scenario.

Acknowledgment

The authors would like to express deep appreciation to Politeknik Mukah Sarawak (PMU) for the permission to carry out this research study work. Finally, the authors would like to thank the respondents for the feedback, Mathematics, Science and Computer Department (JMSK) and Department of Information and Communication Technology (JTMK) for supporting this research study to design and develop an EASY MATH android mobile application.

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Development of An Electrical Energy Meter Monitoring System Using Dashboard MQTT Application

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Due to the current revolution in quick technology use, which results in a decline in energy source, energy consumption is rising. The primary cause of this issue is the unchecked wasteful behavior of consumers when using electricity. The Rapid Application Development (RAD) model, Internet of Things (IoT) technology, the MQTT Dashboard application, AdaFruit IO software as a database of developed systems, a NodeMCU ESP8266 controller, and an ACS712 30A current sensor are all part of the methodology chosen to carry out this project. The ESP8266 NodeMCU microcontroller will interpret the data from the ACS712 current sensor and display it as a monitoring tool on the computer's AdaFruit IO software and the MQTT Dashboard app on the user's smartphone. This project's user-friendly features allow us to track the cost of electricity use over the course of a day and a month, regardless of where we are located. The advantages of this method can be summed up as being cost-effective, straightforward, and simple to maintain.

Keywords: - Electrical energy meter, monitoring system, MQTT dashboard, AdaFruit IO

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1. Introduction

The electricity meter monitoring system using MQTT Dashboard application is developed based on the concept Internet of Things (IoT). The purpose of this product is to make it easier for consumers to monitor the electricity meter in the distance and prevent the occurrence of wastage of electricity. When we enter the new era, the internet will dominate many purposes, albeit humans will only make up a small portion of it. IoT is steadily growing in importance and is now pervasive throughout our daily lives. IoT is a technological advancement that combines a wide range of smart systems, frameworks, intelligent devices, and sensors (Kumar et al., 2019). It is obvious that the object will only be moved by the system. The primary energy source for the industrial, commercial, educational, agricultural, mining, and even domestic sectors is electricity. This energy source offers several advantages that improve socioeconomic conditions, particularly in Malaysia, and the quality of life. Yet, if

people do not understand the value of energy-saving techniques, it will undoubtedly have an impact on how long future generations will live (Othman & Hanis, 2017).

The problem that often arises due to the high rate of consumption of electricity from consumers is that the monthly electricity bill is soaring that the money allocated for the month's electricity bill is insufficient. The problem that often arises due to the high rate of consumption of electricity from consumers is the monthly electricity bill is soaring that the money allocated for the month's electricity bill is insufficient. This system will provide users with indication of LED flash when they have high energy consumption. In addition, this system will display the used electricity readings as well as the bill price to be paid on the MQTT Dashboard application.

Electrical energy meter monitoring system using MQTT Dashboard application was developed to facilitate users monitor the readings of electricity meters remotely regardless of the location of the user's presence. This system uses the concept of Internet of Things (IoT).

Additionally, the purpose of this product development is to inform consumers about the rate of electricity usage that has been utilized through the LED flash so that users can take further steps to ensure that their monthly electricity bills are within the range of expenditures set by them during the month. Consequently, consumers can keep their electricity bills at a moderate level so that their monthly spending money can be saved.

Based on the purpose of this product development, several objectives have been identified. Among the objectives are to design an electric power meter monitoring system using MQTT Dashboard application. Secondly is to test the functionality of an Electric Power Meter Monitoring System using MQTT Dashboard application in accordance with the set criteria.

Based on the utilisation of certain of its capacities, the internet of things (IoT) can be viewed as a service that can meet many forms of demand. Due to their bright future and ability to facilitate the research and study of various elements, IoT has been able to push back other neighboring technologies. (Villamil et al., 2020). The fourth industrial revolution, also known as Industry 4.0, is distinguished by a wide range of cutting-edge applications and services, numerous interconnected devices, and revolutionary manufacturing processes (Maqbool et al., 2023). Industry 4.0 refers to a manufacturing environment that is highly integrated, digitalized, automated, autonomous, and productive. The manufacturing industry has experienced significant, previously unheard-of upheavals and hurdles as we approach the fourth industrial revolution (IR4.0). Workplace disruptions, high implementation costs, changes to organizational and operational procedures, security and privacy concerns, problems with regulatory compliance, and a lack of data management are just a few of the obstacles that must be overcome to keep up with the emergence of new technologies. The business world is facing increasing difficulties because of the growing global rivalry, particularly the adoption of IR4.0 in the manufacturing sector (Othman & Zaidi, 2021).

By using smart machines and converting traditional production systems into smart factories, this new manufacturing paradigm places a strong emphasis on making smart goods and building smart processes. Smart factories are the result of integration through digitization, use of flexible and adaptive structures and strategies as well as artificial intelligence technologies, and they allow the development of intelligent production environments throughout the entire value chain (Pereira et al., 2019). This means that internal systems, wireless sensor networks, automation (intelligent automation for homes and buildings) and so on will contribute to the widespread and effective use of the Internet of Things (IoT) to humans. Energy management and smart metering installations are increasingly important in today's building automations that involve electrical energy systems. Field level integration in these kinds of projects may offer new options for monitoring building energy use and enhancing control performance (Zafar et al., 2020).

In Malaysia, Tenaga Nasional Berhad (TNB) companies are still using the manual method in which they will go from one home to another to read the kilowatt hours meter to issue a monthly rate payable by the user as shown in Fig. 1. This will result in an error when the meter reader takes a reading, resulting in high electricity bills (Gujarathi et al., 2021). It is the user's responsibility to clarify and correct any human errors after receiving an incorrect bill from the energy supply board. The customer will then need to locate the office, wait in line, and get it fixed. The issue is solely the result of human participation, even though these businesses frequently enhance their processes to reduce mistakes and difficulties (Hudemani et al., 2019). According to research by Suruhanjaya Tenaga, most power users have abandoned the tariff block (301-600 kWh), which has led to their high electricity bills (Idris, 2020). This occurred because of a lack of monitoring of the usage based on the kilowatt-hour meter readings.

ML. EL. ELEKTRIK GAB. RIVOTS CUKRAI

Mr. AKAHI : 229137442900

No. Sukuat : 247591

Depot : RM 133.02

No. Baku Cuk : 430227108

YUKAN ENI ENI RIVOTS
RT. 10. NO. 10. AN. AN. TUGAS. GAB. S
UPUT. SAN. KAL. SELAYOR.



Bayanan Tertanggung
NOTES PENGANTARAN
DI BANGUN
TMD CUKRAI
1308.86.5454

Jumlah Perku Dibayar: RM 296.90

Setor 15 OKT 2017

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Depot	RM 167.48	14.13.205	
Proyeksi	RM 2.02		
Jumlah per	RM 170.48		
		Terdik	
Nil. Statistik	RM 128.48	14.05.29.13	
Proyeksi	RM 10.28	14.05.29.17	

Jenis Baku

Kategori Statistik

Setor 15 OKT 2017 RT. 10. NO. 10. AN. AN. TUGAS. GAB. S

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Fig. 1. Monthly electricity bill rate

Due to the kilowatt-hour meter being tampered with using the switching control method with a receiver circuit board inserted illegally within the kilowatt-hour meter to circumvent the meter, the SESCO Berhad company, which operates in Sarawak, has experienced losses. The issue is that the kilowatt-hour meter only accurately measures a small portion of the real electricity utilised by the customer. Due to this, the monthly charge is low and does not reflect the amount used (Tugong, 2019). Nowadays, more service providers or products besides banking institutions, provide services or applications that provide deal details such as Grab and Touch 'n Go. Generally, smart meters as shown in Fig. 2 allow consumers to know their electricity usage every half hour.



Fig. 2. Smart electricity meter

Consequently, energy consumption can be saved by changing the consumption habits that waste electricity. Most of the time, energy use in the house goes unnoticed, and most of the energy-consuming behaviors we engage in are habitual and routine-based (Martiskainen, 2014). For example, not allowing the television to be connected to electricity overnight, even if not watching and installing air conditioners if necessary to reduce electricity bills. The concept of Internet of Things (IoT) is to connect all devices with the buttons 'ON' and 'OFF' to the Internet. These include mobile phones, washing machines, lights, and anything we can think of including machine components such as jet engines in airplanes and others. The journey of this IoT system can be translated into two situations that can be seen in Fig. 3.

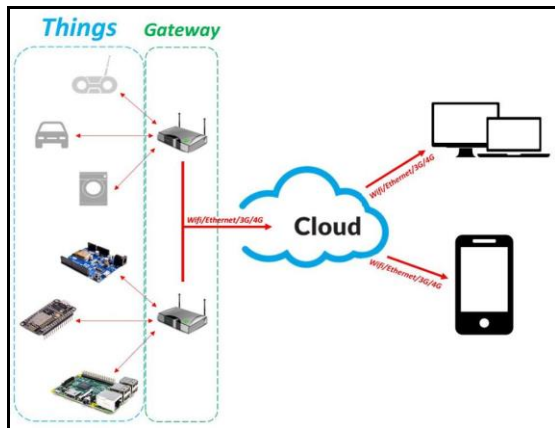


Fig. 3. Basic component distribution in IoT system

2. Methodology

The development of this product is made using a prototype methodology. Prototype is the initial phase of a system application and is the initial source of a system. This approach involves the process of detailing interim pre-interactions where every step of the work will be done repeatedly to ensure that the product developed meets the needs of the user. This approach has been recognized as an effective method of system development. The proposed

Electricity Meter Monitoring System using the MQTT Dashboard application was developed using the Rapid Application Development (RAD) model that can be seen in Fig. 4.

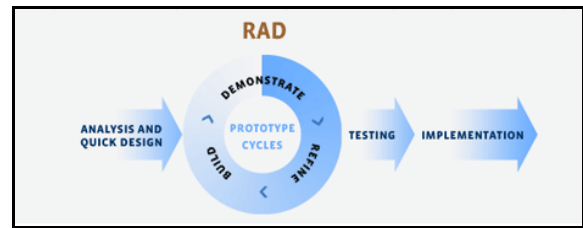


Fig. 4. Phase sequence of rapid application development model

The RAD model was introduced in the 90's and growing. This model is a system prototype concept developed with the emphasis on high product quality and through the process of collecting information from users (Nalendra, 2021). This methodology also enables researchers to interact with users when collecting product requirements, designs, and analysis. This model is more flexible in development cycles such as checking and screening until the development process expires. In producing this product, researchers chose the Rapid Application Development (RAD) model as the basis for the development of the Electricity Meter Monitoring System using the MQTT Dashboard application. The RAD model was chosen because of the systematic development of its system application and can be fully realized.

This model also emphasizes the development cycle short, short, and fast. Short time is an important limitation for this model. Customer satisfaction is a priority for product developers where every aspect will be tested to avoid any unfathered issues when reaching the user's hands. The RAD model uses a recurring method of developing a system where the system works the is built at the beginning of the development stage with the goal of setting user requirements and then being removed.

3. Result and Discussion

This test is done using two different powers of lamps. Electrical energy meter monitoring system using MQTT Dashboard application could measure current, power used, cost of use in a day and usage costs in a month.

Fig. 5 shows the power reading and side bill using MQTT dashboard on smartphones. The data is taken every five seconds. At the time of the 30th, the display of values in "Power" will change to 0.13 watts. When the value of "Power" reaches 0.92 watts, reading "Bill" will increase to RM0.01.

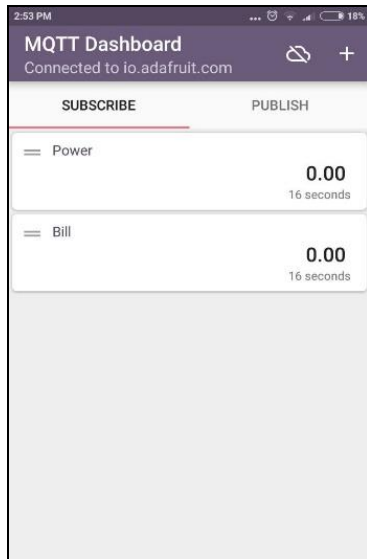


Fig. 5. Basic component distribution in IoT system

Fig. 6 shows the “Power” value next displays a quick upgrade compared to the “Power” value for the use of bulbs (60 watts). The value of 'Bill' increased rapidly in line with the increase in the value of “Power”.

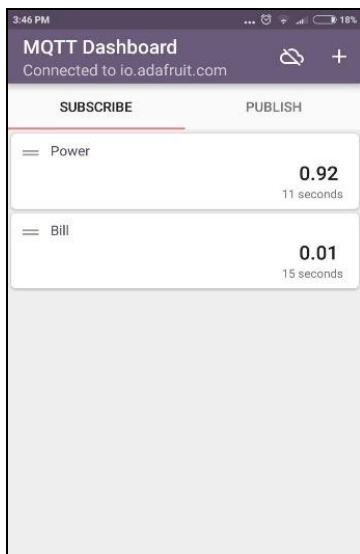


Fig. 6. Power and bill reading on the MQTT dashboard application using 100 watt bulb

Fig. 7 shows the 'Power' and 'Bill' readings on the side are the data displayed on the AdaFruit IO software on the computer. This reading is available in the 'Feeds' section. Read 'Power' and 'Bill' are the same as reading on the MQTT Dashboard.

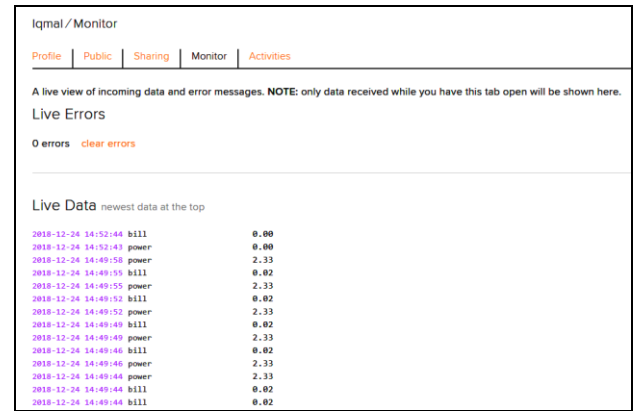


Fig. 7. Power and bill reading on AdaFruit IO software using 60 watt bulb

Fig. 8 shows the graph next to shows the data collected for 'Power' and 'Bill' readings. Graphs were plots based on date and reading values for 'Power' and 'Bill'.

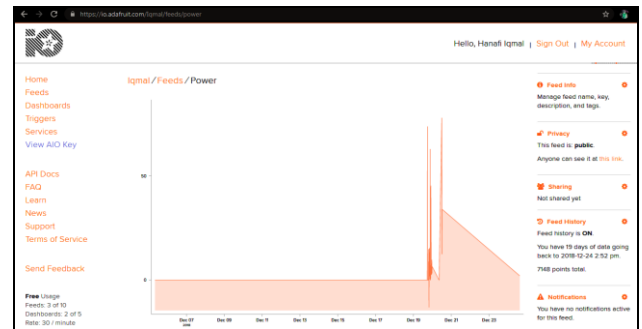


Fig. 8. Power and bill reading on AdaFruit IO software using 60 watt bulb

Fig. 9 shows the data view next to can be found in the 'Dashboards' section. The shape of the display will allow users to see the use of electricity. When the value of 'Bill' reaches the set level of RM0.02, the LED will blink.

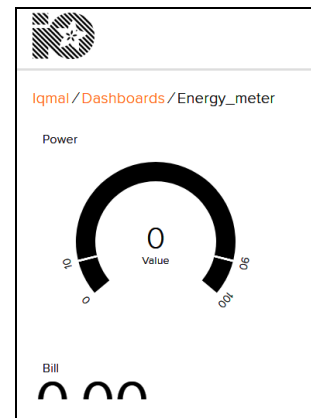


Fig. 9. Power and bill reading on AdaFruit IO software using 60 watt bulb

Fig. 10 shows the reading that is available in the 'Feeds' section. The value reading for 'Power' quickly increases to 0.92 watts. The value reading for 'Bill' also increased to RM0.01 when the value of 'Power' reached 0.92 watts.

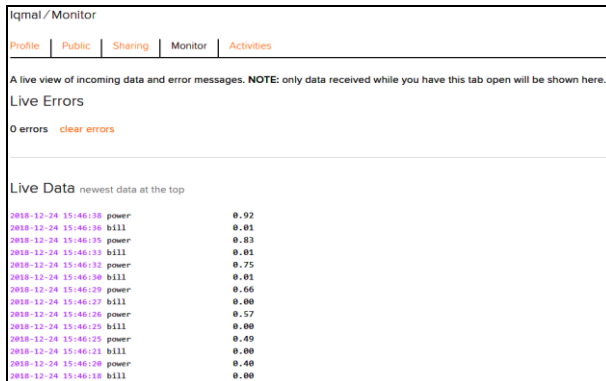


Fig. 10. Power and bill reading on AdaFruit IO software using 100 watt bulb

Fig. 11 shows the graph next to shows the data collected for 'Power' and 'Bill' readings. Graphs on plots based on date and reading values for 'Power' and 'Bill'.

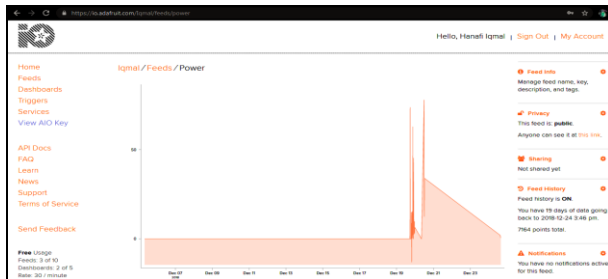


Fig. 11. Power and bill reading on AdaFruit IO software using 100 watt bulb

Fig. 12 shows the data view next to can be found in the 'Dashboards' section. When the value of 'Bill' reaches the set level of RM0.02, the LED will blink.

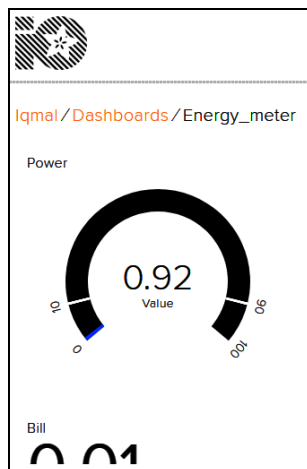


Fig. 12. Power and bill reading on AdaFruit IO software using 100 watt bulb

4. Conclusion

The purpose of develop the Electrical Energy Meter Monitoring System using the MQTT Dashboard application is to help consumers know the amount of power used and the cost of using electricity to prevent further wastage of consumers to plan their monthly expenses. This product succeeds in achieving all the objectives stated earlier.

At the design stage, the selection of appropriate materials and devices is performed to ensure the success of the product. The development phase includes developing a circuit and developing prototype hardware. This phase takes quite a while and needs to emphasize safety aspects during the development of this prototype. Overall, the development of this product gives a positive exposure.

The testing phase is done by testing some things like supply input to ACS712 30A current detector, Wifi module ESP8266 and Arduino Uno. Although the resulting product has achieved its objective, this product still needs to be improved in terms of hardware design and circuit design. Overall, the prototypes that have been produced and certified by experts have achieved the stated objectives.

Acknowledgement

The authors would like to express their greatest appreciation to Politeknik Mukah Sarawak (PMU) for permission to carry out this research study work. Finally, the authors would like to thank the staff in the Department of Electrical Engineering (JKE) for supporting this research study to testing an electrical energy meter monitoring system using dashboard MQTT application.

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Full Paper

Article history

Received

2 August 2023

Received in revised form

2 August 2023

Accepted

3 September 2023

Published online

30 September 2023

Development of Application EasyGuide CXPRO Using Android Studio for Centralised Reference for OMRON PLC Programmer

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Abstract

Toward Industrial Revolution (IR4.0), industrial automation is one of the most growing parts nowadays. Programmable Logic Controller (PLC) are one of the reliable controllers to operate industrial system weather in small, medium, or heavy industry. Omron PLC using CX Programmer software are one of the famous PLC Brand that applied as controller in various industries. EasyGuide CXPRO developed using android studio for centralized guidance and reference for programmer to develop PLC program. Currently, there are too many resources needed to access to find information or guidance for different topics in CX Programmer. By using EasyGuide CXPRO, all the information and reference are centralized and can be accessed in offline mode by considering when the programmer are troubleshooting program at rural area where has no internet accessed. As a result, all information and reference regarding CX Programmer can be easily accessed in one android application.

Keywords: - Programmable Logic Controller, OMRON CX programmer, android apps

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1. Introduction

Programmable Logic Controller (PLC) are one of the most reliable controllers to be used as controller in industries (J. Y. Chen, Tai & G. C. Chen, 2017). Features such as scalability, performance, stability, reliability, data security, and integration with other systems should be considered when deciding a suitable controller. Focusing on OMRON PLC, EasyGuide CXPRO developed using android studio as a part of guidance and reference for programmers to develop PLC program. Using the apps, programmer is easily to refer the information regarding the CX Programmer. EasyGuide OMRON CX Programmer consists of technical specification, software interfacing, connection guide, programming guide and others.

While designing ladder diagrams, basic knowledge for every part of function block is very important. This knowledge will guide the programmer to select suitable

routine and subroutine for the program development.

Basic knowledge of Programmable Logic Controller is very important to become a good PLC Programmer. A programmable logic controller (PLC) is a special form of microprocessor-based controller that uses programmable memory to store instruction and to implement function such as logic, sequencing, timing, counting, and arithmetic to control machines and processes (Bolton, 2015) as shown in Fig. 1.

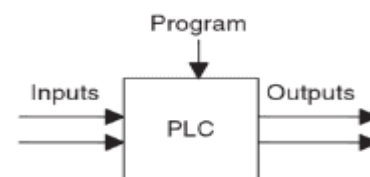


Fig. 1. Basic PLC structure

Currently, there are many diverse types of PLC such as modular, compact card-type PLC. Different types of PLC can also drive to different type of connection, programming language and capacity of memory. Even though they are diverse types of PLC brand, the structure of PLC is still the same. Typically, a PLC system has the basic functional components of processor unit, memory, power supply unit, input/output interface section, communications interface, and the programming device (Lashin, 2014) as shown in Fig. 2.

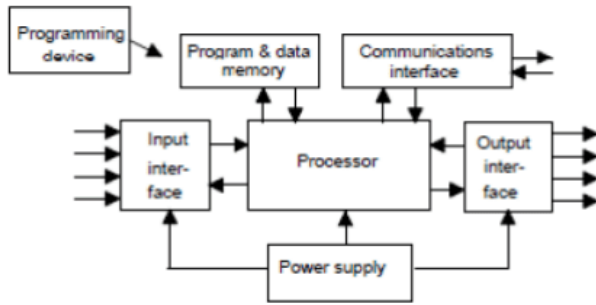


Fig. 2. PLC structure

Mobile and smart devices are very common today and becoming mandatory for everyone. One of the most common operating systems for these devices is Android (Kojo, 2021). Interactive study and interactive notes make learning easier (Agusty & Delianti, 2019). Every brand of PLC comes with their own software. For example, Siemens PLC uses TIA Portal as programming software, Mitsubishi PLC uses GX Works as programming software and Omron PLC use CX Programmer as programming software. Focusing on OMRON PLC, different models, and series will drive to different programming style.

CPM1/CPM1A

The following memory areas can be used with the CPM1/CPM1A.

Data area	Words	Bits	Function
IR area ¹			
Input area	IR 000 to IR 009 (10 words)	IR 00000 to IR 00915 (160 bits)	These bits are allocated to the external I/O terminals.
Output area	IR 010 to IR 019 (10 words)	IR 01000 to IR 01915 (160 bits)	
Work area	IR 200 to IR 231 (32 words)	IR 20000 to IR 23115 (512 bits)	Work bits can be freely used within the program.
SR area	SR 232 to SR 255 (24 words)	SR 23200 to SR 25515 (384 bits)	These bits serve specific functions such as flags and control bits.
TR area	---	TR 0 to TR 7 (8 bits)	These bits are used to temporarily store ON/OFF status at program branches.
HR area ²	HR 00 to HR 19 (20 words)	HR 0000 to HR 1915 (320 bits)	These bits store data and retain their ON/OFF status when power is turned off, or operation starts or stops. They are used in the same way as work bits.
AR area ²	AR 00 to AR 15 (16 words)	AR 0000 to AR 1515 (256 bits)	These bits serve specific functions such as flags and control bits.
LR area ¹	LR 00 to LR 15 (16 words)	LR 0000 to LR 1515 (256 bits)	Used for a 1:1 PC Link with another PC.
Timer/Counter area ²	TC 000 to TC 127 (timer/counter numbers) ³		Timers and counters use the TIM, TIMH(15), CNT and CNTR(12) instructions. The same numbers are used for both timers and counters.
DM area			
Read/write ²	DM 0000 to DM 0999 (1,002 words)	---	DM area data can be accessed in word units only. Word values are retained when the power is turned off, or operation started or stopped.
Error log	DM 1000 to DM 1021 (22 words)	---	Read/write areas can be read and written freely within the program.
Read-only ⁴	DM 6144 to DM 6599 (456 words)	---	Used to store the time of occurrence and error code of errors that occur. These words can be used as ordinary read/write DM when the error log function is not being used.
PC Setup ⁴	DM 6600 to DM 6655 (56 words)	---	Cannot be overwritten from program.
			Used to store various parameters that control PC operation.

Fig. 3. Memory areas OMRON PLC

2. Methodology

EasyGuide CXPRO are developed using android studio. The objective of development is to centralise all information, guidance, and reference for developing PLC

program using software OMRON CX Programmer. All information and reference material are collected from various resources. The data and information then compiled and sorted.

2.1 Collect and Sorting Information Data

The process of collecting information data consists of referring to multiple resources. The two main references are the book from Bolton (2015) and manual data from manufacturer from OMRON. Information from the main sources has been simplified to minimise the time consuming for the user to find the selected information.

For example, when the user is confused on the data memory area, with simple click and selection, EasyGuide CXPRO will drive the user to the information needed.

2.2 Development of Android Studio Application

Android studio is one of the famous application development software. It is always the first choice among manufactures of TV consoles, gaming consoles, augmented reality system because it was open source and free (Craig & Gerber, 2015). Development of the EasyGuide CXPRO started with drafting the framework, sorting data, and designing interface system to make it user friendly.

Android Studio is an integrated development environment (IDE) for developing for the Android platform. It was announced on May 16, 2013, at the Google I/O conference by Google's Product Manager, Katherine Chou (Thamizharasi, 2016). Step for developing apps on android studio:

Step 1: Install Android Studio

Step 2: Open a New Project

1. Open Android Studio.

2. Under the "Quick Start" menu, select "Start a new Android Studio project."

3. On the "Create New Project" window that opens, name your project "HelloWorld".

4. If you choose to, set the company name as desired*. 5. Note where the project file location is and change it if desired.

6. Click "Next."

7. Make sure on that "Phone and Tablet" is the only box that is checked.

8. If you are planning to test the app on your phone, make sure the minimum SDK is below your phone's operating system level.

9. Click "Next."

10. Select "Blank Activity."

11. Click "Next."

12. Leave all of the Activity name fields as they are.

13. Click "Finish."

Step 3: Edit the Welcome Message in the Main Activity

1. Navigate to the activity_main.xml tab if it is not already open.

2. Make sure that the Design tab is open on the activity_main.xml display.
3. Click and drag the "Hello, world!" from the upper left corner of the phone display to the center of the screen.
4. In the project file system on the left side of the window, open the values folder.
5. In the values folder, double-click the strings.xml file.
6. In this file, find the line "Hello world!".
7. After the "Hello world!" message, add "Welcome to my app!"
8. Navigate back to the activity_main.xml tab.
9. Make sure that your centered text now reads "Hello world! Welcome to my app!"

Step 4: Add a Button to the Main Activity

1. Navigate to the Design tab of the activity_main.xml display.
2. In the Palette menu to the left of the phone display, find Button (under the heading Widgets).
3. Click and drag Button to be centered underneath your welcome message.
4. Make sure your button is still selected.
5. In the Properties menu (on the right side of the window), scroll down to find the field for "text."
6. Change the text from "New Button" to "Next Page."

Step 5: Create a Second Activity

1. At the top of the project's file system tree, right click on "app."
2. Navigate through to New > Activity > Blank Activity.
3. Change the name of this activity to "SecondActivity".
4. Click "Finish."
5. Make sure you are in the Design view of activity_second.xml.
6. Drag the text box in the upper left of the phone display down to the center as you did on the Main Activity.
7. With the text box still selected, find the "id" field in the Properties menu on the right, and set it to "text2".
8. Open strings.xml again.
9. Add a new line under "Hello world! Welcome to my app!" that reads "Welcome to the second page!".
10. Navigate back to activity_second.xml.
11. Select the text box again.
12. In the Properties pane, set the "text" field to "@string/second_page".
13. Make sure that the text box now reads "Welcome to the second page!" and is in the center of the screen in the phone display.

Step 6: Write the Button's "onClick" Method.

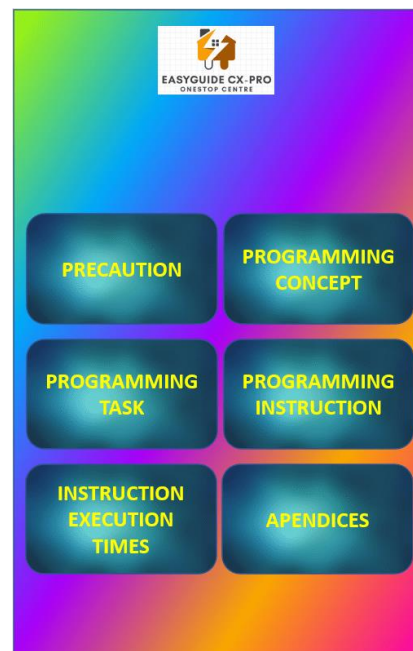
1. Select the MainActivity.java tab along the top of the work environment.

2. Add the following lines of code at the end of the onCreate method: `Button button = (Button) findViewById(R.id.button);`
`button.setOnClickListener(new`
`View.OnClickListener() { @Override public void`
`onClick(View v) { goToSecondActivity(); });`
3. Add the following method to the bottom of the MainActivity class: `private void`
`goToSecondActivity() { Intent intent = new`
`Intent(this, SecondActivity.class);`
`startActivity(intent); }`
4. Click the + next to import at the third line of MainActivity.java to expand the import statements.
5. Add the following to the end of the import statements if they are not already there:
`import android.content.Intent;`
`import android.view.View;`
`import android.widget.TextView;`

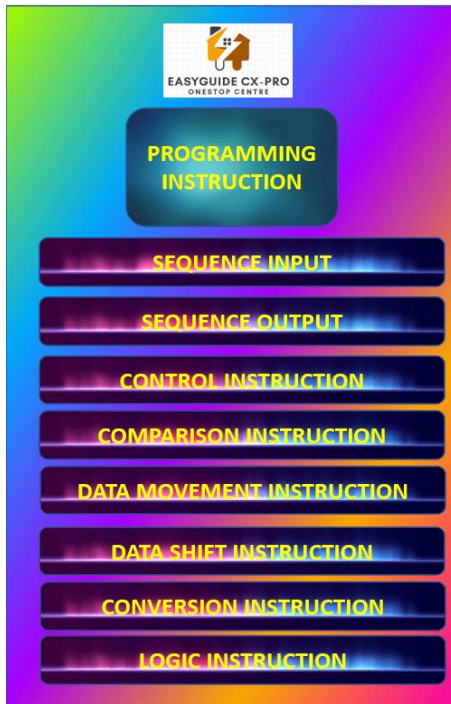
Step 7: Test the Application

3. Result and Discussion

Development of EasyGuide CXPRO was extremely helpful as centralise reference for PLC Programmer especially for OMRON PLC Programmer. Once the application is installed on phone, it can be used whether in rural area that have no internet access. Interfacing that very user friendly make it more convenient to use nowadays.



Fug. 4. Main page EasyGuide CX-Pro



Fug. 5. Main page EasyGuide CX-Pro

4. Conclusion

The development of EasyGuide CXPRO is suitable for programmers at any level whether beginner, intermediate or advance. Users can easily and freely access the apps to find the solution and guidance to develop complete PLC program.

Acknowledgement

The authors express their gratitude to the advisors, reviewers, and supervisors who have guided the authors throughout the study.

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Development of iPROJECT Mobile Application for Mini Project Assessment of Engineering Science Courses

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Please provide an **official organisation email** of the corresponding author

Full Paper

Article history

Received

3 September 2023

Received in revised form

3 September 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

In the advancing world of technology, mobile applications represent a large part of the entire country. The field of education is also informed about mobile applications that are developing rapidly. In the area of education, there is a lot of evidence to support the idea that technology is constantly evolving and will have a significant impact on society. This research paper discusses the stages in the development of our mobile application has named as "iPROJECT". This application was developed to help facilitate the Coursework Assessment documents management process for the DBS10012 Engineering Science course. This is due to the Course Work Assessment management process becomes less effective because there are twelve (12) documents that need to be managed by the lecturers which can cause document loss due to hard copy submission, difficult to control the student's work progress and the student also does not get the highest score for the mini project evaluation. Therefore, in this research study, the iPROJECT android application is designed, developed, and tested for lecturers and students. Adaptation of Agile Model serves as a roadmap for the staged development of this application. To ensure the development needs of this application, preliminary interviews were conducted with lecturers and students. The results of the interview proved that the informant voiced the need to develop an application to help manage documents in the evaluation of mini projects. With the application lecturers and students can manage all the documents in an effective way.

Keywords: - Mobile application, assessment documents management, engineering science, technology, android application

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1. Introduction

Smartphone users have grown to over two and a half billion people and are predicted to increase year after year (Fook et al. 2021). The introduction of smart phones in recent years has altered how mobile phones are defined. The phone has evolved into more than just a tool for communication, but it is now an integral component of daily life and communication, including in line with today's educational developments (Latif et al. 2019).

Smartphone use is increasingly evolving into an effective educational tool that is utilized to enhance teaching and learning process (Darko-Adjei 2019). In the context of this study, smartphones are used to access the iPROJECT application as a medium to receive documents

from lecturers and documents submission from students. Lecturers and students refer to lecturers who teach and students who enroll in the DBS10012 Engineering Science course. The Engineering Science course is a compulsory course for all engineering students at Polytechnic in Malaysia.

One of the evaluated assessments is a mini project, the assessment requires the management of twelve (12) documents by lecturers and students. Lecturers need to provide project instruction, project rubric, example videos, proposal form and proposal status notification. While students need to submit proposals, first to fourth weekly progress report, slide presentation and full report. This shows that an effective document management process is very important for lecturers to prepare and monitor the student's work process from time to time.

According to Khalid et al. (2015), mobile learning services and learning documents management system integration enable anytime, anywhere access to e-learning using communication devices like android mobile application by students and lecturers more easily learning process. Android based mobile applications were created mainly for smartphones and other mobile devices that make it easy for users (Lazareska & Jakimoski, 2017).

Therefore, in this study, iPROJECT was designed and developed with the aim of ensuring the management process of Course Work Evaluation for the DBS10012 Engineering Science course is more organized and facilitates both parties, namely users as lecturers and users as students. Involved institutions that offer the course can use iPROJECT to make it easier for lecturers and students to manage all mini-project documents for various classes and groups anywhere and anytime.

2. Methodology

Methodology is the methodical, theoretical evaluation of the process used to create, develop, and maintain an application (Al-Saqqa, Sawalha, & AbdelNabi, 2020). According to Buladaco and Sabugaa (2022), with the suitable approach in place, application development may be carried out gradually, effectively, and systematically while staying on track.

In this study, Agile methodology is implemented to ensure the development of iPROJECT. Adaptation of Agile Model serves as a roadmap for the staged development of this application. The SCRUM Model (1995) and the Waterfall Model were both improved to develop Agile Model in 2001 by Ken Schwaber and Jeff Sutherland. The use of Agile development methodology can improve quality, flexibility, user involvement, fast cycle time and react immediately to changing requirements (Matharu et al., 2015).

Adaption of the Agile methodology consists of six (6) phases which are brainstorm phase, design phase, develop phase, test phase, release phase, and improve phase as shown in Fig. 1.

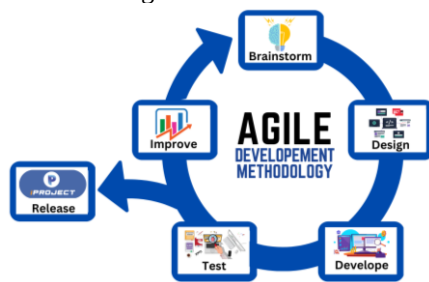


Fig. 1. Agile methodology

2.1 Brainstorm Phase

In this phase, the researcher conducts preliminary interviews with lecturers and students to examine the application development needs. Given that the study's nature is more suitable with informants' experiences, the qualitative case study approach was chosen as the

study design. Informant experience refers to lecturers who have taught this course for at least three years and current semester students who are enrolled in this course.

In this research, semi-structured interviews were conducted with 3 lecturers and 3 students. The purposive sampling selection in this study was made by using referral and chain referral techniques. According to Bagheri & Saadati (2015), purposive sampling is used to select informants, ensuring that the data are rich and comprehensive for the phenomenon being studied. Each interview took place individually between 00:20:04 to 00:30:10 hours and was recorded with informants' consent. After the interview data were transcribed, transformed into transcripts and then categorized into themes (Denzin & Lincoln, 2011). A complete description of the interview results is described in the finding and discussion section.

However, the results of this brainstorming phase show that there is a need to develop an application for the management of mini-project documents that is divided into 2 users, namely lecturers and students.

2.2 Design Phase

This stage involves designing the proposed iPROJECT using the requirements gathered in the previous stage where includes results of the preliminary interview. This initial flow design was created to facilitate the development process in subsequent phases. It is to enable the interaction of user and application needs clearly. Also, to show how the iPROJECT flow of process works and how an integrated project was chosen with precise step-by-step planning in accordance with the design.

Fig. 2. shows user's design for lecturer which consists of user registration, sign in, lecturer hall, student's registration, choose class, proposal submission, weekly report submission, slide presentation and full report submission.

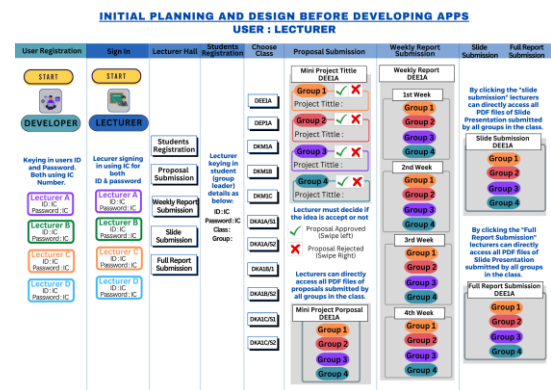


Fig. 2. User initial flow design for lecturer

Fig. 3 shows user's design for student included student's registration, sign in, student hall, mini project submission choose class, mini project submission

menu, proposal submission, proposal status, weekly report submission and slide/full report submission.

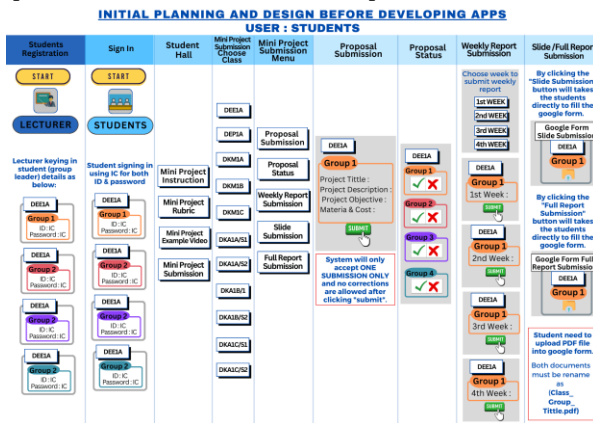


Fig. 3. User initial flow design for student

2.3 Develop Phase

Develop phase is developing the application by referring to the detailed initial flow design that was created in the previous step. This mobile application was developed using Thunkable. In comparison to the other phases, this one is typically thought of as being the longest. This is so because the development phase is so crucial to this phase, which is the foundation of the entire process. However, if the design phase were conducted in a systematic way, the development phase would be successful. Fig. 4 to Fig. 6 shows several interfaces in the iPROJECT mobile application.

Fig. 4 shows the iPROJECT main interface with a combination of several types of blue tones with a login button on the right and a manual (how to use) on the left. The selection of blue color on the main interface is based on the results of research proving blue colour is one of the most important colors in User interface (UI) design and can help students with special needs who have Protanopia and Deutanopia (Red and green colorblind deficiencies). Rigos, Chatzismatis & Tsekouras (2020) stated that Protanopia and deutanopia can often remove the ability to see both red and green, showing the world in bright blues and yellows. The log button is placed on the right side because we have a higher percentage of right-handed users than left-handed users, which lefties make up only about 10% of the population.

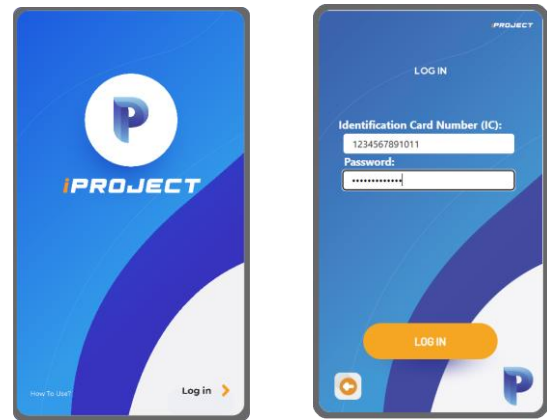


Fig. 4. Main interface of iPROJECT

We chose this arrangement as Fig. 5 because the students must submit a sequence of documents that start with the "Proposal Submission" in the 7th week, then the students must submit the weekly report in the 8th-11th week and finally submit the "Presentation Slide and Final Report" in the 13th week. While the last sequence, the "Student Account Registration", is the least used button that is only used once when registering students or is used only if there is a need.

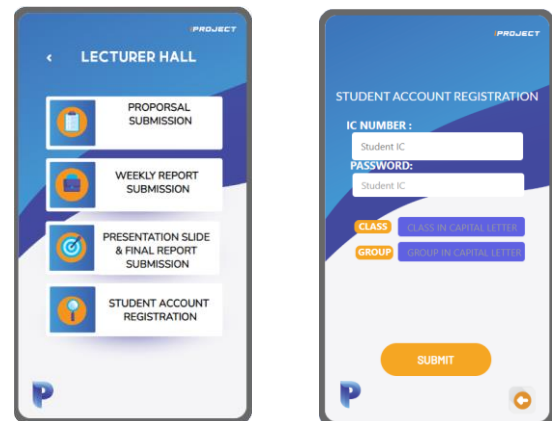


Fig. 5. Lecturer interface

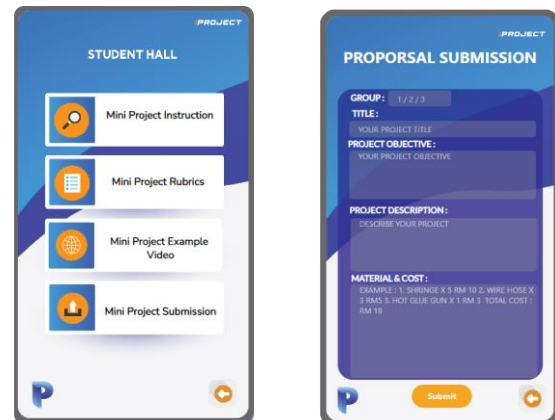


Fig. 6. Student interface

2.4 Test Phase

After iPROJECT is successfully developed, it will be tested on informants who have been selected in the brainstorming phase as application users. In this phase, the developer will try to get comments and suggestions in line with the results of the interviews that have been conducted.

2.5 Release Phase

After iPROJECT is fully developed and tested, the iPROJECT usage manual is given to lecturers and students to see the effectiveness of this mobile application development. Besides, developers find out users' comments and suggestions for improvement for the next phase.

2.6 Improve Phase

The application will go through an improvement phase once it has been completely utilized to pinpoint potential areas for improvement and future work based on the comments and ideas from the prior stage.

3. Result and Discussion

Three (3) themes were proposed as results from the preliminary interview that are cost-saving, time-saving, and one-stop-centre. This interview was conducted to identify the development needs of this application. The following is a complete description of the themes categorized based on the result of the interviews.

3.1 Cost-Saving Application

From the results obtained, all the informants voiced the opinion that the developed application must be able to save money in terms of reducing printing costs and there is no need to use paid applications. Here are some statements from the informants regarding their needs of cost-saving application:

- i. Develop a form of online system, which reduces management costs that previously required hardcopy document involving paper and printing at a high capacity (Informant 2).
- ii. I prefer not to do any printing because I don't have a printer at the hostel and soft copy submission documents are very economical (Informant 4).
- iii. The application developed must be usable by students without having to purchase the application (Informant 6).

All these statements have proved that cost-saving can be one of factors that influence need of this application development. Cost-saving characteristic suggested by the informant of this study is in line with Underwood, Birdsall, and Kay (2015) and Kazhan et al. (2020) where the use of mobile applications has financial advantages over conventional approaches, such as not requiring any costs for printing, storing, distributing, or disposing of applications.

3.2 Time-Saving Application

The results of the study show that the informants stated that they need an online application that saves time such as they do not need to go to the lecturer's office to submit hard copy documents while lecturers also do not need to waste their time looking for student documents that may be lost or misplaced. The following quotes are among the informant's statements about their needs of time-saving application:

- i. There is no need for students to waste time travelling to the lecturer's office to deliver "hard copy" documents (Informant 5).
- ii. Lecturers do not need to schedule meetings with students to keep track of the progress of mini projects but just get a weekly report in the application submitted by the student (Informant 4).
- iii. Every semester I have problems retrieving documents that have been sent by students. I teach several classes, so the documents get mixed up and it wastes my time to organize and save all the hard copy documents (Informant 1).

The findings of this study are in line with (Criollo-C et al., 2018), due to accessibility and mobility, mobile applications can be employed as efficient learning tools. Without requiring students to set aside time to physically interact with the lecturer. Mobile applications are anticipated to be an integral element of all learning activities, both inside and outside of the classroom (Hort et al., 2021).

3.3 One-Stop-Centre Application

Lastly, the results show that informants say they are hoping there is an application that provides all the necessary documents completely without expecting the provision of documents in stages. In the context of this study, it seems that a one-stop-centre application is needed to facilitate the systematic management of documents. Here are some statements from the informants regarding their expected application features:

- i. All the information related to the mini project for the DBS10012 Engineering Science course is compact in one application that makes it easier for users (lecturer & student) to get related information. (Informant 1).
- ii. Lecturers need to provide students with mini project questions, scoring rubrics, example videos and proposal templates. Meanwhile students need to submit mini project proposal, weekly report for four weeks, slide presentation and full report. Therefore, the developed application must be able to store all those documents (Informant 2).
- iii. Lecturers need to get all the documents submitted by each group. One compact application indirectly easier for users to access related documents and submit mini-project requirements through a single application (Informant 3).

This study's findings concur with Zoolkafli (2020) about mobile application that has all the documents completely so that the user will focus on one application only without the need for other references. Besides, based on the results of this study, lecturers seem to need a medium as an organized storage system because lecturers must manage at least more than one class (8 groups) individually. Online document management organized in this compact mobile application is also explained to help users without having to store physical documents (Fook et al. 2021).

4. Conclusion

In overall, findings of the current study demonstrate the development of the mobile application namely iPROJECT can facilitate the Coursework Assessment management process for the DBS10012 Engineering Science course. With the application, lecturers and students only need to focus on one application that stores all the documents related to the Mini Project course work. Indirectly this application saves time and printing costs. For future improvements, this application will be improved in terms of a more detailed and clearer interface related to documentation instructions and requirements.

Acknowledgement

The researchers are grateful to Polytechnic Mukah Sarawak (PMU) for granting permission to conduct this research. The researchers also would like to thank all lecturers and students from Department of Mathematics, Science and Computer (JMSK) for their cooperation in this research.

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Development of Microcontroller Trainer Module for Embedded System Application Course in Politeknik Mukah

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Full Paper

Article history

Received

28 July 2023

Received in revised form

28 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This paper describes the development of a microcontroller trainer module for the Embedded System Application course at Politeknik Mukah, using PIC18F45K22. To facilitate the learning process, the module was developed by offering hands-on instruction and practical skills in microcontroller programming. The aim of the proposed trainer module is to expose the student in creating the hardware of embedded system and microcontroller programming. The trainer was designed to produce an output based on the program that will be uploaded into PIC18F45K22 microcontroller. The trainer module was able to be used for practical work and mini projects based on course syllabus. From the proposed trainer module, students were able to demonstrate hardware output of the programming and enhance their knowledge for the DEC40053 Embedded System Application course.

Keywords: - PIC18f45k22, microcontroller, programming, trainer, hardware

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1. Introduction

Microcontrollers serve an important role in technical education for teaching students the abilities and knowledge necessary to design, construct, and program embedded systems. To achieve this, the development of a microcontroller trainer module can offer students a practical learning opportunity that improves their comprehension of microcontroller programming for embedded systems. The performance, power consumption, and overall cost of the system are all impacted by the microcontroller choice for a given application. Microcontrollers from several families, including the PIC16F877A, ARM-based, PIC24F (24-bit), MOPICs, and PIC18F8722, have been extensively employed in the field of embedded systems because of their superior performance and functionality. However, PIC18F45K22 is regarded as the best option for this study due to its affordability, accessibility, and usability. Due to its simplicity of use and extensive programming choices, the PIC18F45K22 is the suitable

choice in developing the trainer module for Embedded System Application course.

The PIC18F45K22 Trainer Module is a useful tool design to provide students with actual experience in microcontroller programming and creating embedded systems. It enables students to gain practical experience in creating embedded systems and microcontroller programming. The learner can experiment with various input and output set-ups, program the microcontroller using C programming languages, and debug and troubleshoot our code using this tool. It's an effective teaching tool that facilitates learning embedded system development and microcontroller programming through hands-on practice, making the ideas much clearer.

An embedded-based industrial temperature monitoring system utilising GSM was developed by Murugan, Periasamy and Muruganand (2012). Although the system was created for industrial use, it may also be useful for teaching and learning in educational settings. The system, for instance, might be used to instruct students on microcontroller programming and sensor

and GSM interfaces. As a teaching and learning platform for embedded systems design, educational institutions frequently use the PIC16F877A microcontroller. In a GSM-based industrial temperature monitoring system, Murugan, Periasamy and Muruganand (2012) showed the utilisation of the PIC16F877A microcontroller (see Fig. 1). This project serves as a superb illustration of how the PIC16F877A microcontroller may be applied in practical settings. With the use of these tools, educators can create lab exercises, projects, and activities that are both interesting and useful for developing students' skills in embedded systems design and related areas.

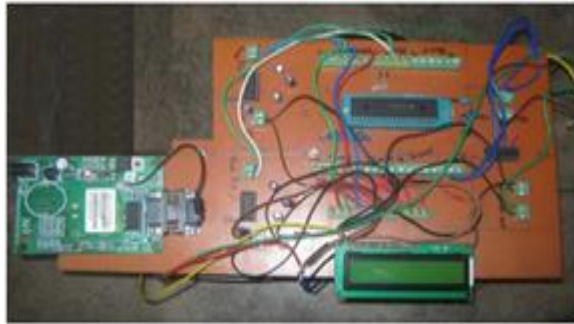


Fig. 1. Hardware set up (Murugan, Periasamy & Muruganand, 2012)

The accessibility of low-cost hardware and software tools has led to an increase in the use of microcontrollers in educational settings in recent years. A low-cost student experiment was created by Kommu, Kanchi and Varadarajula (2013) for the purpose of teaching an ARM-based embedded system laboratory. With the use of an ARM-based microcontroller, the study intended to give students practical experience designing and implementing embedded systems. According to the authors, the students who took part in the lab experiment showed a notable improvement in their comprehension of the ideas around embedded systems and microcontroller programming.

According to Aslam, Ahsan, Hannan, Hamza and Jaffery (2019), a software based PIC24F series microcontroller educational trainer was created to aid students in understanding the fundamentals of microcontroller programming. To program and simulate various microcontroller-based applications, the trainer's hardware and software components can be employed. The trainer's hardware comprises of a microcontroller board, power supply, and different input/output devices, while its software consists of a programming environment, simulation tools, and virtual hardware components (see Fig. 2). The trainer's primary processor is a microcontroller from the PIC24F series, which is also compatible with the MPLAB integrated development environment. The goal of this trainer is to give students a cheap and convenient way to learn about microcontrollers and embedded systems.

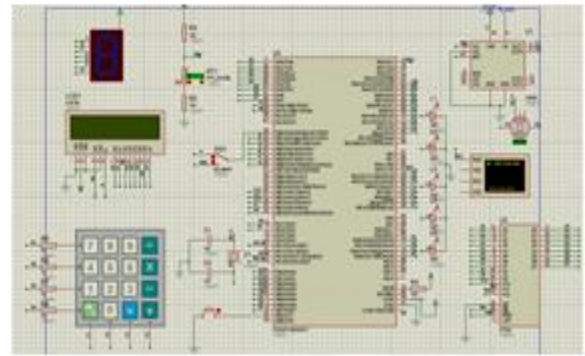


Fig. 2. Schematic for educational trainer (Aslam, Ahsan, Hannan, Hamza & Jaffery, 2019)

The creation of a Multiple Outputs Programmable Integrated Circuits (MOPICs) microcontroller trainer for educational applications has turned into a crucial part of teaching embedded systems, claim Burhan, Azman, Talib, and Aziz (2015). The hardware design was thoroughly analysed in the study, which made use of several peripheral devices like alphanumeric LCD, 7-segment display, relay, and LED. The MOPICs microcontroller trainer was created utilising a technique that included both hardware and software design, with the Proteus design suite software being utilised for the design phase. The dependability, cost-effectiveness, and adaptability of the MOPICs microcontroller trainer were tested and analysed, and the results demonstrated that the produced trainer could meet the requirements for embedded systems teaching. The study also discovered that students' learning experiences and comprehension of microcontroller programming were improved by the trainer's capacity to combine numerous peripheral devices.

Alfonso et al. (2012) claim that the authors created and carried out a lab experiment utilising a PIC18F8722 microcontroller. The goal of the project was to automatically measure an environment's humidity and temperature. To detect the temperature and humidity, the scientists employed a DHT11 sensor and a DS18B20 sensor, respectively. A script was written for the microcontroller to read the sensor values and show them on an LCD screen. The experiment was also managed by the authors using a real-time graphical user interface (GUI) built on a PC. The experiment's findings demonstrated that the system that was created could precisely measure and display temperature and humidity measurements. The system's performance was also assessed by the authors in terms of response time and power usage. Less than one second was discovered to be the system's response time, which was deemed suitable for real-time monitoring applications. The technology was discovered to have a low power consumption, making battery-powered applications possible. The study also highlighted the significance of building an effective system to reduce power consumption and choosing the right sensors and peripherals for a particular application.

In comparison to the PIC24F and ARM-based microcontrollers, the PIC18F45K22 has a smaller footprint and is more affordable, making it a good option for low-budget applications. The PIC18F45K22 is also great for battery-powered applications due to its low power consumption rate. Previous tests have shown that, although having an 8-bit architecture, the PIC18F45K22 nevertheless offers adequate performance for most embedded systems applications. Comparatively, PIC24F and ARM-based microcontrollers have 16-bit and 32-bit architectures, respectively, but they are typically more expensive and difficult to use, which can raise the cost of the whole system and lengthen the time it takes to create. Its affordability, availability, usability, and appropriate performance for the intended application make the PIC18F45K22 microcontroller a good choice for this trainer module.

2. Methodology

To ensure that the microcontroller trainer module for the Embedded System Application course at Politeknik Mukah is efficient in enhancing the learning experience for students, a thorough methodology is needed. The PIC18F45K22 microcontroller was chosen as the course's chosen device because it was both readily available and reasonably priced, as well as suitable for the course's goals. With a variety of I/O pins to allow users to communicate with other devices, the programmable training kit's architecture was made to give students a thorough learning environment for microcontroller programming.

2.1 Designing the Schematic Circuit

Proteus software was used to build the schematic circuit for the microcontroller training module. The PIC18F45K22 microcontroller's I/O pins, a 20MHz crystal oscillator, and a 5V voltage regulator circuit were among the crucial parts that needed to be chosen during the design process shown in Fig. 3. These parts were added to the circuit design using Proteus's component.

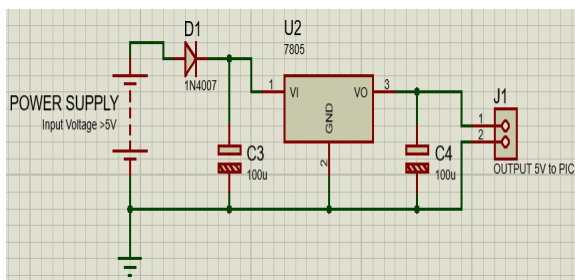


Fig. 3. Schematic of 5V voltage regulator circuit

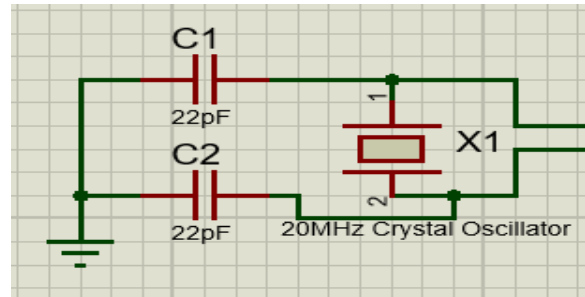


Fig. 4. Schematic of 20MHz crystal oscillator

The microprocessor and other components on the board require a consistent voltage supply, hence the main input of the circuit must be larger, then it will be step down which the 5V voltage regulator circuit was created to deliver. To give the microcontroller an accurate clock signal, a 20MHz crystal oscillator was added to the device as shown in Fig. 4.

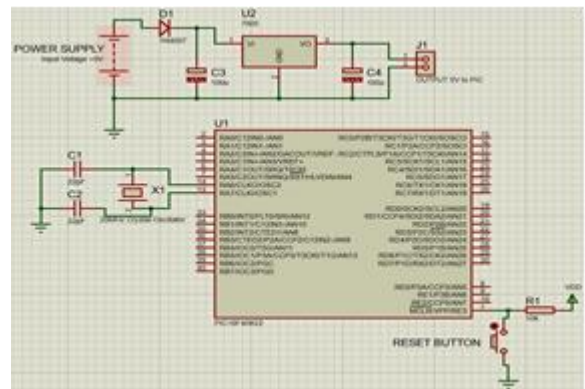


Fig. 5. Schematic of PIC18F45K22 trainer module

2.2 Producing the Module Prototype PCB

Making a printed circuit board (PCB) design from the schematic circuit diagram is the first stage in generating the hardware prototype. In the PCB design process, the electronic components are positioned on the board and the electrical connections are routed. The electronic components chosen in the schematic circuit diagram can be purchased and placed on the board once the PCB design is complete. This entails positioning each component on the PCB in its proper location and soldering it in place. To avoid harming the components or the circuit, it's crucial to check that the component polarity and orientation are right throughout construction. The components are 22pF ceramic capacitor, 100uF electrolytic capacitor, LM7805 voltage regulator, terminal block, input/output pin header, resistor, LED and push button.

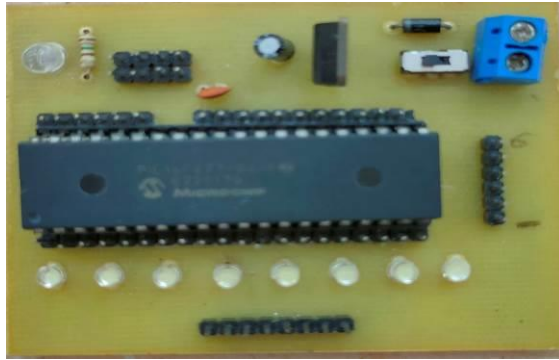


Fig. 6. PIC18F45K22 trainer module prototype

The circuit was tested to make sure it operates as expected after the PCB assembly was finished as shown in Fig. 6. To do this, the circuit must be powered up and the PIC18F45K22 microcontroller must be programmed with a test programme using a microcontroller programmer. Any problems or bugs found during testing should be investigated, fixed, and the PCB design or component assembly modified.

Once the prototype design was tested and operating accordingly, the PCB design was sent to the manufacturer to be fabricated. Fig. 7 shows the fully fabricated trainer module based on the PCB prototype.

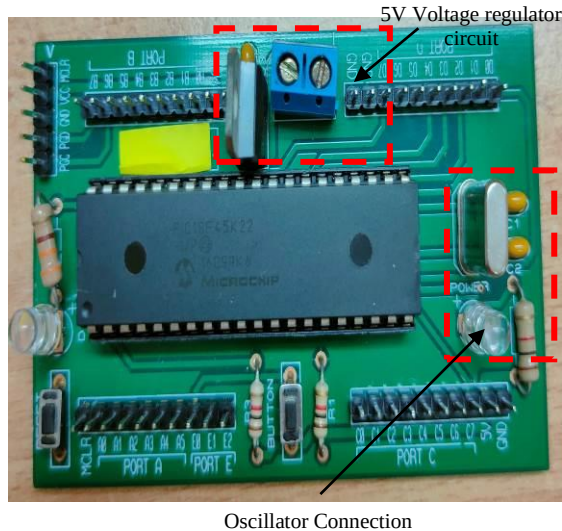


Fig. 7. PIC18F45K22 trainer module

Fig. 7 shows the magnified view of the 20MHz Crystal Oscillator circuit part on the PCB board of the trainer module. It is a must have component to provide accurate clock signal for the microcontroller when there is delay time used in the programming, specifically when TIMER programming implemented. The 5V voltage regulator circuit will provide stable and constant 5V voltage for the trainer module to enable the input output pin operating accordingly as programmed.

3. Result and Discussion

When the trainer module is connected to the power supply, a blue LED indicator will light on. This can be observed on Fig. 8. LED ON shows that the trainer module is receiving constant and stable 5V voltage.

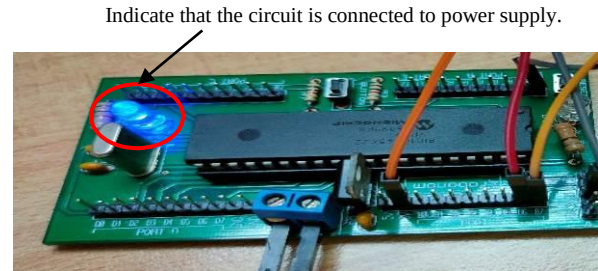


Fig. 8. Trainer module ON condition

Then the trainer module is connected to PIC programmer. Fig. 9 shows the jumper cable connection between the trainer module and the PIC programmer.

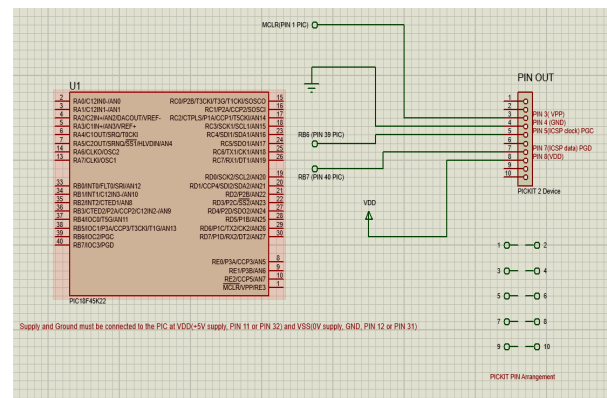


Fig. 9. Schematic guide to connect microcontroller with PIC programmer.

From the PIC programmer there are ten i/o pins but only five pins will be used. Pin 3 is connected to MCLR pin of the PIC, then pin 4 is connected to the ground of the trainer module. After that pin 5 is connected to the programming clock pin (PGC) that is at pin RB6 of the PIC, then pin 7 is connected to programming data (PGD) that is at pin RB7 of the PIC. Lastly pin 8 from the PIC programmer is connected to the VCC from the trainer module. Hence the result of the connection is shown in Fig. 10.

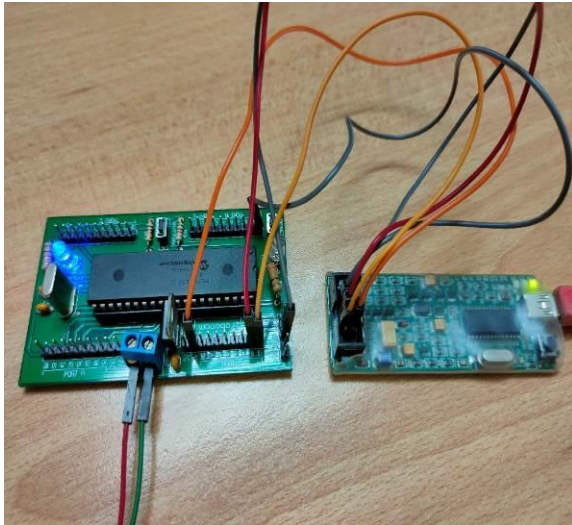


Fig. 10. Trainer module connection with the PIC programmer

When the connection is secure, PICKIT2 software will be open as the interface between the program and the hardware. Then the result of the connection will establish the communication between two devices and the software will detect the microcontroller and the result is as shown in Fig. 11. The results show that the PIC programmer detected that the trainer module is using PIC18F45K22 as the microcontroller.

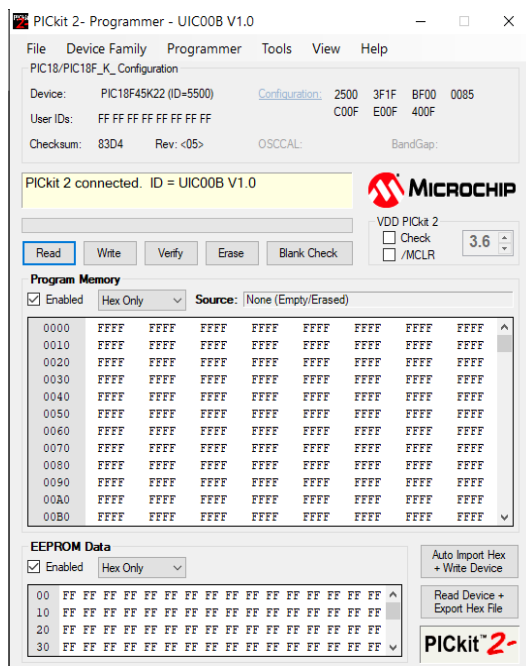


Fig. 11. Detecting the trainer module microcontroller

Once the trainer module and the PICKIT 2 interface were able to communicate, a testing program was uploaded to implement the hardware output. To enable the trainer module to operate in real time accordingly, there are four main configurations that need to be adjusted. The configuration is displayed in Table 1. Without the configuration bit setting, the program will be successful when built and compiled but only be able to simulate in the software.

Table 1. Configuration bit setting

Category	Option	Configuration Bit Setting
Oscillator Selection bits	HSHP	HS oscillator (high power > 16 MHz)
4X PLL Enable	OFF	Oscillator used directly
Power-up Timer Enable bit	OFF	Power up timer disabled
PORTB A/D Enable bit	OFF	PORTB<5:0> pins are configured as digital I/O on Reset

Once the configuration bit was configured, the trainer module will now be able to implement the output on the hardware.

3.1 Basic Input Output Circuit with Switch

To test the functionality of the trainer module input output, a basic input output program was designed using basic delay function. The schematic is as Fig. 12 below.

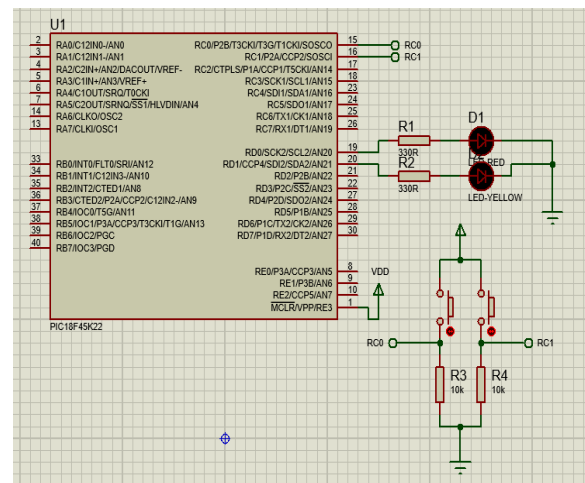


Fig. 12. Two LED and two switches

In this experiment, two switches are connected to RC0 and RC1 which is the input pin then two LED is connected to RD0 and RD1 pin which is the output pin. Once the program was successfully written in the trainer module, the output produced is as shown on Table 2.

Table 2. Output result

Input	Output
Both Switches off	LED 1 and LED 2 off
Only Switch 1 pressed	LED 1 blinking with 500ms LED 2 off
Only Switch 2 pressed	LED 2 blinking with 500ms delay LED 1 off
Both switches pressed	LED 1 on LED 2 blinking with 500ms delay

The hardware output operates accordingly with the programmed done. The hardware connection with the trainer module is shown in Fig. 13. The connection was done on a breadboard. The breadboard to connect the external input output hardware is to enable students to design the circuit and connection themselves and help them understand more on the topic tested.

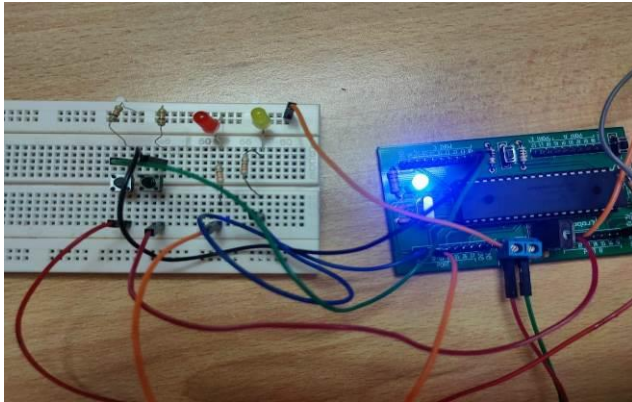


Fig. 13. Basic input output hardware connection

3.2 Interrupt Function

The other experiment tested is the interrupt function, the interrupt function utilized the output pin at RB0 for INT0 and RB1 for INT1. The schematic is as shown on Fig. 14. For this experiment is to demonstrate the dual interrupt function. The “while” program is both LED will turn on once the trainer module is turn on, then when INT0 is pressed LED1 will blink with 500ms delay, LED 2 will turn off, then when INT0 is pressed, LED 2 will blink with 500ms delay, LED1 will turn off. The result was summarized in Table 3.

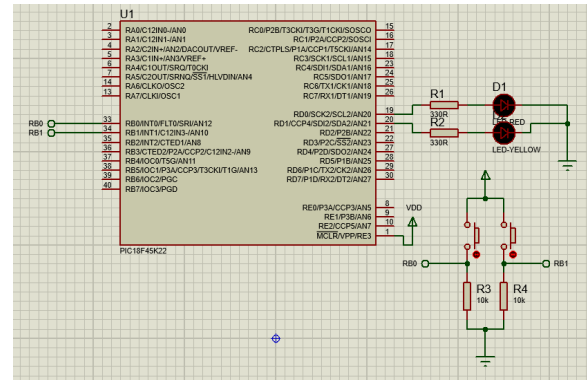


Fig. 14. Interrupt function

Table 3. Result on dual interrupt

Input	Output
When no interrupt occurs	Both LED turn on when trainer module is turn on.
INT0 Pressed	LED 1 blinking with 500ms LED 2 off
INT1 Pressed	LED 2 blinking with 500ms delay LED 1 off
Both interrupts pressed	No changes because only one interrupt can occur at one time

When both interrupt is pressed, no changes occur on the circuit due to only one interrupt can happen at one time. The previous interrupt will still occur until the other interrupt is executed. The hardware implementation interrupt circuit on the trainer module is shown in Fig. 15.

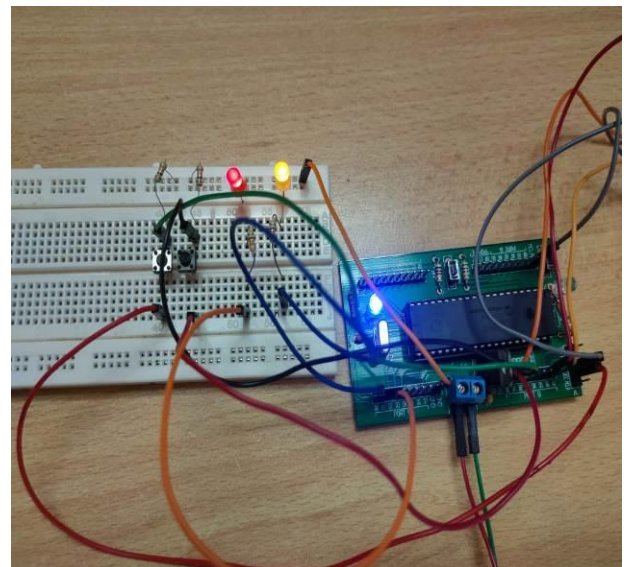


Fig. 15. Interrupt function hardware setup

4. Conclusion

The goal of this trainer module is to enable students to have hands on experience in executing their program into hardware. With a user-friendly design and easy to conduct module, students will be able to relate what they learn in theory and implement it in their practical work. Overall, Polytechnic Mukah students looking to obtain hands-on experience with microcontroller programming will find the PIC18F45K22 trainer module to be a useful educational tool. In the end, it will equip students for success in the field of electronics and embedded systems by allowing them to explore and develop a wide range of projects and applications.

Acknowledgement

We would like to express our gratitude to the Department of Electrical Engineering, Politeknik Mukah for allowing us to produce this trainer module and everyone that has supported us in producing this trainer module.

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Effects of Aeration System to Water Quality

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Abstract

A study of effect of aeration system to water quality in Sungai Kangka, Politeknik Kuching Sarawak has been conducted to identify the suitable aeration system can be applied in Sungai Kangka as alternative method to reduce pollution level in Sungai Kangka to a safe level for recreational purposes. Through this aim, the main objective of this study is to provide technical data of water quality in Sungai Kangka after been conducted in several aeration test. The parameters that have been evaluated are dissolved oxygen (DO) which contribute to the healthy growth of organisms in river and surrounding, the aerator speed which is rotation per minute (RPM) and the dimensions of the bubble stone aerator (mm). The water sample was taken on two conditions which are the continuously flowing and stagnant point in river stream. Dissolved oxygen levels in flowing river stream were set as benchmarks and the dissolved oxygen level at the stagnant point was enhanced through aeration system which is impeller and fan aeration system and bubble aeration system. Water sampling initially measured in two sampling points, which is 5.31 mg/L and 4.61 mg/L respectively before aeration process conducted on stagnant point sampling. The data obtained shows that impeller and fan aeration system suitable for river stream which ensures the river stream to continuously flowing and reducing stagnant point in river. Although, the increase the DO level in bubble aeration system has higher percentage compared to fan aeration system, it's suitable to use in pond, water treatment plant and sewerage treatment plant.

Keywords: - Pollution, dissolved oxygen, aeration process

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1. Introduction

Rivers are utilized for a variety of purposes such as transportation, agriculture purposes, recreation, drinking water and other uses of water. About 70% of the earth is covered by water and only 2.5% is fresh water and only 0.3% is available for human consumption (Central California Area Office, 2020). Therefore, water treatment process is essential to ensure water quality is determined according to the standard requirements.

Among the water treatment processes is aeration process. Aeration is the process in which air is circulated through, mixed, or dissolved in a liquid or substance. Aeration brings water and air into close contact and causes dissolved gases such as carbon dioxide, CO₂, to be removed.

Politeknik Kuching Sarawak (PKS) is a higher education institution that accommodates more than 3500 people including students and staff. Sungai Kangka is located inside the Politeknik Kuching Sarawak campus. Sungai Kangka is used for co-curricular activities such as kayaking, fishing, and other water activities. Sungai Kangka pathway is located near palm plantation area. Furthermore, sewerage treatment plant system from Politeknik Kuching Sarawak located next to the Sungai Kangka pathway. Also, water from the final tank is discharged directly to the river. Fig. 1 shows a map of Sungai Kangka, Politeknik Kuching Sarawak that obtained from Unit Pembangunan dan Senggaraan (UPS), Politeknik Kuching Sarawak.



Fig. 1. Demographic of Sungai Kangka

Aeration system is a mechanism used to provide oxygen for bacteria in wastewater and aquatic living in water while they are consuming dissolved oxygen (Mal, 2021) Furthermore, the excessive or insufficient amount of dissolved oxygen level in water may affected the growth of organisms in surrounding of the river (Cao et al., 2021), (Lipizer et al., 2014).

1.1 Problem Statement

As reported in previous work from (Shah et al., 2022), the water quality analysis of Sungai Kangka can be categorized under class II of National Water Quality Standard for Malaysia. This classification indicates that the river is suitable for recreational activities involving bodily contact. However, they have found that a stagnant point along the rivers with low oxygen dissolved value and poor life aquatic living that limit the chances to develop a recreation sector at Sungai Kangka. The improvement of water quality along the Sungai Kangka is required to be conducted before gazetted this river safe for recreational activities of PKS community. Besides, the stagnant point in Sungai Kangka is near with the suggestion area of recreational activities. Fig. 2 shows the non-point source that affects the parameters in stagnant point along the river stream. Therefore, this work is proposed and conducted to study the improvement of oxygen dissolved which indicates the pollution level along Sungai Kangka especially the stagnant point.



Fig. 2. Non-point source along the stream of Sungai Kangka

1.2 Objectives

The specific objectives of this research are as follow:

1. To study the effect of aeration system in stagnant point of Sungai Kangka towards.
2. To provide the technical data for suggestion aeration system in stagnant point of Sungai Kangka

2. Methodology

2.1 Water Sampling

To conduct analysis on the effect of aeration system in Sungai Kangka, PKS, water sampling points were taken in two points as shown in Fig. 3 and Fig. 4. In detail, two stations were selected based on the criteria which flowing and non-flowing. For flowing site on the river, it was set as benchmark for dissolved oxygen level and the point selected on manmade natural aerator, which has elevation on the structure and cause natural waterfall to occur, therefore increase the dissolved oxygen level. For second point, which stagnant point in river pathway about 30 meters from the first point at the corner pathway of the river. The second was chosen based on the geography location on the river, which limited the river stream access the location and caused stagnant point to occur.



Fig. 3. Continuous flowing river



Fig. 4. Stagnant point and near to non-point source

2.2 Magnetic Stirrer

Water evaluation has been conducted after been applied aeration system fan blade concept by using magnetic stirrer as shown in Fig. 5 where water sample been place inside the beaker for 300mL and been stirred using magnetic stirrer for 10 minutes. This method applied the concept of aeration system on small scale before applying on large scale which is on the river pathway. Parameters used in this concept are the speed of the stirrer, where 200 rpm, 400 rpm, 600 rpm and 800 rpm were set. As for constant variable, water sampling and time set were 300mL and 10 minutes respectively.

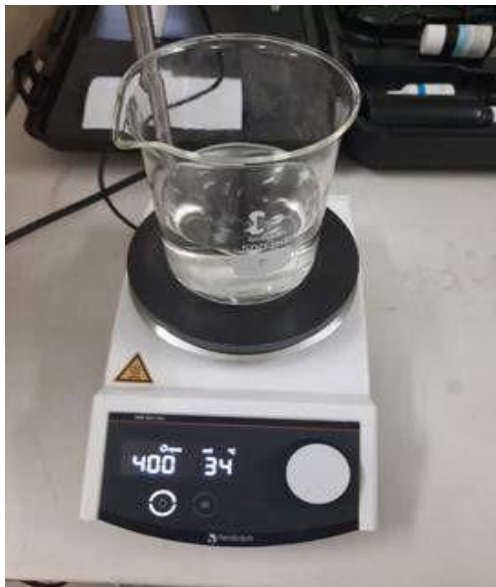


Fig. 5. Magnetic stirrer

2.3 Bubble Aerator

Application of bubble aerator which using stone aerator is commonly used sewerage treatment plant, for example, used at Kuching Centralized Sewerage Treatment Plant as site visit was conducted. The concept of aeration system is where the air injected into water will produce an increase of dissolved oxygen level as shown in Fig. 6. Components involved in this aeration system concept are an air pump, hose and stone aerator which simulate the real-life aeration system. The specification of air pump used produce 2.5 Watts of power, 3L/min of volume flow rate and 0.02MPa of air pressure. The stone aerator used in the analysis has three dimensions to indicate the difference of dissolved oxygen level.

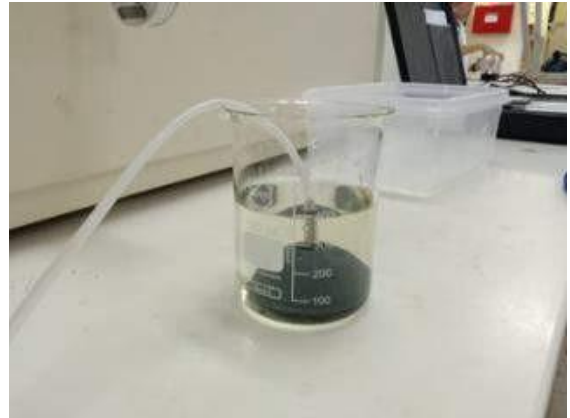


Fig. 6. Bubble aerator

2.4 Dissolved Oxygen Meter

For dissolved oxygen level evaluation were tested using Dissolved Oxygen meter (Brand: HANNA HI98193) on sampling station and on the lab after analysis conducted as shown in Fig. 7. Each water sampling was evaluated using a DO meter to determine the DO level and effect of aeration system for both types. Dissolved Oxygen were calibrated before conducting the analysis to reduce error and increase the efficiency of the value.



Fig. 7. Dissolved oxygen meter

3. Result and Discussion

The level of dissolved oxygen in Sungai Kangka was measured at two different points. The first point was measured at flow point and second point were measured at stagnant point in the river which value at 5.31 mg/L and 4.61 mg/L respectively. The first point was higher than the second point due to the human build structure that produces aeration system and increase flow rate as presented in Figure 4. It indicates that the creation of natural aeration and build structure for improvement of dissolved value significantly promote a better water quality with high levels of oxygen dissolved to improve the water quality of effluent domestic wastewater in PKS which discharges into this river.

3.1 Magnetic Stirrer

Evaluation of aeration system to water quality using magnetic stirrer with different speed is conducted by using different water sampling point of stagnant point of Sungai Kangka. Table 1 shows the relationship of aeration power by speed towards the dissolved oxygen value. The magnetic stirrer process was simulated by the natural aeration concept in beaker with magnetic stirrer as impeller mixing to increase the dissolved oxygen level in water. Several speeds were used and dissolved oxygen significantly increased from initial dissolved value at 4.61 mg/L. From this data, the percentage of dissolved oxygen gradually increased up to 38% from initial value.

Table 1. Percentage of dissolved oxygen increment by magnetic stirrer

Water Sample	A	B	C	D
Speed (RPM)	200	400	600	800
Percentage of dissolved oxygen increase, %	17	24	38	38

It indicates that the suggestion specification can be applied for aeration system in Sungai Kangka, PKS is around 400 rpm to 600 rpm. The main factor of this specification selection is due to the consumption of electricity and lifespan of the aerator which is impeller or fan blade used in aeration system. Besides that, referring to Table 2, the difference of dissolved oxygen level between 600 rpm and 800 rpm is slightly different. Therefore, considering the energy consumption of the aeration process, 400 rpm to 600 rpm is suitable for this type of aeration system.

3.2 Bubble Aerator

The analysis conducted on this type of aeration is where air was injected into water through stone aerator. Basically, the type of aerator used for aquatic living increases the dissolved oxygen level in water. The

analysis was conducted with sample of water is the constant variable, maintained at 300mL and 10 minutes of each analysis. For every analysis conducted, a new sample was used that has been collected on the same site at Sungai Kangka, PKS. Based on Table 2, the data analysis was recorded and categorized on three different dimensions of stone aerator. From this data, it shows that the level of dissolved oxygen increases alongside the dimension on the aerator due to the larger surface area. Based on the suitability in Sungai Kangka, the bubble aerator as sample B suits the aeration system where the dissolved oxygen level was increased to 48%.

Table 2. Percentage of dissolved oxygen increment by bubble aerator

Water Sample	A	B	C
Stone Aerator Dimension (mm)	60 × 46 × 5	80 × 50 × 5	170 × 85 × 5
Percentage of dissolved oxygen increase, %	26	48	81

Based on the analysis obtained, impeller aeration system which is fan blade or impeller is suitable to be used to ensure river stream continuously flowing. This method will reduce stagnant point water along river pathway. Theoretically, will cause turbulence effect in river stream and increase dissolved oxygen level in Sungai Kangka, PKS (Marcy et al., 2010). On the downside of this type of aeration system, this equipment will use various mechanical parts such as bearing, motor, floating device, and others. If this aerator is not well maintained, it tends to have a short lifespan due to immersing in water and will cause corrosion. Compared to bubble aerator, which has fewer parts compared to blade aerator, which led to less maintenance activities conducted on side. Furthermore, bubble aerator increases the level of dissolved oxygen higher compared to fan blade aeration system. The purpose of the analysis conducted was to determine ways to increase the efficiency of water aeration process (Amano et al., 2013). The objective of the analysis was achieved using propeller and fan blade designs and air diffuser. Standard Oxygen Transfer Efficiency (SOTE) were analyzed and indicated a decrease in impeller and fan blade aeration system compared to standard model air diffuser (Amano et al., 2013).

Compared to bubble aerator which induced air into water to increase the dissolved oxygen level, more mixing causes an improvement of Standard Oxygen Transfer Efficiency (SOTE) for the system (Boyd, 1998). These facts were supported with data obtained from Table 2 after analysis conducted. Dissolved oxygen, which indicates the quality of the water, is one of the most essential factors to sustain healthy life for organisms in aquatic (Sombatjinda et al., 2011).

4. Conclusion

Data obtained from the analysis conducted shows that aeration system gives an immediate effect of dissolved oxygen level in certain amount of time. For both types of aeration system used in the analysis, it can be concluded that fan aerator suitable for ensuring river stream to continuously flowing and reducing the possibilities of the stagnant point, hence increase the level of dissolved oxygen. Although bubble type aeration system also has the same purpose which increases the dissolved oxygen, based on the data obtained, this type of aeration increases the dissolved oxygen level more quickly compared to fan aeration system. On the downside, this type of aeration system is suitable to use in ponds such as water treatment plant or sewerage treatment plant due to its ability to ensure river stream to continuously flowing.

Acknowledgement

We would like to express our gratitude to Politeknik Kuching Sarawak (PKS) management for the support to conduct this research and enable us to use the facilities on the campus. Secondly, we would like to express our gratitude to our project students, Jesline, Farhanis, Preya and Rachel Anne who helped during conducting this research and helped us during data analysis. Finally, we would like to thank my fellow colleagues in the Petrochemical Department, especially the Head of Department who encouraged us during the conduct of this research.

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Full Paper

Article history

Received

23 July 2023

Received in revised form

23 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Enhancing Student Learning and Engagement in Financial Management: An Assessment of the Impact of the ED Puzzle Application

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Abstract

An effective learning environment and digital video application that emphasizes interaction with students can be useful tools in the classroom. Due to the declining student score results in financial management for the last two semesters, the ED puzzle method was highlighted to attract students. This research study examines the impact of using the Ed Puzzle application as an effective learning tool in the financial management classroom. The study aims to assess the students' understanding of financial management concepts and the teaching effectiveness of instructors at Commerce Department Politeknik Mukah Sarawak's. Additionally, the study aims to improve student learning and engagement using e-tools and provide insights into the integration of technology in education to enhance academic performance. A total of 79 students enrolled in financial management courses participated in the study. A quantitative method was employed, and a questionnaire was distributed to the students using a Google form. The results indicated that the implementation of the Ed Puzzle application led to a significant improvement in the exam pass rate, increasing from 52% to 70%. The positive response from students suggests the potential acceptance of Ed Puzzle in other educational institutions. These findings provide valuable guidance for lecturers in optimizing their teaching methods and improving students' exam results. Future research can focus on evaluating the transferability of skills and knowledge acquired through the Ed Puzzle application to real-world financial management contexts.

Keywords: - ED puzzle, student engagement, academic performance

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1. Introduction

The emergence of COVID-19 has prompted many polytechnic lecturers to adopt a teaching approach that combines stand-alone video modules with live teaching sessions. The use of digital video as a progressive teaching method highlights the importance of student-centered teaching. In accounting, the dropout rate is relatively high compared to other subjects, leading to a lower pass rate. Subjects such as financial management, economics, and management accounting are the subjects that cause the most difficulties for students in the learning process. According to the material that is currently accessible, a student's likelihood of dropping out depends

significantly on the subject and programme that they are enrolled in as well as the degree that they have already earned (Graham, 2016). ED puzzle is a video-sharing platform that allows the lecturer to improve the instructional quality of web videos by incorporating questions, annotations, and audio explanations into existing content. In addition, it provides the ability to record and analyze data on student progress and performance. In a financial management course, researchers found that implementing ED puzzle for homework and assessments resulted in positive student feedback and improved attention throughout the course. Digital natives, or Generation Z, are those who were born between 1995 and 2012 (Singh, 2014), making them the first generation to grow up with smartphones and internet

access (Williams, 2015). Surveys have shown that the use of digital media has a significant impact on students' skills, interests, and attitudes. With a focus on the use of internet-connected mobile devices, digital natives have seen continuous improvements in technology (Considine, Horton & Moorman, 2009). It is acknowledged that traditional education needs to be improved, considering the advantage of the use of internet platforms, mobile devices, and innovative teaching methods utilizing mobile learning (Szymkowiak et al., 2021). The aim of this study was to assess the impact of using the Ed Puzzle application on students' understanding of financial management concepts and the teaching effectiveness of financial management instructors at Politeknik Mukah Sarawak's Commerce Department. Additionally, the study aimed to improve the quality of student learning and engagement using e-tools and provide insights into the integration of technology in education to enhance academic performance. By examining the effect of a quiz platform on performance of Financial Management students, this study may also close this gap. The research findings can be used by a lecturer to develop instructional materials that get over obstacles to using ED puzzles in the classroom. Flipped classroom techniques can also be used to increase student engagement. Additionally, flipped classroom techniques can be used to increase student engagement.

2. Literature Review

The most important goal of the Commerce Department is to create such an environment in the classroom to inspire learning among students in a way that does not make the learning process tedious and monotonous. The lecturer must ensure comfort, safety, and security in the classroom environment so that student learning is not hindered. Online platforms like ED puzzle not only help students better understand academic concepts but also help reduce the undue workload of lecturers. According to Gray (2016), the lecturer must navigate the available means to improve teaching methods and enhance the potential of EdTech to impart knowledge in all aspects. The search for more feasible assessment methods is also becoming necessary for lecturers. Finding a solution is crucial to ensuring that the evaluation procedure is unaffected even when learning occurs online. Findings from Baker (2016) examined how the ED puzzle is used for student evaluation. Students were required to watch movies that were interspersed with a series of questions as part of the study. Different students view the movie and complete the questions at various rates. Students should not use the interface. When faced with a specific question, they must answer it because there is no skip or back option to check the answer. Scores are securely saved by ED puzzle. In the same study, comparing the ED puzzle with the conventional pen-and-paper learning method showed that employees prefer the learning method. From the questionnaires, it was found that 85% of the respondents were not ashamed to prefer the ED puzzle.

This is a result of how simple the technology is to use and how knowing the ED problem allows for some flexibility. To show how the ED conundrum affects teaching and learning, the study's findings must be presented. Let's just say that ED puzzles engage pupils in ways that are not possible with traditional teaching techniques. This tool allows lecturers to not only conduct carefully guided lessons but also provide detailed, well-structured feedback accurately represented by real-time data, ultimately helping to significantly reduce teaching time and assess student learning outcomes.

Furthermore, the ED puzzle is an interactive tool in teaching practice. Therefore, it is important to understand the advantages of employing technology in place of conventional teaching techniques. More student participation is the primary benefit (Mischel, 2019). The calibre of the instruction offered is crucial for a constructive learning environment and for pupils to provide their best effort. If kids don't receive a great education, the knowledge they learn won't have a big impact on their situation. The quality of education for pupils must be improved, even though children are more accustomed to traditional techniques (Schwartz, Cappella, & Aber, 2019). However, numerous studies have also highlighted the obvious drawbacks of utilising technology in the learning process since students are hesitant to utilise a setting where there is a literal and figurative screen between them and the teacher. Some less tech-savvy pupils may feel excluded because of this. However, they still favour conventional assessment techniques despite these worries. The ED puzzle can facilitate a variety of learning processes, according to University of Massachusetts Amherst's study from 2019. Behaviourism, social constructivism, technology-enhanced learning, connectedness, and cognitive constructivism are presented as examples.

Assigning quizzes to specific students or classes, or embedding them in websites like Blackboard or Moodle, is another function of ED puzzle (Mischel, 2019). The platform can keep track of the information provided about each student's performance. Students can readily access any of the films allocated to them in the classroom or at home once they register an ED puzzle student account, which boosts the capacity to flip the classroom. The movie will immediately stop playing if the learner opens new tabs in the same window while watching it. Unfortunately, the videos continue playing even after opening a new window (Mu & Paparas, 2016). Because the video is public, teachers are free to utilize or alter other people's ED puzzle videos however they see fit (Aydin & Demirer, 2016). Moreover, the ED puzzle lets you keep track of how many times a student has seen a certain segment of a video. This enables teachers to investigate the areas where students are having difficulty. Children can gain a deeper comprehension of the complicated elements of videos by having the ability to rewatch them. Additionally, the application enables teachers to gather data on each student's test-taking strategies as well as their answers to a particular question.

This enables lecturers to gauge how well their pupils comprehend the material using Bloom's taxonomy. The goal of the study is to become an expert user of the ED puzzle and discover applications for it both inside and outside the classroom. The study also examined how to engage students of various levels and enhance their performance when utilizing the tool to prepare for examinations. It has been demonstrated that ED puzzle can assist them in enhancing their confidence and problem-solving abilities.

D'Aquila, Wang & Mattia (2019) state students show that these types of platforms may drive them, and they value the degree of independence and flexibility that tools like ED puzzle allow them. Even though students may find this platform to be intriguing, some academics and researchers contend that websites like ED Puzzle are inappropriate for college students. However, there is general agreement that it is a terrific tool to support students' practical knowledge and enable them to independently master the most challenging subjects.

The materials support the efficacy of this method in every subject and course, even though it has appeared and is being used to teach students and acquaint them with the most cutting-edge technical tools. The research is extremely uncommon. After altering learning contexts, self-regulating learning (SRL) draws attention. This innovative approach to education and learning has grown in response to societal demands; it emphasises the value of lifelong scholarships and views the development of informal learning ecosystems as the ideal foundation. development through self-control (Graham, 2016). To promote school regulation of low-achieving children, many strategies have been taken into consideration. It has mostly been introduced through the integration of technology-based instructional activities into curricula (Holtzblatt & Tschakert, 2011). In addition to stimulating and enhancing learners' minds, the proper and effective use of technology in the sphere of information delivery may also place them in a position where they must suffer. responsibility. Self-reliant and answerable for one's education with minimal guidance from a teacher. Additionally, the use of technology in school improves cooperative learning and fosters a variety of other abilities, including social abilities, a sense of responsibility, problem-solving abilities, self-confidence, and more. skills other than machine learning, to which learners have adapted Ghavifekr, Afshari & Amla (2012).

3. Methodology

Participants in this study were Financial Management 1 (DPA30063) students enrolled in Diploma Accountancy Programme, at Politeknik Mukah Sarawak's. There were 79 students who joined the ED puzzle in a formative evaluation to determine their level of understanding of financial management concepts and completed all questions. The formative assessment's average results showed that 65 students got scores of 60% or higher. By Arbaugh (2008), a questionnaire about students' learning

experiences was modified. This questionnaire consisted of two sections. The first section of the students' learning experiences on teaching presence, cognitive presence, and social presence featured five-level Likert scale questions with the following response options: 1 = strongly disagrees, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

The survey includes 24 closed-ended questions that were modified from da Costa, da Silva, Nasu, Nogueira, & Marques (2021). All the instrument's closed-ended questions used a Likert scale of five points, ranging from strongly disagree (SD) to strongly agree (SA). Participants used ED puzzle outside of the classroom every week to post feedback videos to exercises that complement their classroom learning. The study analysed the responses to investigate students' perceptions of the impact of using ED puzzle on their learning experience and their perceptions of the pros and cons of using ED puzzle in the DPA30063 Financial Management 1 courses. The results analysis using SPSS version 26. The data used in this article is based on a survey of 79 students enrolled in the course DPA30063 Financial Management 1. The study analysed survey responses to investigate students' perceptions of the impact of using the ED puzzle on their learning experience and their perceptions of the pros and cons of using it.

4. Finding and Analysis

Table 1 demographic profile of the respondents showed that 84% of them were female and 16% were male. In addition, 96% of the students identified themselves as members of the Generation Z, often known as the "digital natives," who were born between 1995 and 2012 (Singh, 2014), making them the first generation to be born in an internet-connected world as well as the smartphone era. A total of 79 respondents participated in the survey are semester three students DAT 3A and DAT 3B take DPA 30063 Financial Management 1 for session 1 2021/2022.

Table 1. Respondent demographic profile

Characteristics		N	
Age	19	76	96%
	20	3	4%
Gender	Male	13	16%
	Female	66	84%
Class	DAT3A	37	47%
	DAT3B	41	53%

With a mean score of 4.77, respondents agreed, as shown in Table 2, that the ED puzzle increased class engagement. With a mean score of 4.71, it is evident that the tool is beneficial as a learning tool. The use of ED puzzles helped students learn about money management and achieve a mean score of 4.66. According to statistics, students said utilising ED puzzles was easy and that it

helped their general learning. Their mean score is 4.65. Next, the ED puzzle, with a mean score of 4.61, is appropriate for use as a teaching tool and should be used for a variety of subjects. It demonstrates that using ED puzzles in learning exercises is useful for students studying finance. With mean values ranging between 4.49 and 4.58, the level of student satisfaction was moderately good while using the ED puzzle as an interactive tool. The category's highest mean value, 4.58, is a result of an improvement made using the ED puzzle activity.

Table 2. Mean and Standard Deviation (SD) for perceptions of students

No.	Item	Means	Standard Deviation
Use of ED puzzle			
1	It's simple to utilise the ED puzzle.	4.65	0.481
2	I found the ED puzzle to be useful as a learning tool.	4.71	0.457
3	The ED puzzle increased class participation.	4.77	0.422
4	ED Puzzle helped me with this course's education.	4.66	0.477
5	I like using the ED puzzle to find the financial management formula.	4.66	0.477
6	This course suitable to use the ED puzzle as a learning tool.	4.61	0.541
7	The ED puzzle ought to be applied to a variety of topics.	4.61	0.541
8	The ED puzzle worked well as an interactive tool.	4.56	0.525
9	The interactivity of the videos in the ED puzzle increased my satisfaction in relation to the traditional classes.	4.52	0.574
10	The amount of time given to answer each question was adequate.	4.54	0.595
11	My satisfaction with the subject increased due to the use of the ED puzzle.	4.58	0.522
12	The way the ED puzzle has been incorporated into the course is satisfactory to me.	4.49	0.677

Table 3. Mean and standard deviation for perceptions of students to improve the quality of learning and student achievement

No.	Item	Means	Standard Deviation
The quality of learning and student achievement			
1	I constantly practiced remembering the formula before using it for the ED puzzle problem since I needed to remember it for a financial management assignment.	4.47	0.695
2	I use the ED puzzle first and then update the money management calculation.	4.57	0.614
3	My recollection of the financial management formula has improved since using the ED puzzle problem.	4.42	0.672

4	The ED puzzle helped me learn new things.	4.52	0.596
5	The ED puzzle should be used in another program.	4.48	0.658
6	I enjoyed seeing a digital video in ED puzzle.	4.53	0.596
7	Compared to other subjects that do not use the ED puzzle problem, I learned this subject more easily.	4.54	0.616
8	The interaction of the videos and audio notes made by the lecturer in the ED puzzle helped my understanding (if there is an audio note from the lecturer).	4.54	0.616

4. Conclusion

The ED puzzle can be utilized to enhance the present educational system, which underutilizes students' skills and abilities, based on the statistical findings of the study. It is true to say that ED puzzle will be embraced by many more educational institutions if student response is positive. It shows the effectiveness of using the ED Puzzle activities among financial management students at Politeknik Mukah Sarawak's (PMU) Commerce Department. Surveys of the students were used to obtain feedback. Another study may look at the findings of this one (Silverajah & Govindaraj, 2018). According to the quantitative statistics, up to 100% of the students who took part in the survey believed that the ED puzzle material they had access to had effectively prepared them for their final test or assessment. The students appreciated ED puzzle for providing the tools and noted in their remarks that they "really offered us the background knowledge needed to solve the assessment questions." The Ed puzzle has educational value when used in class activities, as shown by a thorough analysis of the findings. The usage of ED puzzles has significantly enhanced student participation in class activities. They have always benefited from this when trying to compute, analyse a situation, or think critically. Furthermore, it was recommended that lecturers create lectures using video content on the ED puzzle platform, providing them the capacity to compile movies from different sources, present quizzes, and assess student performance. Therefore, by including this technology in a few CIDOS courses, the learning environment can be improved. Future research modules and activities would be greatly aided by the organisation of theory courses or practical courses finished with peers. Future studies could examine how well the information and abilities gained through the Ed Puzzle programme translate to actual financial management situations. This could involve assessing students' ability to apply the learned concepts to practical financial decision-making scenarios and evaluating the application's effectiveness in developing practical financial management skills. Investigating these facets will help one get a more thorough grasp of the application's effects, allowing one to make wise judgements about its implementation and potential future

advancements. Due to the study's temporal constraints, it is difficult to evaluate the long-term transferability of the skills and knowledge learned through the Ed Puzzle application. Beyond the purview of the study, transferability may necessitate continual practise and application in real-world situations.

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Factor That Influences Motivation Towards Satisfaction Among Volunteers: A Case of Yayasan Sukarelawan Siswa (YES) Politeknik Metro Betong Sarawak

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Full Paper

Article history

Received

30 July 2023

Received in revised form

30 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This research comprises the study of factors that influence motivation toward satisfaction among Yayasan Sukarelawan Siswa (YES) Volunteers at Politeknik Metro Betong Sarawak. The study's goal is to determine the motivation factors related to volunteers, which are extrinsic and intrinsic factors that provide satisfaction to the volunteers. Following that, the study will seek to identify the factors that contribute to the satisfaction of volunteers who have participated in any volunteering activities. This research was divided into five major sections: introduction, literature review, research methodology, findings, conclusion, and recommendation. Volunteering has been shown to produce benefits related to boosting one's confidence and responsibility. Students primarily assisted with community development, sports, and education-related activities at their university. Having an array of suitable volunteering activities and good institutional networking with external agencies should be the support university provides to the student so that they will gain many benefits that enhance personal skills and future employability.

Keywords: - Volunteer, volunteer motivation, satisfaction

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1. Introduction

A volunteer is a person who spends unpaid time carrying out tasks to benefit others. Examples of volunteering include, among many other things, helping at a local food bank or community garden, campaigning or raising awareness for a good cause, working in a local charity shop, or providing administrative support for charities (Taylor, 2023).

Boyer (2017) stated that volunteering requires more than just giving time to selfless deeds or activities that benefit others. It has a higher overall societal influence. Volunteers help the community by participating in a range of activities. These opportunities are one of the reasons why more students should volunteer. Volunteers' intention to continue volunteering was mostly related to the motives for someone to become a volunteer,

expressed through personal growth, extrinsic rewards, career orientation, and other motives (Brown, 2005; Olsen, Vogt, & Andereck, 2018). According to the Corporation for National and Community Service, approximately 63.4 million Americans, or 26.8 percent of the adult population, volunteered for 8.1 billion hours' worth \$169 billion in 2009. Volunteering is a type of action in which an individual does without expecting anything in exchange for assisting others, such as the community and organizations affected by a disaster. (Mykletun & Himanen, 2021). Volunteering can be defined as any unpaid activity that involves spending time doing something that benefits the environment (Ralston et al., 2005). The subject of this study is volunteer motivation towards satisfaction (Lee, 2011). Dickson (2012) define volunteer as "formal activity undertaken through public, private, and voluntary organizations." Volunteer participation is based on two factors: extrinsic

motivation and intrinsic motivation (Ryan & Deci, 2009). Intrinsic motivation is motivated by personal enjoyment, interest, or pleasure. Intrinsic motivation, as Deci et al. (1999) observed, energizes, and sustains activities through the spontaneous satisfactions inherent in effective volitional action. Thus, extrinsic motivation contrasts with intrinsic motivation, which refers to doing an activity simply for the sake of doing it, rather than for its instrumental value (Ryan & Deci, 2000). In recent years, discussions about volunteer motivation have drawn researchers such as Warner et al, (2011) and Pearce (1983), who argue that motivation alone are poor predictors of volunteer support. The problem is discovered to be the volunteer's attitude during the event (Yeung, 2004). To do so, one must first understand the sources of satisfaction for volunteers as well as the factors influencing their future volunteer intentions (Pauline, 2011). As a result, the primary goal of this research is to determine the impact of volunteering motivation on satisfaction (Kim, 2014). Future research should investigate other factors that influence volunteer satisfaction, such as work career, social relationships, and personal development (Clary et al., 1998; Pearce, 1983; Warner et al., 2011).

1.1 Research Objective

1. To identify the motivation factors of volunteers. Therefore, this study is aiming to find the motivation factors of volunteers.
2. To identify the relationship between motivation factors and volunteer satisfaction. Therefore, this study is aiming to find the relationship between motivation factors and volunteer satisfaction.

2. Methodology

2.1 Research Design

Polit and Hungler (1999) describe the research design as a blueprint, or outline, for conducting the study in such a way that maximum control will be exercised over factors that could interfere with the validity of the research results. Burns and Grove (2001) state that designing a study helps researchers to plan and implement the study in a way that will help them obtain the intended results, thus increasing the chances of obtaining information that could be associated with the real situation. This study will use a quantitative method research to identify the influence of volunteer motivation towards satisfaction. Quantitative research options have been predetermined and many respondents are involved (Lee, 2009). According to Burns and Grove (1993) define quantitative research as a formal, objective, systematic process to describe and test relationships and examine cause and effect interactions among variables. By using quantitative research, the research can generalize results from a sample to the population of interest; measure the incidence of various views and opinions in a chosen sample (Smith, 2010).

2.2 Population

According to Salkind (2009), the population is a group of potential participants or respondent to whom the result is generalized. Thus, the population for this study comprised of all Yayasan Sukarelawan Siswa (YES) volunteers at Politeknik Metro Betong Sarawak. In total there were 169 number of volunteers registered in Politeknik Metro Betong Sarawak.

2.3 Sampling Technique

Sampling is the process of selecting several elements from the total population (Sekaran, 2003). The sampling process will help the researchers to save time and money by selecting a significant number of respondents that will represent the entire population. The technique used in this study is Convenience Sampling. Convenience sampling is a type of sampling where the first available primary data source will be used for the research without additional requirements. The sample is selected because they are convenient. This is the most common type of probability sampling technique (Salkind, 2009).

2.4 Data Instrument

Data collection instruments refer to devices used to collect data such as questionnaires, tests, structured interview schedules and checklists (Seaman, 1991). The instrument is obtained via a self-administered questionnaire. The questionnaire consisted of four broad areas designed to achieve the purpose of the study. A five-points Likert scale was used in this study. Section A included demographic information of respondent. The next section, Section B included items assessing extrinsic motivation factors. In section C, the item assessed the intrinsic motivation factors of the volunteer. On section D, are included the satisfaction factors that influence motivation of the volunteer.

2.5 Data Collection Method

Data collection is a term used to describe the process of preparing and collecting data. It is a systematic gathering of data for a particular purpose from various sources, there has been systematically observed, recorded, and organized. To carry out this study, the researcher distributed 169 questionnaires through Google Form survey to all Yayasan Sukarelawan Siswa (YES) volunteers at Politeknik Metro Betong Sarawak in duration of 2 weeks.

2.6 Data Analysis

Data analysis was conducted using the latest version of SPSS, which is version 22. Data received from the questionnaires were transferred into the software and a series of analysis including descriptive analysis and reliability statistics was operated to produce the required data that answered the research questions which is reliability analysis and descriptive analysis.

3. Result and Discussion

3.1 Reliability Statistics

Table 1 shows that the alpha Cronbach value is 0.730. According to Salkind (2009), the reliability score for the variable should be above 0.6. The analysis of reliability facilities for the first factors of motivation was committing this assumption and this measurement was well ready for further inferential analysis.

Table 1. Reliability Statistic ($n=169$)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.730	.732	12

3.2 Survey Return Rate

A total of 169 questionnaires were distributed to the respondents from Yayasan Sukarelawan Siswa (YES) volunteers at Politeknik Metro Betong, Sarawak. The questionnaire was returned 100% completed and achieved the expected result. The total numbers of 169 questionnaires were completed and had been returned by 169 respondents. been defined in the abstract.

3.3 Demographic Information of Respondents

It was found that 96 are female (56.8%) and 73 are male (43.2%) participate in this survey giving the total of respondents was 169. Therefore, the female respondents are higher than male respondents.

Table 2. Gender of respondents ($n=169$)

Frequency		Percentage %
Female	96	56.8
Male	73	43.2
Total	169	100

The highest percentage was (38.5%) which is 65 of the respondents volunteered for an event for 5 to 10 times in 1 year. Another (37.3%) shows that 63 of the respondents were volunteering for an event more than 10 times in a year. Lastly, the lowest percentage shows that (24.3%) of the respondents shows that only 41 respondents volunteer less than 5 times in a year.

Table 3. Average volunteering involvement in 1 year ($n=169$)

	Frequency	Percentage %
Less than 5 times	41	24.3
5 – 10 Times	65	38.5
More than 10 times	63	37.3
Total	169	100

3.4 Extrinsic Factor

Comparing the mean among the items for Extrinsic Factor, the highest mean was 3.12, SD = 0.901 for item “I became a volunteer because I want to win others respect”. The lowest factor of extrinsic motivation factor was the item “I became a volunteer because I want to get free food” with the mean of 2.55, SD = 1.107.

Table 4. Extrinsic Factor ($n=169$)

	N	Mean	Std. Deviation
I became a volunteer because I want to win others respect	169	3.12	.901
I became a volunteer because I want to get free ticket/free admission to the event	169	2.99	.954
I became a volunteer because I want to get event's informs/official apparel	169	2.80	1.027
I became a volunteer because I want to get free food	169	2.55	1.107
Valid N (listwise)	169		

3.5 Intrinsic Factor

Comparing the mean among the items for Intrinsic Factor, the highest mean was 3.14, SD = 0.925 for item “Participating in volunteering is fun”. The lowest factor of extrinsic motivation factor was item “Participating in volunteering activities help develops my interest” with the mean of 2.83, SD = 0.924

Table 5. Extrinsic Factor ($n=169$)

	N	Mean	Std. Deviation
Participating in volunteering is fun	169	3.14	.925
Being a volunteer help me fulfil my expectation towards the event	169	3.08	.834
Volunteering satisfies my curiosity about the events	169	2.98	.948
Participating in volunteering activities help develops my interest	169	2.83	.924
Valid N (listwise)	169		

3.6 Total (MEAN) motivation factor ($n=169$)

The most significant motivation factor was intrinsic factor with mean at 3.0089 and standard deviation (SD) at 0.58369. However, extrinsic factor has the least factor which the mean at 2.8669 and standard deviation (SD) at 0.60629. As for the motivation factor, intrinsic

factor has the higher motivation factors compared to extrinsic factor for volunteer satisfaction.

Table 5. Total mean (motivation factor)

	N	Mean	Std. Deviation
Intrinsic Factor	169	3.0089	.58369
Extrinsic Factor	169	2.8669	.60629
Valid N (listwise)	169		

3.7 Extrinsic & Intrinsic Motivation

What is the relationship between motivation factor and volunteer satisfaction?

H1: There is a significant relationship between extrinsic motivation factor and volunteer satisfaction.

Based on Table 6, the finding of the relationship between motivation factor and volunteers' satisfaction. There was a weak positive relationship between extrinsic factor and volunteer satisfaction ($r = .379$, $p < .000$). Therefore, H1 is accepted.

Table 6. Extrinsic and motivation factor

		Extrinsic Motivation Factor	Volunteer Satisfaction
Extrinsic Motivation Factor	Pearson Correlation	1	.379**
	Sig. (2 tailed)		.000
	N	169	169
Volunteer Satisfaction	Pearson Correlation	.379**	1
	Sig. (2 tailed)	.000	
	N	169	169

H2: There is a significant relationship between intrinsic motivation factor and volunteer satisfaction.

Then, intrinsic factor has the moderate positive relationship between motivation factor and volunteer satisfaction ($r = .554$, $p < .000$). Therefore, null hypothesis is rejected, and alternate hypothesis was accepted. Thus, the correlation coefficient is very highly significantly different from zero.

Table 7. Intrinsic motivation factor

		Extrinsic Motivation Factor	Volunteer Satisfaction
Extrinsic Motivation Factor	Pearson Correlation	1	.554**
	Sig. (2 tailed)		.000
	N	169	169

Volunteer Satisfaction	Pearson Correlation	.554**	1
	Sig. (2 tailed)	.000	
	N	169	169

4. Conclusion

There are several factors that lead to motivation of the respondents to get involved in volunteering work. The factors related to motivation factors are extrinsic and intrinsic motivation. Based on the study, the most affected factors that motivate respondents to influence satisfaction were intrinsic factors. In intrinsic factor, high number of the respondent was choosing is "Participating in volunteering is fun". According to Ryan 2010, when an intrinsically motivated person is moved to act for the fun of, challenge entailed rather than because of external prods, pressures, or rewards.

The volunteers find that when participating in volunteering program or event is fun for them to gain their experience and fulfil the volunteer expectation towards the event. The volunteering program also can be ensuring to satisfy the volunteer curiosity towards the event that they join as part of their motivation factors. Next, volunteering activities also can help develop interest of the volunteer to join another event based on the type of interest of the individual to join in as volunteer in any program or event.

Based on the findings, researchers found out that there was relationship between motivation factors and volunteer's satisfaction based on analysis that been made. From having extrinsic and intrinsic factors that can support motivation factors of the volunteer make the volunteers more satisfy to join in volunteering in event. Intrinsic factors play have the highest relationship which the volunteers are fun when participating the event. This is because the event helps to fulfil the expectation towards the event. When the volunteers satisfy about the curiosity of the event, it will make motivation increase and make the volunteer satisfy with the program their join in as volunteer.

On top of that, when the volunteer joining the program, the volunteer wants to get others respect from which it influences volunteers to satisfy volunteering the event. According to Junaide (2014), the factors that tend to influence for joining volunteering is extrinsic rewards which is money rewards and also merchandise rather than to gain experience. Event organizers play much emphasis on the importance of intrinsically rewarding motives, such as the enjoyment of the activity of volunteering, interacting socially with other volunteers and event participants, and contributing to the larger social good.

Acknowledgement

We would like to take this opportunity to express our profound gratitude and deep regards to all Yayasan Sukarelawan Siswa (YES) volunteers for participating in

this research and assisting us for this research. We also would like to thank everyone who is involved directly or indirectly in the period of completing this research study.

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General Election 15th: Analysis the Tendency of Voters at Peninsular Malaysia

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Full Paper

Article history

Received

24 July 2023

Received in revised form

24 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This research purposely has been done to determine the tendency of voters of the 15th General Election at Peninsular Malaysia. The characteristics of voters analyze in this research included the early voters, voters aged 18-20 years old, the total number of voters at each parliamentary seats, races and average gross income of the voters. However, this research has only taken into consideration the parliamentary seats won by Perikatan Nasional (PN) and Pakatan Harapan (PH) as the biggest coalition won the seats at Peninsular Malaysia. The analysis is dependent to the data from government agencies' website which are Suruhanjaya Pilihan Raya Malaysia (SPR) and Department of Statistics Malaysia Committee (DOSM). The data has been analyze using SPSS Statistical Software (SPSS) by computing the significance level and the relationship between the chosen Member of Parliaments and the characteristics of the voters. From this research, the parliamentary seats won by each coalition is significantly influenced by all characteristics mentioned above except the percentage of early voters. This research is important as the 15th General Election shows an unexpected political situation which no coalition can simply form a government. It then led to the unstable political environment which also impact the performance of the country. Hence, the analysis of the voters' characteristics is important to discover what is the reason led to the result of the election.

Keywords: 15th General election, Perikatan Nasional, Pakatan Harapan, Peninsular Malaysia

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1. Introduction

Since the inauguration of the Federation of Malaysia in 16th September 1963, the unique multiracial country had witnessed over fifteen general elections in six decades. Malaysia is a constitutional monarchy practicing a Westminster-style parliamentary system comprising thirteen states and three federal territories. It has a bicameral legislature consisting of 70 members of the Upper House Representatives or Senate (Dewan Negara) called as senator and 222 members of the Lower House Representatives (Dewan Rakyat) called as member of parliament (MP). All senators are appointed for a term of three years and renewable at once. 26 of them were elected by their respective thirteen State Legislative Assemblies (Dewan Undangan Negeri), 4 were appointed representing three Federal Territories (2 for Kuala

Lumpur and one each for Labuan and Putrajaya), while the remaining 40 were appointed by the Yang di-Pertuan Agong on the advice of the Prime Minister. Any dissolution of the Parliament does not affect the senators and Dewan Negara.

In terms of Dewan Rakyat, the total number of 222 members of parliament representing each constituency in contrast, are not going through direct appointment but shall be elected in the contested General Election (Pilihanraya Umum).

The state of Sarawak composes the largest number of parliamentary seats of 31 seats whereas the state of Perlis composes the least number of seats of only 3. The Federal Constitution 1957, as the supreme law of the land requires a general election to be conducted every five years to enable the people to exercise their rights of voting with the Suruhanjaya Pilihanraya (SPR) acted as

the governing authority. Any vacancy of a member of parliament's seat due to the death, resignation or disqualification of the incumbent member requires an immediate by-election to be held. However, if such tenure is remaining less than two years and will not affect the ruling party or coalition, the seat will be leave vacant until the next general election.

In general, there are various factors which may affect the outcome of a general election. Among the factors are the influence of the social media Sani & Azizuddin (2014), the malappropriation of electoral districts favoring the ruling party Ostwald (2013), the role of credible personalities in regime transitions Abdullah (2018), the reform agenda of a new government, the primacy of identity politics, the continuity of many policies that address ethnic relations, the voters' turnout rate, the demography and rate of predominant ethnic voters in a constituency. Besides, according to Chin (2018), the local factors and state nationalism are also one of the main factors influencing a general election.

The 15th General Election was arguably the most dynamic, unanticipated and competitive election in Malaysian history with no political coalition succeed to prove a resounding simple and clear majority for the first time ever. With the previous mandate expired on 10th October 2022 following the dissolution of the parliament by the Yang di-Pertuan Agong, Abdullah of Pahang upon the requisition of the Prime Minister Ismail Sabri Yaakob, the 15th general election was held on Saturday, 19th November 2022. It was highly hoped to end the prolonged political instability over the past two and half years with the changes of the ruling coalition party and the sworn-in of two Prime Ministers. According to the Suruhanjaya Pilihanraya, the 15th General Election recorded voters' turnout rate at 73.89%. In Peninsular Malaysia, the 15th General Election was widely contested by three dominant political coalitions of Pakatan Harapan led by Anwar Ibrahim, Perikatan Nasional led by Muhyiddin Yassin and Barisan Nasional led by Ahmad Zahid Hamidi.

This paper reviews and analyses several characteristics of voters in the 15th general election recently commenced particularly in Peninsular Malaysia. The comparison between the coalition of Pakatan Harapan dan Perikatan Nasional was made by the researchers as the two had secured the highest number of 142 winning seats with 71 seats each. This amounted to 63.9% of the total number of seats nationwide. The objective of this study is to highlight several factors influencing the outcome of the 15th General Election result in term of early voters, 18-20 years old group of voters, number of voters in a constituent, number of Chinese voters, number of Indian voters, number of Bumiputera voters and voter's average gross income. Throughout this highlight, it was hoped that readers will be able to acknowledge and consider the relevant factors affecting the 15th General Election result.

2. Literature Review

The Pakatan Harapan (PH) is a political coalition formed in 2015 to succeed the previous Pakatan Rakyat (PR). The coalition initially consist of Parti Keadilan Rakyat (PKR), Parti Tindakan Demokratik (DAP), Parti Peribumi Bersatu Malaysia (BERSATU), Parti Amanah Negara (AMANAH) and several other parties. Since winning the landslide and unprecedented result in the 14th General Election by ending the six-decades reign of Barisan Nasional (BN), the coalition had lost its' power and majority at the federal level following the sudden resignation of the then Prime Minister Mahathir Mohamad.

It is then led to the departure of the Parti Peribumi Bersatu Malaysia (BERSATU) and 11 members of parliament from Parti Keadilan Rakyat (PKR) from the coalition in February 2020

The Perikatan Nasional (PN) is a political coalition formed in early 2020 comprising the Parti Pribumi Bersatu Malaysia (BERSATU), Parti Islam Se-Malaysia (PAS) and Parti Gerakan Rakyat Malaysia (GERAKAN) with the intention of replacing the ruling coalition of Pakatan Harapan.

Since it is not mandatory for everyone to exercise and cast their vote in a general election, the voter's turnout rates are indeed playing a major and significant influence on the electoral outcome. The 13th General Election has recorded the highest voters' turnout rate in Malaysian history with the rate of 84.8%. The rate however is considered relatively low after being compared with the voting age, total of population and the number of eligible voters according to Hua et al., (2021). There are various factors affecting a general election. According to William (2014), the candidates' personal attributes, the state of economy and finance of country and the evaluation of the performance of the political leader may influence the way an individual vote at the ballot box. Apart from that, the factors may also include the voter's background and identification with the candidates, party identification and view of the incumbent's previous performance based on Ashley (2014), findings.

In Malaysia, the racial and ethnic based politics are well alive and widely significant to the outcome of the general election. In the 13th General Election, the results aggravated the ruling Barisan Nasional (BN) as the coalition had unprecedentedly lost its popular votes to Pakatan Harapan's forerunner, Pakatan Rakyat. Pakatan Rakyat who secured 51 percent of total federal votes and denied Barisan Nasional of two-third majority of the federal seats however only managed to gain 40 percent of parliamentary representation due to the excessive gerrymandering and malapportionment of constituencies. Out of 222 of the Dewan Rakyat seats, Barisan Nasional had a comfortable majority of 133 seats, a reduction of only 5 seats from the previous election. Despite of this, the Prime Minister Najib Razak blamed the "Chinese Tsunami" by citing the racial politics and opposition by the Chinese ethnic as the reason for the election's

unconvincing victory (The Edge, 2013).

However, this is not the sole factor influencing such performance. According to Ng et al., (2015), urbanisation was the other factor influencing the 13th General Election outcome as the Pakatan Rakyat secured strong support in urban constituencies whereas the Barisan Nasional always managed to secure majority votes in rural constituencies. Further study by Ng et al. (2020) suggests that both ethnicity and urban development affect the electoral outcomes with the former being the more dominant factor. The Encyclopedia Britannica defines urbanisation as the process by which large numbers of people become permanently concentrated in relatively small areas, forming cities.

According to DOSM, the national urbanisation rate has tripled over five decades from 28.4% in 1970 to 75.1% in 2020. This supported by the analysis of O'Neill (2023) which found that the rate of urbanisation in Malaysia gradually increase every year from 71.61 percent in 2011 to 77.7 percent in 2021 and the growth are expected to continue from time to time.

The number of Bumiputera voters is the next significant characteristic influencing the electoral outcomes. Bumiputera in Malaysia amounted to 21.13 million in 2022 according to the Statistics Department of Malaysia (DOSM) and contributed to the highest percentage of voters. In the past elections, the ability of the Barisan Nasional in securing majority votes of Bumiputera especially in the rural constituencies has proven benefited and instrumental to their uninterrupted six decades tenure as the ruling government. However, in the 15th General Election, the newly formed Perikatan Nasional (PN) coalition succeeded in securing the Bumiputera swing votes of 31.2 percent in Perlis, 28.8 percent in Putrajaya, 23.4 percent in Kedah and 22.26 percent in Melaka. It was a huge blow to the the Barisan Nasional indicating a clear signal of rejection of the Malay voters. The 73 seats won by the Perikatan Nasional are also inclusive of 22 seats clean swept in the predominant Malay state of Terengganu and Kelantan.

According to the Suruhanjaya Pilihanraya (2018), the amendments to Federal Constitution 1957 lowering the voting age and minimum running age from 21 years old to 18 years old has resulted in the young voters expected to be the majority voters in the future. Such amendments also enable automatic voter registration for those who turned 18 years old.

Prior to the amendment, 86% of countries in the world already had 18 years as the threshold voting age. In term of the readiness of the young voters (Gen Z) to vote at the age of 18 years old, Shahimi et al., (2020), indicates that family factors and the attitude of respondents had negative significant relationship and the social media, knowledge and peer factors cannot be the factors influencing the Gen Z to vote. The impacts of the 18 years old voting age amendment according to Lee (2020), will increase the total number of new voters by close to 16 percent and increase the share of Bumiputera voters that will likely benefit Barisan Nasional (BN) and Parti

Islam Se-Malaysia (PAS) even though a lower voter turnout could benefit the incumbent Pakatan Harapan (PH).

In analysing several characteristics and tendency influence the outcome of the 15th General Election result, the researchers come out with the following hypothesis:

H1: Higher the number of early voters will lead to the win of PN as a member of caretaker's government.

H2: Higher the number of 18-20 years old group of voters is highly lead to the win of PN.

H3: Higher number of voters will lead to the win of PH.

H4: Higher number of Chinese voters leads to the winning of PH.

H5: Higher number of Indian voters leads to the winning of PH.

H6: Higher number of Bumiputera voters leads to the winning of PN.

H7: Higher voter's average gross income leads to the winning of PH.

Varpio et al., (2020), stated that a theoretical framework is a set of principles that are interrelated in explaining a systematic situation. This type of framework can explain the phenomenon by identifying the relationship and correlation between the appropriate variables.

Fig. 1 shown is a summary of the theoretical framework depicting the independent variables of early voters, 18-20 years old group of voters, number of voters in a constituent, number of Chinese voters, number of Indian voters, number of Bumiputera voters and voter's average gross income. The dependent variable refers to the characteristics influencing the outcome of the 15th General Election. It can be concluded based on the above theoretical framework that there are seven characteristics that have a relationship with the outcome of the 15th General Election.

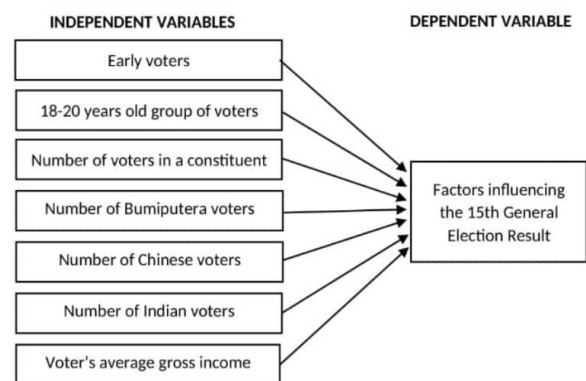


Fig. 1. Theoretical framework

3. Methodology

There are various methods that can be used for the collection of research data. For this study, researcher using the information as reported by the government agencies which are Suruhanjaya Pilihan Raya Malaysia (SPR) and Jawatankuasa Pemandu Banci, Jabatan

Perangkaan Malaysia (DOSM). For the information related to the General Election's result, the numbers of voters and classification of voters has been collected from the SPR's report on General Election 15th. For the population and average gross income data has been accumulated from the latest DOSM's official report. All the data used in this study is reliable and valid as all the information used is fully gathered from government official websites and publicly available report. This is supported by James et al., (2018), that the data from the government is credible especially for the non-performance data.

From the data collected, researcher has classified the parliamentary seats wins by PN and PH based on Table 1. The parliamentary seats win by both coalitions is the same with both have 71 parliamentary seats in Peninsular Malaysia. Researchers did not apply sampling method in this study. 100% populations of 142 parliamentary seats have been selected for this study. The data has been analysed using SPSS Statistical Software (SPSS) by computing the significance level and the relationship between the chosen Member of Parliaments and the characteristics of the voters.

Table 1. Parliamentary seats by states

States	PN	PH
Johor	2	15
Kedah	14	1
Kelantan	14	-
Melaka	3	3
Negeri Sembilan	-	3
Pahang	7	2
Pulau Pinang	3	10
Perak	10	11
Perlis	3	-
Selangor	6	16
Terengganu	8	-
Wilayah Persekutuan Kuala Lumpur dan Putrajaya	1	10
	71	71

4. Result and Discussion

The findings of this study are solely based on the secondary sources which is the official report issued by SPR and DOSM. Researcher has classified PN as "1" and PH as "2" for the parliament seats items to run the result using SPSS. The descriptive analysis of the parliamentary seats is as Table 1.

Table 2. Descriptive analysis

Items	N	Min	Max	Mean	SD
Parliament seats	142	1	2	1.500	.5017
Early voters (%)	142	-	0.13	0.123	.0201
18 – 20 years old voters (%)	142	0.02	0.10	0.633	.0133
Total numbers of voters	142	38,686	303,430	111,741	45963
Bumiputra (%)	142	16.90	99.60	69.60	22.62
Chinese (%)	142	0.20	72.90	22.75	18.87
Indian (%)	142	-	26.00	6.93	5.859
Average gross income (RM)	142	3,579	20,521	7,342	2,790

Referring to Table 2, all the output collected is for 142 seats of parliaments at Peninsular Malaysia. There are at least one parliamentary seat wins by both coalitions based on the minimum number shown in the statistics. For the early and 18-20 years old voters, the population has been computed using the percentage of the respective voters to the total number of voters in each parliament. There are a very minimum number of both early and 18-20 years old voters as the maximum percentage of population is within the range of 0.10% to 0.13%.

There is also at least one parliament that do not have any early voters. For the total of voters, the range of voters for all 142 seats is between 38,686 to 303,430 numbers of voters. From all population of voters in Peninsular Malaysia, majority race is Bumiputra, followed by Chinese and the least population is Indian. There is also at least one parliamentary seat that has no Indian voters. For the average gross income, the gross income of the voters for all parliamentary seats is within the range of RM 3,579 to RM 20,521.

From the descriptive analysis in Table 2, researcher has run a Pearson Correlations analysis to determine the relationship between the parliamentary seats wins by the coalition with the five factors examine by this study which are percentage of early voters, percentage of 18-20 years old voters, numbers of voters, race and average gross income. According to Taylor (1990), the r s value is used to determine the strength of the correlation coefficient for each factor. The level of correlation coefficient can be simplified as in Table 3.

Table 3. Interpretation method of mean score

Pearson Correlation (rs)	Level
< .35	Weak
.36 to .67	Moderate
.68 - .90	High
.90 – 1.0	Very High

There is a positive and negative correlation. Positive correlation shows a linear impact while negative correlation shows an inverse impact between the factors and the variable tested. Correlation which is the value near to 1.0 is considered high while no relationship shows. But, before analyse the relationship level, researcher has to analyse the level of significance (p) for each factor with the parliaments seats wins by the coalition.

Based on Table 4, researcher has found that all factors have a significant relationship with the parliamentary seats wins by the coalition except for the percentage of early voters. The percentage of early voters which the p-value that above 0.05 is consider insignificant factors for this study.

Table 4: Pearson correlations for factors studies and parliaments seats win

Factors	Significant Value (p)	Pearson Correlation (rs)
Early voters (%)	.740	.037
18 – 20 years old voters (%)	.009	-.217
Total numbers of voters	.000	.412
Bumiputra (%)	.000	-.805
Chinese (%)	.000	.770
Indian (%)	.000	.642
Average gross income (RM)	.000	.562

Note: Correlation is significant at the 0.05 level (2-tailed)

As it is not significant, the correlation level for this factor will be excluded in the findings. Hence, the result shows that the H1 below is not valid:

H1: Higher the number of early voters will lead to the win of PN as a member of caretaker's government.

For the 18-20 years old voters, it shows a negative relationship with the seats won by the coalition. Higher the number of this group of voters is highly lead to the win of PN. This result shows that H2 is accepted. Even though the level of impact is .217 classified as weak, the results show that there is an impact due to the implementation of the voters below 21 years old. This is in-line with the study done by Zhang et al., (2022) that shows a positive little impact of the youth voters towards the Perikatan Nasional.

The number of voters represented the H3 which stated that higher number of voters will lead to the win of PH. This hypothesis is accepted as proven by the result that shows moderate correlation of .412 between the numbers of voters and the parliamentary seats win by the coalition. The chances of the parliamentary seat winning by PH is higher when the number of voters is higher. The geography factor which shows that the urban area has higher population than the rural area (Masron, Yaakob, Ayob, & Mokhtar, 2012) is one of the keys for the winning of PH. Other than that, Jan (2018), has mentioned that the relatively higher mixing of the races and in urban seats is also one of the factors of the wins of PH. Even some of the urban seats have a collectively higher percentage of non-Bumiputra.

This is supported by this study that also shown that the higher number of Chinese and Indian voters leads to the winning of PH with rs value of .770 and .642 which is consider as a high impact. Hence, the hypothesis H4 and H5 are accepted. This is also the same impact due to urbanization which led to the mixing of the races. Based on the list of the cities issued by the Ministry of Housing and Local Government in 2022, out of 32 local government which is classified as city, only 4 cities win by PN which represented only 12.5%. However, this trend is expected by analyzing the result of the past two General Elections held on 2008 and 2013. However, Govindasamy et al., (2018), stated that this is not only because of the mixing races, but the urban voters are also concerned on the personality of the candidates.

Aside to that, the Bumiputra is still represents the highest number of voters in Malaysia. Based on the analysis done by the researcher, there are only 26 parliamentary seats that has a minority percentage of Bumiputra which represented 18.3% of the 142 seats wins by PN and PH in Peninsular Malaysia. In addition, none of the 26 seats were won by PN. However, for the states that has a percentage of Bumiputra more than 80% which are Kedah, Kelantan, Pahang, Perlis, and Terengganu, PN has wins 93.8% parliamentary seats in General Election 15. This is in line with the H4 that stated the higher number of Bumiputra voters will lead to wins for PN. And this study shows that the correlation is high with a rs value of .805. Mohamed et al., (2017), stated that emotion and anxiety is one of the factors that impact the choices of the voters. While non-Bumiputra voters tend to vote for PH due to the reform of racial hierarchy promised by the leader of PH, Bumiputra is tend to vote PN for the status-quo of Bumiputra (Ostwald, & Oliver, 2019).

This is because PH is always being relate to the largely Chinese party, DAP which was seemed to control the agenda and the policies of the government after GE-14 (Dettman, 2020). Study done by Saat (2019) shows that PH is losing their way to communicates with the Bumiputra voters while PN-PAS struggling to obtain votes from the highly multiracial seats.

The average gross income is highly related to the stratum of the demographic of the parliaments. Report issued by Economic Planning Unit of Malaysia in 2022 shows that the monthly average gross income in Malaysia from 1970 until 2019 proved the urban's income is always higher than rural's income. Then, the correlation of average gross income of .562 which is considered moderate is also influenced by the population of races in each urban and rural seat. From the findings above, all hypothesis as per below is accepted:

H2: Higher the number of 18-20 years old group of voters is highly lead to the win of PN

H3: Higher number of voters will lead to the win of PH

H4: Higher number of Chinese voters leads to the winning of PH

H5: Higher number of Indian voters leads to the winning of PH

H6: Higher number of Bumiputra voters leads to the winning of PN

H7: Higher voter's average gross income leads to the winning of PH

5. Conclusion

Based on this study, out of 7 characteristics that has been examined, 6 of it have a significant impact on the result of the General Election 15. While 18-20 years old and bumiputra voters leads to the win of PN, other factors have led to the win of PH. As the result of latest general election shown a balance seat of both coalitions at Peninsular Malaysia, the seats from Sabah and Sarawak will be the decider seat for any coalition to form a government. Hence, future research may analyse the characteristics of voters in Borneo. Other than that, this study proved that each main race in Peninsular Malaysia have the tendency to vote for the coalition that they believe will give benefits to their race. If this trend of voters keeps to continue for a long term, it will lead to the division of races in Peninsular Malaysia. It is not in-line with the aspiration of Malaysia.

In addition, all coalition should reform their approach to ensure that they can be accepted by all races without compromised their principles. As a limitation, this study using a latest official report of the government which may not considering other subjective factors on the ground.

Acknowledgement

This research is fully supported by Politeknik Mukah especially the top management and head of department. The research results are hoped to help the public, political parties, or activist to understand the current political situation in Malaysia. This is important as the formation of the government is based on the achievement of all coalitions in the election.

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Graphical User Interface for A Risk Assessment Against Lightning Protection System in Malaysia

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This paper presents the general risk assessment calculations based in Malaysian Standard, Protection against lightning-Part 2 (MS IEC 62305-2:2007) using MATHLAB - Graphical User Interface (GUI). A GUI application was developed to calculate the general risk assessment concerned and compare it with the tolerable risk. All parameters' values and calculation techniques used in (MS IEC 62305-2:2007) are available to the user. The parameter value used to calculate the risk assessment was guided in the program. This paper also provides the capability to evaluate new risk assessment after selecting the appropriate class of lightning protection system. The selection of the protection level would result in reducing the risk assessment, thus protecting the structure, power line and telecommunication lines.

Keywords: - Malaysian Standard, Graphical User Interface (GUI)

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1. Introduction

Lightning is a natural occurrence which can be fatal to humans and destroy service and property. In nations like Malaysia that have a high number of lightning flashes, the effect is more noticeable (Abulaban & Siow, 2021). Malaysia witnessed 100 to 140 days of lightning on average of each year with 600000 to 1300000 of lightning strikes (Rahim et al., 2016). Lightning flashes may cause fatalities, injuries, damage to the structure and connected service as well as failure in electrical system due to over voltages. Besides that, there have been documented losses of RM250 million in Malaysia because of communication failure, structural and equipment damage, and system downtime (Ab-Kadir, 2016). Hence there is a risk assessment against lightning protection system. Assessing the danger lightning to structures is the main goal of lightning risk assessment (Abulaban & Siow, 2021). Furthermore, risk assessment findings can confirm the adequacy of the lightning protection level used by

considering the building's installations and various parameters (Kasza & Kovacs, 2019).

The risk assessment present in this paper is based on the Malaysian standard of protection against lightning (MS IEC 62305-2:2007). This paper implements the general risk assessment of MS IEC 62305-2:2007 determining the necessity of protection measures and evaluates the risk components concerning the structure, power line and telecommunication line. Furthermore, the aim of this study is to devise a system that can aid users in conducting risk assessment by allowing them to input the necessary parameters through MATLAB -Graphical User Interface (GUI). Once the user has entered these parameters, the proposed system will carry out the risk calculations in accordance with the standard guidelines. This paper suggests the use of MATLAB- Graphical User Interface (GUI) to assist users in comprehending and evaluating risk assessment of buildings with the intention of raising awareness of the risk faces by the user.

2. Literature Review

Graphical User Interface (GUI) in MATLAB have surpassed all other types of user interfaces for engaging with computing system (Oulasvirta et al., 2020). It helps the user to determine the risk of building by entering the parameters needed. It is important to build user friendly risk assessment against lightning to evaluate the total risk concern.

The current lightning risk assessment technique is based on IEC62305-2, which is a comprehensive and practical lightning risk assessment system. Lightning risk assessment is a type of assessment technique that includes a comprehensive risk calculation for casualties (Yu & Ren, 2014).

As per MS IEC 62305-2:2007, the choice to safeguard the structure or service and the selection of protection measures must be made by the following subsequent procedure:

- Identification of the object that requires protection along with its specific characteristic.
- Identification of all forms of loss associated with the object and assessment of corresponding risk.
- Evaluation of risk.
- Comparison of the evaluated risk with the tolerable risk to determine the necessity of the protection.

The lightning current is the primary source of damage. The sources of damage on lightning affect are the flashes to the structure, near a structure, to the service and near a service. The type of loss that may appear depends on both the physical and content properties of the thing. Along the way to protect the structure, power line and telecommunication line, there are many criteria's concerns to complete the calculation of risk assessment. The length, width and height of the building are very important to calculate the collection area for the structure. The length of the cable in power line and telecommunication line is also important to define the collection area to the power line and telecommunication line.

Lightning protection is built into buildings as part of the development process (Syakura et al., 2019). It is a system function to reduce the effect of lightning strikes especially to the power lines and telecommunication lines. There are two types of lightning protection systems, which are the air termination system and down-conductor system.

An arrangement of sacrificial conductors called an "air termination system" is put up to serve as a preferred attachment point to lightning strikes, protecting the protected structure (Adekita & Rock, 2020). The air-termination system of a lightning protection system is function to prevent uncontrolled lightning strikes to the structure to be protected. The appropriate dimensioning of the air-termination systems can reduce the effect of lightning strike. The rolling sphere method is the universal method to determine the arrangement and the sitting of the air-termination systems.

Table 1. Classification of the lightning protection system and radius of the rolling sphere

Max building height		
LPS	Radius of the rolling sphere (r)	Mesh size (M)
Class I	20m	5 x 5 m
Class II	30m	10 x 10 m
Class III	45m	15 x 15 m
Class IV	60m	20 x 20 m

The down conductor system is a part of external Lightning Protection System (LPS) which directs the current from the lightning strike to the ground when lightning hits the structure (Ariffen et al., 2019). The quantity of down conductors required is contingent upon the perimeter of the external edges of the roof and its projection on the ground surface.

Table 2. Typical values of the distance between down conductors and between ring conductors according to the type of lps

Class of LPS	Typical distance (m)
I	10
II	10
III	15
IV	20

3. Methodology

The aim of this paper is to provide an easier way to perform risk assessment against lightning that are outlined by MS IEC 62305-2:2007. This is achieved by employing a MATLAB – based Graphical User Interface (GUI) which allows users to access all the relevant parameters, values and calculation method specified in the standard. This tool provides the capability to evaluate the total risk components concerned and compare it with the recommended tolerable risk. Furthermore, this project also would recommend solving the problem regarding the total risk components higher than tolerable risk.

a. Risk Assessment

The destruction caused by lightning can be confined to a section of the structure or it may affect the entirety of the structure. In addition, it may impact the internal system that is linked to the structure's service. The resulting loss from each type of damage may vary depending on the object being protected. A lightning flash may cause damage depending on the characteristics of the object to be protected. The risk, R1 is the value of a probable average annual loss. The pertinent risk components must be defined and calculated to assess risk. However, this project only considers the risk component for a structure due to flashes to the structure, power line and telecommunication line.

Step 1

The computation of pertinent quantities entails determining the collection of area structures and lines. The calculation area is defined as the region of intersection between the ground surfaces and a straight line having a slope of 1/3 which passes through the upper portions of the structure (touching it there) and rotates around it.

The calculation of collection area involves the structure, Ad , power lines, $AI(P)$ and telecom line, $AI(T)$. The collection area to the structure, Ad , power line, $AI(P)$ and telecom line, $AI(T)$ can be calculated by using this formula (Malaysia & Standard, 2012):

$$Ad = [Lb \times Wb + 6Hb \times (Lb + Wb) + \pi \times (3Hb^2)] \quad (1)$$

$$AI(P) = \sqrt{\rho \times [Lc \times 3Hb]} \quad (2)$$

$$AI(T) = 6Hc \times [Lc - 3Hb] \quad (3)$$

Where Lb is the length of structure, Lc is the length of cable, Wb is the width of structure and Hb is the height of structure.

Step 2

The average yearly count of perilous incidents caused by lightning strikes on a safeguarded object is reliant on two factors which is the physical characteristics of the object and the level of thunderstorm activity in the area where it is situated. To derive the numerical value of this count N it is commonly practiced multiplying the lightning ground flash density Ng by collection area of the structure. The value of lightning flash density is fixed to 20 per km² per day and it is suitable value for the condition of lightning occurrences in Malaysia (Malaysia & Standard, 2012). Additionally, the location factor, Cd will be considered to adjust for the relative position structure whether it is situated in an exposed area or surrounded by other objects.

The number of flashes due to the structure, ND , power line, $NL(P)$ and telecom line, $NL(T)$ can be calculated by using this formula:

$$Ad = ND = Ng \times Ad \times Cd \times 10^{-6} \quad (4)$$

$$NL(P) = Ng \times AI(P) \times Cd(P) \times Ct(P) \times 10^{-6} \quad (5)$$

$$NL(T) = Ng \times AI(T) \times Cd(T) \times Ct(T) \times 10^{-6} \quad (6)$$

Where Ad is the collection area to the structure, $AI(P)$ is the collection area to the power line, $AI(T)$ is the collection area to the telecommunication line, Ng is the lightning flash density, Cd is the structure location factor, $Cd(P)$ is the power line location factor, $Cd(T)$ is the telecommunication line location factor and $Ct(P)$ is the transformer factor.

Step 3

The pertinent risk components need to be specified and calculated to assess the risk calculation to be made on the need for protection. The risk to the structure, RB is the component related to the physical damage caused by dangerous sparkling inside the structure triggering fire or explosion, which may endanger the environment. On the other hand, the risk to the line, RV pertains to the

physical damage (such as fire or explosion caused by hazardous sparking between external installations and metallic components usually at the point of entry of the line into the structure) resulting from the lightning current transmitted through the incoming services.

The number of risks to the structure, RB , risk to the power line, $RV(P)$, risk to the telecom line, $RV(T)$ and total risk, R can be calculated by using this formula:

$$RB = ND \times PB \times hz \times r\rho \times rf \times Lf \quad (7)$$

$$RV(P) = NL(P) \times Pv \times hz \times r\rho \times rf \times Lf \quad (8)$$

$$RV(T) = NL(T) \times Pv \times hz \times r\rho \times rf \times Lf \quad (9)$$

$$R = RB + RV(P) + RV(T) \quad (10)$$

Where R is the total risk, RB is the risk to the structure, $RV(P)$ is the risk to the power line, $RV(T)$ is the risk to the telecommunication line, ND is the dangerous event to the structure, $NL(P)$ is the dangerous event to the power line, $NL(T)$ is the dangerous event to the telecommunication line, hz is the special hazard, $r\rho$ is the reduction factor, rf is the risk of fire and Lf is the loss by physical damages.

The tolerable risk, Rt use in this project is 10^{-5} . So, when the total risk is greater than tolerable risk, the system needs protection. There are four levels of Lightning Protection Level (LPL) which is class 1, 2, 3 and 4. The maximum values of lightning parameter relevant to LPL must not exceed with a probability of 99%, they are reduced to 75% for LPL 2 and to 50% for LPL 3 and 4. The minimum peak current respectively for LPL 1(3kA), LPL 2(5kA), LPL 3(10kA) and LPL 4(16kA) lead to the rolling sphere radius equal to 20, 30, 45 and 60 m (Malaysia & Standard, 2012).

Every level of lightning protection system will result in a different value of probability of physical damage to a structure, PB . The values of probability PB depends on the protection measures to reduce physical damage of the structure. Furthermore, the protection measures also would reduce the value of probability of physical damage to the power line and telecommunication line, PV . Table 3 shows the new values of PB and PV after selecting the level of lightning protection. The structure not protected with lightning protection system will have value of PB and PV as 1. In a country with high lightning flash density, the suggestion of the best lightning protection level was LPL 1. LPL 1 can protect the smaller zone of the structure. In fact, LPL 1 has the lowest minimum peak current which is more secure compared with others. When there is a lightning strike, LPL 1 could require at least 3kA to protect the structure and the system.

Table 3. Values of PB and PV depending on the protection measures

Characteristic of the structure	Class of LPS	P_B & P_V
Not protected by LPS	-	1
Protected by LPS	IV	0.2
	III	0.1
	II	0.05
	I	0.02

The process in calculating the risk assessment of the building is clearly explained in Fig. 1. The tolerable risk, R_t for this work is 10-5.

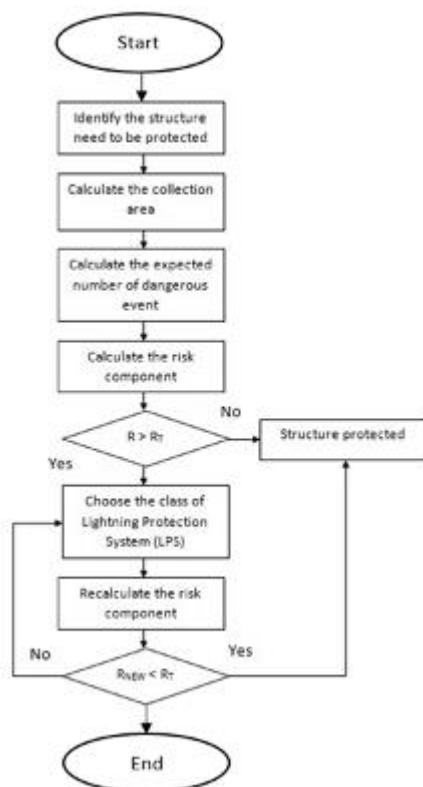


Fig. 1. Flowchart of risk assessment

b. Graphical User Interface (GUI)

Graphical User Interface (GUI) in MATLAB is an illustrative interface to a program which can generate progress that easy to use by proffering them with a consistent appearance and with intuitive controls like pushbutton, edit text, static text and many more. There are four components that are required in creating this GUI project. The elements are:

i. Pushbutton

Push buttons are a function to generate an action when clicked. For example, the calculate button might calculate the equation written in the programming language. When the users click a push button, it will calculate and show the answer in the edit text.

ii. Edit Text

Edit text is the component that enables users to enter or modify text strings. These edit texts also function to act as display for the push button.

iii. Static Text

Static text controls display lines of text. Static text is typically used to label other controls, make a description, or indicate equations associated. Users cannot change static text interactively.

iv. Axes

Axes enable your GUI to display graphics such as graphs and images. Like all graphics objects, axes have properties that you can set to control many aspects of their behavior and appearance.

Fig. 2 shows the development in calculating risk in MATLAB-GUI. At the end of the program, if the risk assessment is higher than tolerable risk, the user will choose the level of lightning protection system to reduce the risk and protect the structure against lightning.

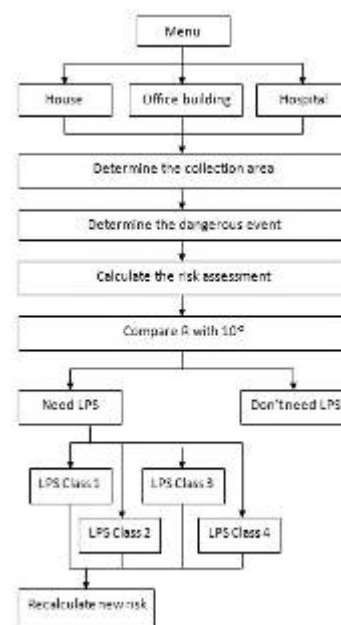


Fig. 2. Block diagram for whole structure in GUI

4. Result and Discussion

It was clearly stated in the previous session that risk assessment should be done to determine whether the building need protection or not. If the risk component concern is higher than tolerable risk, the building needs protection. Fig. 3 shows the menu for this project. The user needs to enter the name of the building and choose the type of building correctly. Fig. 3 shows that the user enters "BAIT AL-HUSNA" as the name of the building and chooses "HOUSE" as the type of the building.



Fig. 3. Main menu

The next slide is called Collection area calculation which the user will see the “Step 1”. There is the collection area calculation to the structure, power line and telecommunication line. The details of the input data from the user were shown in Fig. 4. The user enters the length, width, and height to the structure as 15, 20 and 6m. The answer of collection area to the structure, A_d is 2578.01 m². The user also enters the length of power line as 1000 m and the answer is 21957.5 m². Then, the user fills the length of telecommunication line and height as 1000 m and 6 m and the answer is 35352 m². The results of the calculation were saved in m-file. The saved data then imported to the next slide which the expected annual number of dangerous events slides.

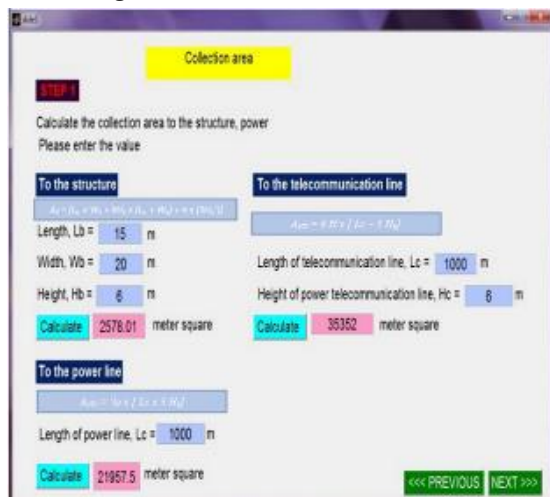


Fig. 4. The collection area calculation

Fig. 5 below shows the calculation of dangerous events to the structure, power line and telecommunication line. For the structure, the user enters the location factor, C_d as 1 and the result of the calculation is 0.0386701 per year. The selection of the location factor was detailed when the user clicks “Table C_d .” In calculation of power line, the user enters the location factor, $C_d(P)$ and transformer factor, C_t as 1 and 1. The answer for the power line is 0.329363 per year. For the telecommunication, the user

enters as 1 for the location factor, $C_d(t)$ and the result is 0.53028 per year. All the answers were also saved in m file and the answer was imported to the next slide which is the slide of step 3.



Fig. 5. Calculation of dangerous event

Fig. 6 below shows the calculation of risk assessment. In this slide, the user needs to decide whether the protection of the building is necessary. If the total risk assessment is higher than tolerable risk (0.00001) then the user is recommended to get the protection of the building. All the input parameters for special hazard, fire protection, risk of fire and loss by physical damage are 1, 1, 0.001 and 0.1. The value of the input parameter is the same for the structure, power line and transmission line. From Fig. 6, the total risk component is 8.9631×10^{-5} . This condition does not comply with the tolerable risk, R_t . So, the building needs protection. The user must click “YES” to continue.



Fig. 6. Calculation of total risk

The last slide of this project is shown in Fig. 7 which is the slide for selection of protection level. When the user clicks each of the classes of LPS, the message box will appear to show the characteristic of each class. Each of the classes would result in a different value of probability of physical damage for the structure, power line and telecommunication line. From Fig. 7, the user chooses class 2 of LPS which gives the new value of probability of physical damage of 0.05. Thus, the user can recalculate the new risk assessment which is 0.00000449. The new risk assessment now is less than the tolerable risk. So, the building now is protected which reduces the damage and loss due to lightning flashes.



Fig. 7. Selection of LPS

5. Conclusion

In conclusion, the use of MATLAB - Graphical User Interface (GUI) facilitates the risk assessment process for lightning protection systems in buildings. By providing users with a mean to input relevant parameters, the proposed system can calculate the level of risk associated with lightning strikes and suggest appropriate protection measures to mitigate the potential damage and loss. Adhering to the Malaysian Standard on protection against lightning is crucial in ensuring the safety and protection of structures, power lines and telecommunication lines. Implementing such standards can aid Malaysian users in assessing and reducing the risk of lightning strikes on buildings.

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Investigating the Impact of Student Participation in a Decentralised Virtual Laboratory on the Practical Learning of Open-Source Operating System at Politeknik Mukah

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Full Paper

Article history

Received

24 July 2023

Received in revised form

24 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

The decentralised virtual laboratory approaches are advantageous from an economic and administrative standpoint, and they have also been demonstrated to be a viable alternative for delivering practical learning, enhancing student achievement, and improving learning outcomes. Using the decentralised virtual laboratory approach, students can perform laboratory tasks on their own laptops or workstations at any time, location, and pace. Type-2 or hosted hypervisors are important virtualization technologies for the strategy because they allow several virtual machines to run concurrently on the host computer. Students participating in this study deploy Oracle VM VirtualBox, which is mostly hosted on Windows machines, to perform Linux administrative tasks or activities. A descriptive study of the students' post-responses leads to an investigation of their perspectives and acceptance of the approach. The primary factor that defines the effectiveness of the solution is the extent to which the approach helps students better comprehend the concept. This study concludes that the approach provides strong support for the hypothesis that participation in a decentralised virtual laboratory has a positive effect on students' perceptions of and motivation for hands-on learning. This method can continue to be adopted because it has a beneficial effect on students' decisions to continue their majors and study plans at Politeknik Mukah.

Keywords: - Virtualization technology, practical learning, open-source operating system, Linux

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1. Introduction

Wang et al. (2015) claim that learning in a virtual environment is increasingly important. This is because learning outcomes in virtual environments can determine and describe the abilities of students directly. According to W. I. Bullers, Burd, and Seazzu (2006), virtualization technology has proven to be extremely beneficial in the case of practical courses. The technology also substantially supports the utilisation and improves the manageability of the traditional laboratory (Koratagere et al., 2023; Stackpole, Koppe, and Guay, 2008; Ruth, 2013).

The use of virtualization technology in education during the COVID-19 pandemic has become an essential tool for remote learning (Affounh et al., 2021; Alvarado-

Silva et al., 2023). The studies revealed that virtualization technology allows for synchronous and asynchronous learning, which provides flexibility for students and educators.

The hosted or type-2 hypervisor is an important virtualization technology in education because of the meaningful features to facilitate the teaching of different practical courses. This technology requires a host operating system to be installed beforehand. To enable users to run multiple guest operating systems in their own application window, at the top of the host operating system there is a software layer called hypervisor or virtual machine manager. Chen et al. (2011) found that by employing a decentralized virtualization model they could provide students with the opportunities to learn and practice the skills they need to succeed in the real-world.

1.1 Background

With the availability of the free and open-source Oracle VM VirtualBox software, students can run virtual machines on their computers to complete laboratory exercises (Li, 2009). Although Windows is a host operating system, it has reliable support for Linux as a guest operating system and many types of proprietary operating systems (Sayler, Grunwald, Black, White, & Monaco, 2014).

Previous studies have found that VirtualBox enables educators to create easily distributable decentralised virtual laboratory environments. However, we must also investigate the motivation and perceptions of students regarding perceived learning. Specifically, whether students are motivated to participate in a decentralised virtual laboratory and whether they find working with the environment an appealing aspect of practical learning.

Students participating in the decentralised virtual laboratory are evaluated on aspects of their professional demeanour and technical skills, including critical thinking and teamwork. The study can also provide information on whether this new approach has a positive effect on students' major studies, including their future course selections.

1.2 Research Objectives

The main goal of this research is to investigate the implementation of the decentralised virtual laboratory through VirtualBox, a distributed hosted (type-2) hypervisor solution. This paper will focus on the research question, "Are students motivated by participating in a decentralised virtual laboratory and finding that working in the environment is an interesting aspect of learning computing?" Hence, this paper will discuss the following objective: to evaluate the impact of student participation in a decentralised virtual laboratory on the practical learning of the open-source operating system course at Politeknik Mukah.

1.3 Research Scopes

This study focuses on the model of the virtual laboratory that is customised to the course's and instructor's needs. At Politeknik Mukah, students enrolled in the DFN30053 Open-Source Operating Systems course (previously known by the code DFN4023) participated in the study.

2. Literature Review

A computer laboratory employed virtualization technologies as early as 2002 (Stockman, 2003). However, due to the high cost and unproven dependability of x86 virtualization technology, it has not been widely implemented in education or industry until more recently. Various courses have successfully

included practical learning using a virtual laboratory during the past few years.

In 2016, Potkonjak et al. (2016) reviewed the most recent stage in the progress of virtual laboratories and virtual worlds in various fields, including science, technology, and engineering. Virtualization technology provides a cost-efficient way for education institutions to organise high-quality practical tasks in related disciplines. This technology increases the flexibility of a virtual laboratory by allowing for the creation of various hands-on activities involving various components. A virtual laboratory allows students to modify system configuration that regularly cannot be changed in a real system, as well as damage resistance.

2.1 Practical Courses Learning

In virtual laboratories, virtualization technology is frequently used to deliver immersive computer science and information technology education. Particularly in the learning of operating systems or system administration (Vollrath and Jenkins, Adams and Laverell, 2005; Nieh and Vaill, 2006; Ruth, 2013), computer networks and administration (Nakagawa et al., 2003; Steffen, 2004; Nabhen and Maziero, 2006; Bower, 2010; Chen et al., 2010; Mok, Lee, and Tan, 2012), and network security (Mamajonov & Abdunazarov, 2023; P. Li et al., 2008; Wu, 2010; Zaki et al., 2010; Peltsverger and Zheng, 2013; L. Xu, Huang and Tsai, 2014; Xu et al., 2014; Wang et al., 2015). The type-2 hypervisor has also been used in teaching software engineering (Sommerville, 2013; Ma et al., 2014) and database administration (Cranitch and Rees, 2009; Ruth, 2013).

From an educational perspective, the hosted (type-2) hypervisor technology becomes the main selection or dominates most cases (Bower, 2010). The main factor is due to security concerns as well as facilitating administrative matters when a host operating system is used. Virtual machines run on host machines are user-level processes and do not have privileges to affect host operating systems. Thus, even if the user is logged in as administrator (called root or superuser in a Linux system) on a virtual machine, they have no special ability to engage in malicious activities or to do harm to the host computer or the network.

VMware Workstation Player and Oracle VM VirtualBox are the two main free (no-cost) desktop software packages for running virtual machines (Li, 2009; Bower, 2010; Xu et al., 2014; Hale et al., 2016; Hamdani and Utama Siahaan, 2016). For each virtual machine on both platforms, the virtual disc drive is just an image file to represent a drive that has different guest operating systems. They feature a virtual network to support network adapters, including a bridge, network address translation (NAT), and an internal network. Users can view, configure, save, start, and stop virtual machines in both software packages.

2.2 Decentralised Virtual Laboratory Approach

Li (2010) classifies laboratory virtualization techniques as either centralised or decentralised. Li, Jones, and Augustus (2011) discuss the use of VMware Workstation and Oracle VM VirtualBox in the development of several types of virtual laboratories from the perspective of higher education. However, a centralised remote laboratory strategy is not the optimal answer for us due to the high expense of building, deploying, and maintaining a data centre. This type of distribution also requires that every student has access to high-speed Internet in any place (Li, 2009).

Studies on the decentralised virtual laboratory have determined the approach's advantages over the deployment of a centralised laboratory. By utilising a decentralised virtual laboratory approach, it might offer students the chance to study and practise the skills necessary for success in the actual system (Mitra & Gupta, 2020; Vollrath and Jenkins, 2004; Nieh and Vaill, 2006; Li, 2009; Ruth, 2013; Ma et al., 2014; Seeling, 2014; Wang et al., 2015). Generally, these methods include the arrangement of many virtual machines for distribution to students. Students are then able to complete laboratory tasks on their own computers or workstations. Students must understand how to configure the hypervisor so that virtual computers can be organised into a virtual network.

3. Research Methodology

There are two sets of research hypotheses investigated in this study that correspond to the research objective. Each set has a null and an alternative hypothesis:

H_{10} : Student participation in a decentralised virtual laboratory has no impact on student motivation to study the Linux operating system.

H_{1a} : Student participation in a decentralised virtual laboratory has a positive impact on student motivation to study the Linux operating system.

H_{20} : Student participation in a decentralised virtual laboratory has no impact on student decisions on major studies and future elective courses.

H_{2a} : Student participation in a decentralised virtual laboratory has a positive impact on student decisions on major studies and future elective courses.

3.1 Data Source

The research was conducted during two semesters at Politeknik Mukah, Sarawak. The participants in this research consisted of a total of 136 diploma students enrolled in open-source operating system courses. One section with 67 students served as the control group, while the other section with 69 students served as the experimental group. The participants will be selected based on the following criteria:

a) Has fundamental knowledge of operating systems and networking connections.

b) Has experience using the desktop environment and basic Linux commands.

However, the participants will be chosen through convenience sampling, which is one of the non-probability sampling methods (Kasunic, 2005).

3.2 Data Collection

The data collection is done during the experiment period by two methods: questionnaire and students' assessment results. The procedures of the experiment in this study were based on three overall steps: conventional laboratory orientation for all students, deployment of a decentralised virtual laboratory for the experimental group, and a post-experiment survey for the experimental group. The same lecturer conducted both groups with the same laboratory topics, which consisted of two parts: practical activities on the real machines (the orientation phase) and decentralised virtual laboratories (the treatment phase).

3.3 Data Analysis

A questionnaire survey was conducted among students that participate in decentralised virtual laboratory (DVL) includes some background information as well as a series of response statements that use a Likert scale. The background information includes student ID, gender, programme, and self-reported Linux system administration ability. The Likert scale uses five points from "strongly disagree" to "strongly agree," with "neutral" as the midpoint value.

The Likert section of the survey consists of three sections: the first section focuses on student perceptions of motivation, the second on student perceptions of learning, and the third on student decisions on major studies and future elective courses. Individual pre- and post-survey responses are not matched when post-experiment surveys are administered. Tables 1 to 3 show each of the three types of questions. The Likert scale responses were converted to ordinal numbers between 1 and 5, with 1 representing "strongly disagree" and 5 representing "strongly agree."

Table 1. Set of questions about students' perceptions of motivation

Item ID	Description
VL 1	Participating on the DVL gives me a better appreciation for the usefulness of virtualization technology.
VL 2	I have a greater awareness of the potential for virtualization technology to benefit practical learning due to participating on the DVL.
VL 3	I wanted to involve on the DVL because I want to share to the people the benefit from the virtualization technology.
VL 4	Participating in the DVL inspires me to use my computing skills to help others.
VL 5	Knowing that my involvement will help to improve learning approach motivates me to do my best on the DVL.
VL 6	Working in groups in DVL utilizing a virtual laboratory has increased my interest in computing.
VL 7	I enjoyed working on the DVL because it allowed me to perform the laboratory tasks in any machine without the

	need to install the platform/software.
VL 8	Participating on the DVL project increases my interest in open-source technology.
VL 9	I enjoyed participating on the DVL because the project can positively impact the preparation and completion of my laboratory tasks.
VL 10	Participating on the DVL increased my confidence in my computing ability.
VL 11	Participating in the DVL environment made me more comfortable with computing.

Table 2. Set of questions to assess student perceptions of learning

Item ID	Description
LA 1	I can list the administrative systems plan for Linux system in a real-world environment.
LA 2	I am comfortable that I could manage and performing Linux system configuration in a virtual environment.
LA 3	I can list the steps in the installation process of Linux operating system.
LA 4	I can describe the configuration files of various services in various Linux distribution system.
LA 5	I am sure that I can actively practice more on command-line interface (CLI) utilizing commands to perform tasks in Linux.
LA 6	I have gained some confidence in managing user and local group accounts in Linux.
LA 7	I am confident that I can manage the sudoers settings, ownerships and permissions on files and directories for security reasons in Linux.
LA 8	I can use the appropriate tools and techniques in managing and creating partitions or file systems in Linux.
LA 9	I can manage networks and printers, able to access remotely Linux system via various services (SSH, RDP, VNC).
LA 10	I am confident that I can create and update repositories to manage software packages (install, remove, update) in Linux.
LA 11	I can describe the drawbacks and benefits of Linux distribution system to society.
LA 12	I can describe the drawbacks and benefits of Linux distribution system to business.
LA 13	I can use all tools and techniques employed in a virtual machine to solve problems in the real machine.
LA 14	I can participate in the PBT (Problem-based Task) team's interactions to complete the task in DVL.
LA 15	I can identify when peers are behaving in an unprofessional manner in the DVL.
LA 16	Participation in the DVL has improved my understanding of how to behave like a system administrator.

Table 3. Set of questions to examine the student's decisions on major studies and future elective courses

Item ID	Description
OT 1	Participation in the DVL has caused me to consider networking systems as a major.
OT 2	Participation in the DVL has positively improve my learning outcomes in courses related to networking and system/server management.
OT 3	Participating in DVL has caused me to consider of having a machine with adequate specification for my learning in future.
OT 4	Participation in the DVL has caused me to consider taking further other related courses.
OT 5	The subject matter of this DVL is highly relevant to my future practical learning approach.
OT 6	I have a high level of experience in the DVL subject matter.
OT 7	Overall, I am very satisfied with my learning in the DVL environment.

4. Finding and Analysis

This section describes the data analysis and discussion of the post-survey results. Table 4 provides an overview of all students, including their participation in the decentralised virtual laboratory and the survey (experimental group). Most of the surveys were distributed in hardcopy form in the post-virtual laboratory phase or at the end of the project, which may have contributed to the high average response rate of 98.57%.

Table 4. Summary of student population

Num. of Students	Control	Experimental	Administered	Num. of Surveys	Response Rate
137	67	70	69	69	98.57%

4.1 Student Motivation

From Table 5, a mixed picture is presented by the responses to survey items related to the student motivation of a decentralised virtual laboratory (DVL). The null hypothesis is that the mean height of items is equal to 3 (neutral). In our data, the mean was above 3 for all but one item, VL 9: "I enjoyed participating in the decentralised virtual laboratory because the project can positively impact the preparation and completion of my laboratory tasks," for which the mode was 2.99 (below 3). Therefore, we conclude that the student agrees with the rest of the eight items.

Table 5. Mean, median and mode for item VL 1 to VL 11

Item	Mean	Median	Mode
VL 1	4.71	5.00	5
VL 2	4.67	5.00	5
VL 3	3.28	3.00	3
VL 4	3.22	3.00	3
VL 5	4.72	5.00	5
VL 6	4.48	5.00	5
VL 7	4.74	5.00	5
VL 8	4.74	5.00	5
VL 9	2.99	3.00	3
VL 10	3.39	3.00	3
VL 11	3.54	3.00	3

When looking at the survey items related to the impact on student motivation from participation in a decentralised virtual laboratory, the mode for item VL 1, VL 2, VL 5, VL 6, VL 7, and VL 8 is 5. While the mode for the other five items is 3, this includes items VL 3, VL 4, VL 9, VL 10, and VL 11. In addition, the median for six items is 5, including items VL 1, VL 2, VL 5, VL 6, VL 7, and VL 8. The median for items VL 3, VL 4, VL 9, VL 10, and VL 11 is 3.

4.2 Student Perceptions on Learning Impacts

This section includes survey questions pertaining to students' perceptions on the impact of learning, specifically their Linux system administration skills. As shown in Table 6, the survey results indicated a mean greater than 3 for all questions except one, LA 10: "I am confident that I can create and update repositories to manage software packages (install, remove, update) in Linux," which had a mean less than 3. Participating in a decentralised virtual laboratory enables students to acquire administrative abilities, as indicated by the fact that the student agrees with nearly all the claims.

Table 6. Mean, median and mode for item LA 1 to LA 16

Item	Mean	Median	Mode
LA 1	4.10	4.00	4
LA 2	4.62	5.00	5
LA 3	4.77	5.00	5
LA 4	4.10	4.00	4
LA 5	4.54	5.00	5
LA 6	4.83	5.00	5
LA 7	4.07	4.00	4
LA 8	3.72	4.00	4
LA 9	4.67	5.00	5
LA 10	2.90	3.00	3
LA 11	4.12	4.00	4
LA 12	4.09	4.00	4
LA 13	3.97	4.00	4
LA 14	4.12	4.00	4
LA 15	3.33	3.00	3
LA 16	3.87	4.00	4

Based on the responses from the 69 students in a decentralised virtual laboratory, the medians for all items are equivalent to their modes. Items LA 2, LA 3, LA 5, LA 6, and LA 9 had the highest median and mode values of 5. Most items related to Linux system administration ability showed a median and mode of 4, including items LA 1, LA 4, LA 7, LA 8, LA 11, LA 12, LA 13, LA 14, and LA 16. Only two items have a median and mode of 3, which are items LA 10 and LA 15.

4.3 Student Future Plan

As indicated in Table 7, all survey questions pertaining to major and study plan received a mean score greater than four. The student concurs that participation in a virtual laboratory environment motivated them to enrol in another system-related course and continue their networking systems major. Except for one item, OT 7: "Overall, I am very satisfied with my learning in the DVL environment," for which the median was 4, the median was 5 for all other items. The mode of all items exhibiting the same pattern.

Table 7. Mean, median and mode for item OT 1 to OT 7

Item	Mean	Median	Mode
OT 1	4.49	5.00	5
OT 2	4.72	5.00	5
OT 3	4.74	5.00	5
OT 4	4.59	5.00	5

OT 5	4.88	5.00	5
OT 6	4.88	5.00	5
OT 7	4.13	4.00	4

5. Conclusion

The relationships between research outcomes and research objective are summarised in Table 8. All 69 students who have successfully participated in the project have completed the post-survey. The post-survey responses were used to investigate the research objective, which was to identify the impact of student participation in a decentralised virtual laboratory on practical learning. There is strong evidence to support the claim that students agree that participating in a decentralised virtual laboratory has a positive impact and influences their decision to continue their major and study plans. The mean for all items is above 3 (above neutral), while the median and mode are 4 (agree) or 5 (strongly agree).

Table 8. Relationships between research outcomes with research objective

Research Objective		
To evaluate the impact of student participation in a decentralised virtual laboratory on practical learning of the open-source operating system course at Politeknik Mukah.		
Outcome	Remarks	
a) Analysis of the 11 items related to the impact on student motivation in a decentralised virtual laboratory.	Student participation in a decentralised virtual laboratory has a positive impact on student motivation to study the Linux operating system.	
b) The mean above 3 is 10 out of 11 items.		
c) Analysis on the 16 items related to the impact on practical skills and abilities among students in the decentralised virtual laboratory.		
d) The mean above 3 is 15 out of 16 items.	Student participation in a decentralised virtual laboratory has a positive impact on perceived learning related to practical skills.	
e) A study of the seven items related to the impact on majors and study plans of students in a decentralised virtual laboratory.		
f) The mean for all items is above 3.		
	Student participation in a decentralised virtual laboratory has a positive impact on student decisions on major studies and future elective courses.	

Students' perspectives on motivation and perceived learning were mixed. While the overall results appear to indicate that students gain professional experience and are motivated by participating in a decentralised virtual laboratory project, there are some confounding variables in this study. Participation in a decentralised virtual laboratory has no positive impact on the student's preparation and completion of the tasks. In addition, students have difficulties creating and updating repositories to manage software packages (install, remove, and update) in Linux. Besides that, the mean for almost all items in both categories is above 3 (above neutral). For median and mode, there are five items

related to the student's motivation: 3 (neutral), and six items: 5 (strongly agree). Meanwhile, the following are the median and mode for items related to perceived learning: six items have a rating of 5 (strongly agree), while only one has a rating of 4 (agree).

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OBE in Teaching and Learning: Implementation Level Study at Sultan Mizan Zainal Abidin Polytechnic

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Full Paper

Article history

Received

23 July 2023

Received in revised form

23 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Polytechnic Malaysia was first introduced to Outcome-Based Education (OBE) since 2010 to meet the requirements of the Malaysian Qualifications Framework (MQF). The concept of OBE was introduced to replace traditional education. One of the principles of OBE is "curriculum design down" which requires alignment between each level of implementation. Sultan Mizan Zainal Abidin Polytechnic (PSMZA) is one of the polytechnics that strives to cultivate the OBE ecosystem among staff and students. However, PSMZA faces several problems in implementing OBE, such as the lack of clarity regarding the level of the OBE ecosystem that has been implemented in PSMZA, difficulties in identifying lecturers according to departments who need OBE-related workshop courses, and difficulties in setting the focus of the OBE course content for the short term. The purpose of this study was to examine the implementation level of the OBE ecosystem such as planning, delivery and assessment in teaching and learning at PSMZA. This study was conducted as a survey and the research data was analyzed using the statistical software package The Statistical Package for Social Science (SPSS) version 18.0. to obtain the mean and standard deviation as well as significant relationships and differences. The results of the analysis show a high level between the practice of planning, implementation, and assessment of learning at PSMZA, while the correlation analysis shows that there is a significant relationship between the three and there is no difference in the level of implementation of OBE among departments except JTMK in terms of evaluation. In conclusion, the OBE ecosystem has become a culture at PSMZA, but efforts are still needed to overcome some of the problems encountered in its implementation.

Keywords: - OBE, planning, delivery, assessment

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1. Introduction

OBE (Outcome-Based Education) is an education system that emphasizes the results that students want to achieve, not the learning process itself. In this system, the focus is on what students should achieve because of their learning, not on the traditional teaching-learning process. OBE focuses on the achievement of results that can be observed and measured, such as the ability to solve problems, think critically, and work together with someone else. This is different from the traditional education system that emphasizes transcription, tests, and assignments. By

emphasizing the result, OBE is expected to provide students with an education that is more meaningful and relevant to the real world. This system is also expected to improve students' ability to adapt to a changing environment and overcome challenges in the future.

Sultan Mizan Zainal Abidin Polytechnic Action Transformation Plan 2021-2025 stipulates that at least 6 courses or workshops related to OBE need to be planned and implemented throughout the year for lecturers to improve their understanding and improve the practice of delivering the ecosystem-based curriculum of OBE in daily teaching and learning (PSMZA, 2020). The KPI of

these 6 courses or workshops is set since there are 6 study departments here, namely the Department of Civil Engineering (JKA), the Department of Electrical Engineering (JKE), the Department of Mechanical Engineering (JKM), the Department of Information and Communication Technology (JTMK), the Department of Mathematics, Science and Computer (JMSK) and General Studies Department (JPA). Accordingly, PSMZA sets a KPI for all its lecturers to attend at least 1 course or workshop related to OBE.

However, in the process of inculcating OBE, the management of PSMZA faces a vague situation in deciding to set at least 6 courses or workshops related to OBE that need to be planned and implemented throughout the year for the lecturers to be maintained or abolished due to no concrete statement that the OBE ecosystem has become a culture in the curriculum presenter at PSMZA.

Whereas if this KPI continues then there will be difficulties in identifying the target group of lecturers according to the department who need a course or workshop related to OBE and making the OBE course more focused.

The OBE (Outcome-Based Education) ecosystem includes various elements that are interrelated and need to be observed holistically in implementing OBE. Among them include the Learning Outcome itself which is the main aspect in OBE. Learning outcomes must be clearly defined for each course or program. This includes the knowledge, skills, values, and attitudes that students want to achieve. Learning outcomes at Malaysian polytechnics including PSMZA have been clearly defined in the curriculum. The polytechnic curriculum has been redesigned to meet the goals and learning outcomes that have been set since the 2014 version. This curriculum development process has considered the needs of the job market and current technological developments (Rahmat, 2020).

The evaluation element in OBE needs to be focused on the learning outcomes that have been set. Students are evaluated based on their ability to achieve the learning outcomes. Meanwhile, the teaching concept needs to be implemented effectively by using appropriate teaching methods and strategies to achieve the set learning outcomes. Resources and technology need to be provided to facilitate students and lecturers in the teaching and learning process. This includes reading materials, teaching aids, teaching and learning software, as well as online learning platforms.

In terms of competence, lecturers need to be trained and provided with sufficient skills and knowledge in implementing OBE. They also need to understand the concepts of OBE and can facilitate students in achieving learning outcomes. While the students need to be trained to be more proactive in their learning process. They need to understand the concepts of OBE and be able to carry out learning activities independently.

Apart from that, the maintenance of OBE needs to be observed holistically, including monitoring, and improving

the program, as well as improving the quality of teaching and learning.

This study focuses on the OBE ecosystem in terms of the relationship between planning, delivery, and evaluation at PSMZA. Instructional planning means planning appropriate learning activities to achieve the desired learning outcomes. In OBE, teaching planning needs to be done based on the learning outcomes that have been set. Therefore, when evaluating the level of implementation of teaching planning, assessment is done to ensure that the planned teaching activities are related to the learning outcomes set (García-Ramos & Díaz, 2021).

Teaching delivery means carrying out planned learning activities. In OBE, teaching delivery needs to focus on students as the center of learning. Therefore, when evaluating the level of implementation of teaching delivery, assessment is done to ensure that the way the teaching is delivered gives students the opportunity to achieve the set learning outcomes. Among the delivery methods practiced by most PSMZA lecturers, whether they are aware of it or not, is the "Flipped Classroom" concept (Abeysekera, 2015).

Teaching assessment means measuring the achievement of learning outcomes that have been set. In OBE, assessment needs to be carried out based on the learning outcomes that have been set. Therefore, when assessing the level of implementation of teaching assessment, the assessment is done to ensure that the way the assessment is done gives an accurate picture of the level of achievement of the learning outcomes that have been set (Lim, 2020).

Overall, evaluating the implementation level of teaching planning, teaching delivery, and teaching assessment based on the OBE approach means seeing the extent to which the teacher or lecturer has followed the basic principles of the OBE approach in implementing learning activities. This will help ensure that the desired learning outcomes have been achieved by students through effective teaching planning, delivery, and assessment.

Therefore, the objective of this study is to evaluate the level of implementation of teaching planning, teaching delivery and teaching assessment based on the OBE approach and to identify the level of relationship and significant differences in the OBE ecosystem implemented at PSMZA by lecturers based on placement in the department.

2. Methodology

This study was conducted at PSMZA by using research instruments that were distributed to 185 lecturers who had attended the Outcome-Based Education (OBE) curriculum interpretation workshop until August 2022. Of these, a total of 111 (60%) lecturers responded to the questionnaire given.

The questionnaire of this study consists of two main parts. The first part contains questions related to the demographics of the respondents, such as age, gender, teaching experience, education level, and placement in the

department. Meanwhile, the second part contains questions about certain habits or behaviors that want to be studied, namely the level of planning implementation (7 questions), delivery (10 questions) and assessment (10 questions). The results of the pilot test showed a Cronbach Alpha reliability value of 0.870, which means it has good and acceptable reliability.

This study is important because it can provide an overview of lecturers' habits in implementing the OBE curriculum, especially in the aspects of planning, delivery, and assessment of teaching. Findings from this questionnaire can help the management of the institution to make improvements in teaching and learning, as well as strengthen the OBE curriculum to be more effective and provide the best benefits to students. In addition, this study also provides information on the demographics of lecturers which is expected to help the management of the institution in making decisions related to the management of OBE-related training and provision among lecturers.

This study is a qualitative descriptive study where it involves the analysis of mean and standard deviation to assess the level of implementation of planning, delivery and assessment of teaching based on the OBE approach. While the significance analysis to identify the level of relationship and significant differences of the OBE ecosystem implemented at PSMZA by lecturers based on placement in the department. The overview of this study is illustrated in the framework of the study as in Fig. 1.

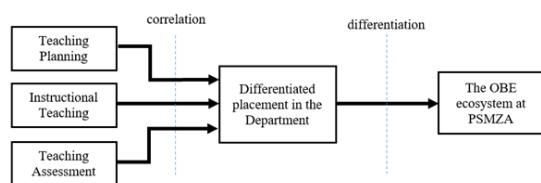


Fig. 1. Framework of the study

Correlation analysis uses the null hypothesis and alternative hypothesis approach. The initial hypothesis statement in this study is as follows:

Null Hypothesis 1 (HO1):

HO1: There is no significant difference in the level of the OBE ecosystem implemented at PSMZA by lecturers based on placement in the department.

Alternative Hypothesis 1 (HA1)

HA1: There is a significant difference in the level of the OBE ecosystem implemented at PSMZA by lecturers based on placement in the department.

The appropriate analysis method to find differences in OBE practices between the departments is inferential statistical analysis, such as the ANOVA (Analysis of Variance) test. The next step is to do further analysis to find out the difference, a post-hoc test is done to find out where the difference lies. In this test post-hoc Tukey model is used.

3. Result and Discussion

3.1 OBE Ecosystem Implementation Level at PSMZA

Based on the findings of the study analyzed descriptively, it can be concluded that the level of lecturers' teaching planning, delivery methods and assessment based on the OBE curriculum in the programs offered at PSMZA is at a high level where the OBE ecosystem can be said to have been implemented comprehensively and in parallel between all three, with each planning with a mean score of 4.19, delivery with a mean score of 4.19 and assessment with a mean score of 4.20. While the standard deviation is 1.02. All the finding as show in Table 1.

Table 1. Min score and standard deviation

Element teaching	Min	S.D	Interpret
planning	4.19	1.02	High
delivery	4.19	1.02	High
assessment	4.20	1.02	High
average	4.19	1.02	High

S.D=Standard Deviation

Based on the data provided, there are several conclusions that can be drawn regarding the respondents' views on aspects of learning and teaching in the context of teaching alignment. In general, respondents have a positive view of teaching alignment with an average value above 4 on all aspects evaluated.

Thus, the conclusion can be made that overall, the lecturer has used effective and appropriate teaching methods in the class. Research conducted by Osman (2014) in Malaysia found that the use of different teaching techniques, such as lectures, group discussions, group assignments, and presentations, had a positive influence on learning outcomes.

Similarly, research by Halai (2018) in Pakistan shows that the use of varied teaching techniques, such as group discussions, assignments, and presentations, can increase learning motivation and student academic performance.

3.2 The Relationship Between the Implementation of The OBE Ecosystem Between the Departments At PSMZA

Table 2 shows the Pearson correlation value and significance (p-value) for three variables: "Mean score for planning", "Mean Delivery Score", and "Mean Assessment score". Each factor is evaluated based on the mean score obtained by each tested factor. In this context, Pearson's correlation measures how strong the linear relationship is between two variables.

Table 2. Relationship of OBE implementation

	Min skor planning	Min Skor delivery	Min skor assessment
Pearson Correlation	0.048	0.088	0.068
Sig. (2-tailed)	0.550	0.423	0.369

Pearson correlation values range from -1 to 1, where a value of -1 indicates a perfect negative relationship, a value of 0 indicates no relationship, and a value of 1 indicates a perfect positive relationship. In the table, all the Pearson correlation values are quite low, i.e., below 0.1, which shows that the relationship between the variables is quite weak.

Table 2 shows the level of implementation of the OBE ecosystem in the department because of the Pearson correlation test between the three variables namely planning, delivery, and assessment. The Pearson Correlation value shown for each pair of variables indicates the strength of the linear relationship between the two variables. The Pearson Correlation value varies between 0 and 1, where a value of 1 indicates a perfect positive relationship between two variables, a value of 0 indicates no linear relationship between the two variables, and a value of -1 indicates a perfect negative relationship between the two variables.

In addition, Sig. (2-tailed) is the p value for the hypothesis test conducted to determine if there is a significant relationship between the two variables. A p value of less than 0.05 indicates that there is a significant relationship between the two variables, while a p value of more than 0.05 indicates that there is no significant relationship between the two variables.

In this case, the Pearson Correlation value between planning and delivery is 0.048 with a p value of 0.550. This shows that there is a weak and insignificant relationship between planning and delivery. The Pearson Correlation value between planning and assessment is 0.068 with a p value of 0.369. This also shows that there is a weak and insignificant relationship between planning and assessment. Furthermore, the Pearson Correlation value between delivery and assessment is 0.088 with a p value of 0.423. This also shows that there is a weak and insignificant relationship between delivery and assessment. Therefore, the conclusion is that there is no significant relationship between planning, delivery, and assessment in this study.

Therefore, the conclusion that can be drawn is that there is no significant relationship between the three variables, HO1 is rejected and HA1 is accepted, that is, there is a significant relationship in the level of the OBE ecosystem implemented at PSMZA by lecturers based on placement in the department.

Several factors can cause a significant relationship between planning, delivery and assessment of teaching based on principles (OBE) at PSMZA, there has been a

relationship that can be considered consistent between planning, delivery and assessment leading to optimal learning outcomes. Planning must be well integrated with delivery and assessment so that learning objectives can be achieved effectively (Farooq, 2018).

It can be said that the lecturers have used appropriate instructions during the learning process which affects the teaching methods used must be in accordance with the objectives and expected results. The use of appropriate teaching will help build students' skills and knowledge in meeting the learning outcomes that have been set.

OBE emphasizes the achievement of desired learning outcomes. Therefore, planning, delivery and assessment must be based on desired outcomes, which must then be measured and evaluated equivalently as established in the curriculum. A significant relationship between planning, delivery and assessment can also occur when students understand and respond well to the material taught (Thomas L. Good, 2008). Appropriate teaching and learning methods can help students understand and respond to the material.

In conclusion, the OBE ecosystem has been successfully cultured among the lecturers at PSMZA when the planning, delivery and assessment that have been implemented are able to create a constructive alignment between the three.

3.3 Differences in The OBE Ecosystem Between Departments

The appropriate analysis method to find differences in OBE practices between the departments is inferential statistical analysis, such as the ANOVA (Analysis of Variance) test. ANOVA analysis is best used in social science research to find differences between more than two groups of data. In this study, we compared differences in OBE practices among six different departments. Therefore, ANOVA analysis is suitable to answer this hypothesis because it allows us to test whether there is a significant difference between the data groups.

F-ratio is the ratio between the variability between data groups and the variability within data groups. Larger F-ratio values indicate greater differences between data groups. If the F-ratio value is greater than the critical value associated with the chosen significance level, then there is a significant difference between the data groups.

Table 3 shows the results of ANOVA analysis for three different factors, namely planning, delivery, and assessment in the context of measuring OBE practices among 6 departments at PSMZA. Here is a description of each column in the table:

In the context of the table above, we can see that only the assessment factor has a low statistical significance value (p-value = 0.015). Therefore, we can conclude that there is a significant difference in the practice of OBE in the context of assessment among the 6 departments at PSMZA. However, planning and delivery factors did not show significant differences.

Table 3. Differentiation result of anova analysis

		Sum of Squares	df	Mean Square	F	Sig.
planning	Between Groups	5.475	6	.913	1.133	.344
	Within Groups	205.391	105	.805		
	Total	210.866	111			
delivery	Between Groups	10.984	6	1.831	2.118	.052
	Within Groups	220.409	105	.864		
	Total	231.393	111			
assessment	Between Groups	15.499	6	2.583	2.692	.015
	Within Groups	244.674	105	.960		
	Total	260.173	111			

To determine the part of the department that has a significant difference in assessment, the Post-Hoc-Test model of Turkey is used. Fig. 2 shows a comparison of the significant difference scores between departments in the assessment factor. The description indicates that in a post-hoc test using Tukey's test, there is a significant difference between the JTMK department and all other departments in the context of OBE practice that is evaluated through factors that have been determined. The low significance value (between 0.019 and 0.13) shows that the difference has a high level of significance and can be trusted. However, there is no significant difference between JTMK and JMSK departments (0.651).

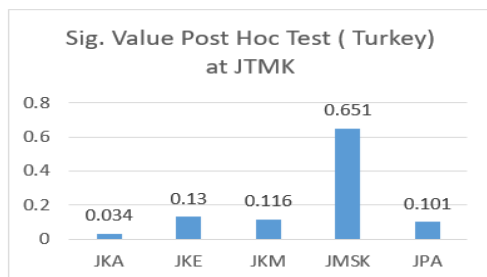


Fig. 2. Significant value throw post-hoc-test (Turkey) at JTMK

So, it can be concluded that the JTMK department has a significant difference in practice for OBE when compared to other departments. This can be caused by factors such as differences in the planning, delivery, or assessment of OBE carried out by the JTMK department compared to other departments.

Therefore, from the anova analysis there is a significant difference for the assessment factor and from the post-hoc-test it is found that this significant value difference is contributed by the JTMK department. This is likely that the assessment process at JTMK, PSMZA is based on the requirements of the Malaysia Board of Technology (MBOT) because it offers programs related to technology while for other departments, the assessment process is based on the requirements of the Engineering Technology Accreditation Council (ETAC) because other departments offer programs related to engineering.

The field of engineering and the field of technology are two different but closely related fields (Smith J., 2021). The main difference between the two fields is to begin with the objective. The main objective in engineering is to design, develop, and produce products or systems using the principles of science and mathematics. While the main objective in the field of technology is to use technology to

improve processes, productivity and safety in various sectors including business, services, and industry.

In terms of focus, engineering is the design, development, and production of physical objects such as bridges, buildings, vehicles, and machinery. Meanwhile, the focus in the field of technology is on the use of technology in services and industries such as software, computer networks, information technology, and e-commerce systems (Lee, 2022).

Next, the emphasis in engineering is on mathematics, science, and modeling to design and develop products or systems. This is in line with the findings in Fig. 2 showing that there is no significant relationship between JTMK and JMSK (0.651). This is because some courses from JTMK, especially mathematics, are taught by the same lecturers at JMSK. Mathematics, science, and modeling are used in every phase of design and development, including identification of needs, concept development, analysis, and testing (Smith J., 2021). But the emphasis in the field of technology is on the use of technology to speed up processes and reduce costs in business or services. While in terms of approach, in the field of engineering it is to develop the best product or system by using a systemic and holistic approach and the approach in the field of technology is to use technology to solve problems or meet needs in a more specific aspect.

4. Conclusion

From the findings of the analysis above, it can be concluded that the OBE ecosystem works well at PSMZA if viewed in terms of planning, delivery, and assessment of teaching. This shows that respondents or lecturers consider it important to plan learning alignment that is suitable with CLO and use appropriate educational resources in achieving CLO.

This good OBE ecosystem is expected to have a significant positive impact on PSMZA. Here are some of the possible impacts:

1. Improving the quality of teaching and learning:
By implementing the principles of OBE well, teaching and learning can be improved with more emphasis on the achievement of learning objectives and efficiency in the delivery and assessment of learning outcomes.
2. Increasing student satisfaction:
Students who follow teaching and learning based on OBE may feel more satisfied because it emphasizes on the achievement of learning objectives and a deep understanding of the topics studied.
3. Attract more students: educational institutions known for good implementation of OBE may attract more students to enroll because it is considered a modern and effective approach to teaching and learning.
4. Improve the image of the institution:
With the reputation of the educational institution as a place that implements the principle of OBE well, it can improve the image and reputation of the institution in the community and industry.
5. Increasing the competitiveness of institutions:
Institutions of learning that have a good reputation in implementing OBE well may have a higher

competitiveness in exhibiting excellence in teaching and learning. This can open opportunities to collaborate with industry and have a positive impact on student career achievement.

6. Improving student performance:

Implementing OBE well may have a positive impact on student achievement. Therefore, educational institutions may be able to improve students' performance in tests and examinations and increase their success in their careers.

In conclusion, implementing OBE well can provide various benefits to educational institutions. Therefore, it is important for educational institutions to ensure that the principles of OBE are applied effectively and efficiently in teaching and learning.

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Performance Study of Tea Waste as Nutrient Rich Organic Fertilisers

Full Paper

Article history

Received

24 July 2023

Received in revised form

24 July 2023

Accepted

3 September 2023

Published online

30 September 2023

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Abstract

The amount of tea waste grows rapidly along with the increasing consumption of tea products. Global demand increases led to the increasing of tea waste which normally into the landfill together with other waste. Therefore, there is availability to increase the potential of tea waste utilization into high added value products such as organic fertilizer. The objective of this study is to investigate the performance of tea waste as an organic fertilizer for *Murraya koenigii* plant. The efficiency of tea waste was determined by comparing pH values, plant growth measurement as well as chemical component characterization using Fourier-Transform Infrared (FTIR) analysis. Accordingly, the methodology begins with the preparation of organic fertilizer made from tea waste as well as other organic waste source material of fish waste. Four samples were prepared and pH readings for each sample were recorded. The performance of the tea waste organic fertilizer was observed based on the plant growth measurement. The results show that the additional of tea waste as organic fertilizer towards *Murraya koenigii* plant significantly increased the plant growth. Besides that, additional of other organic material has affected the plant growth performance as well as affecting the soil properties that would interfere the process of plant growth.

Keywords: - Tea waste, organic fertilizers, waste utilisation, *Murraya koenigii*, FTIR

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1. Introduction

Waste from tea bags, waste from tea preparation, or the tea leaves left over after the tea has infused are all examples of spent tea waste. Tea leaves, tea dust, and other organic materials typically make up its composition. Spent tea waste can be used as an organic fertiliser for gardens and crops due to its natural qualities.

However, tea waste increases gradually as the increased production of tea bags due to demand for human usage for tea drinks. The production of tea bags can affect the environment's ecosystem, such as deforestation for tea plantations, alterations of natural water flows, and soil erosion (Yang et al., 2019).

This study aims to use tea waste as an organic fertilizer made from the spent tea waste for home usage. Normally, spent tea waste at kitchen normally discarded as waste together with other kitchen waste which led into

increasing of waste and landfill area.

As a result, the use of spent tea leaves as fertiliser has been a topic of investigation for researchers for several years. As stated by Ozdemir et al., (2009), Morikawa & Saigusa (2011) and Eudoxie & Martin (2019), several research have been carried out to establish the efficacy of spent tea waste as a fertiliser and to understand its effects on plant development and soil health.

Organic fertilizers are materials that are derived from natural sources and contain nutrients that can help promote the growth of plants. Organic fertilizers are often used in place of chemical fertilizers since they can provide the same benefits while reducing the risk of environmental contamination (de Corato, 2020).

This study objectives to assess the efficiency of tea waste as an organic fertilizer to replace the use of chemical fertilizers for domestic usage. In addition, the effect of spent tea waste as an organic fertilizer in terms

of pH values, chemical components present and plant growth were investigated in this study.

2. Literature Review

Tea waste, also known as tea dregs or tea residues, is the leftover material from brewing tea, and it is considered an organic waste that can have potential benefits in agriculture. The waste contains various organic compounds such as polyphenols, flavonoids, tannins, and caffeine that can have a positive impact on soil properties and plant growth.

Tea waste can be used for two purposes: first, as a reliable supply of biodegradable garbage, and second, as a helpful source of compost. In addition, organic materials such as compost have the potential to serve as an important source of plant-available nutrients such as nitrogen (N), phosphorous (P), potassium (K), sulphur (S), and magnesium (Mg), hence lowering the amount of synthetic fertiliser inputs that are required (Luo et al., 2021).

Several studies have been conducted to investigate the potential use of spent tea waste as a fertilizer. One study conducted by Gupta et al., (2020) showed that tea waste compost can improve the physical and chemical properties of soil, including the pH, organic matter content, and nutrient availability. The authors also reported an increase in the growth of lettuce and tomato plants when tea waste compost was used as a fertilizer.

Another study by Pane et al., (2014) found that spent tea waste extract can promote the productivity of lettuce and kohlrabi. The authors attributed the positive effects of tea waste extract to its high concentration of plant growth-promoting compounds.

In addition to promoting plant growth, spent tea waste can also suppress the growth of plant pathogens. A study by Li-rui (2008) showed that tea waste extract can inhibit the growth of several plant pathogenic fungi, including *Bipolaris maydis*, *Colletotrichum musae* and *Fusarium oxysporum*. The author suggested that tea waste extract can be used as a natural alternative to synthetic fungicides.

To boost crop yields, an excessive number of chemical fertilisers are being used. On the other hand, if chemical fertilisers are applied in quantities that are beyond a certain threshold, they might damage ecosystems and accumulate in agricultural plants. As a result of this, environmentalists have begun to shift their focus to organic farming, which can be defined as the cultivation of non-polluted crops using biofertilizers and biopesticides. These methods ensure that plants have access to the maximum amount of nutrients while also preventing diseases and controlling pests. It is possible to pollute the air, water, and soil with chemical fertilisers if they are misused or abused. Chemical fertilisers are manufactured in an industrial setting using known quantities of elements such as nitrogen, phosphorus, and potassium (Wazir et al., 2018).

3. Methodology

Accordingly, the methodology was started with the preparation of organic compost fertilizer made from the spent tea waste followed by the compost preparation. Then, it continues with the preparation of *Murraya koenigii* plant samples. The efficiency of spent tea waste acts as organic fertilizer was compared based on plant samples and all results are recorded and analysed.

3.1 Preparation of Spent Tea Waste

The tea bags residue was washed first with distilled water to remove any impurities inside the spent tea waste as shown in Fig. 1. The washing and cleaning steps were repeated several times until there was no longer any coloured solution. It functions also to reduce caffeine contains inside the tea leaves which reduce the growth of plants (Muratova et al., 2020). After that, the spent tea leaves are in a mesh tray and exposed to sunlight during the drying process, which function to remove moisture content as shown in Fig. 2.



Fig. 1. Spent tea bags waste



Fig. 2. Dried of tea waste from tea bags

Next, tea leaves residues were removed from the tea bags after drying process was completed. The materials used for the preparation of organic fertilizer from tea residues were arranged according to the composition determined to ensure the quality of yield and effectiveness of this organic fertilizer.

3.2 Addition of Compost Material

Additional of compost material was used in this study to compare the performance as additional nutrient source for the organic fertilizer. Compost fertilizer is a product that provides helpful nutrients to soil, plants, flowers, and vegetables (Xiao et al., 2022). Fish waste was used as the composting materials. The fish waste consists of fish sediments, bones-rich heads, and fish backbones. In addition, the compost material was used in the study which to investigate the efficiency of spent tea waste organic fertilizer by including together with the tea waste.

The entire composting procedure for fish waste takes two weeks. Due to the emission of methane gas by the composting materials, which has the potential to demolish the container, the container for this medium must be opened at least once every three days.

Besides that, brown sugar is added together with the fish waste in this process. The addition of brown sugar served as a catalyst to accelerate the composting process and a growth promoter for microorganisms (Zhang et al., 2013). In addition, the brown sugar also contains 20 – 30 times more glucose compared to normal fine sugar at market, which glucose function in helping the composting process due to carbon source presence.

3.3 Preparation of Plant Samples

Murraya koenigii plant or often called as curry leaf plant was selected to compare the efficiency of the organic fertilizer performance plants for this study. The availability of this plant on the market was an advantage in this study. Four plant samples were prepared with one plant that acts as the control sample. Meanwhile, other three plant samples were prepared and added with spent tea waste, fish waste compost and combination of spent tea waste and fish waste compost. All samples were placed at an outside control condition and all growth data was recorded.

The duration of plant growth samples recorded for period of two weeks. Four samples were prepared which consists of Sample A (no additional nutrient), Sample B (added with tea waste), Sample C (added with fish waste compost) and Sample D (added with tea waste & fish waste compost). All samples were located at a constant place and kept left outdoor.

3.4 Identification of Functional Group & pH Analysis

The identification of chemical functional group presence in the spent tea waste and fish waste compost were analysed using Fourier transform infrared spectroscopy (FTIR).

Spent tea waste sample was characterised using adsorption mechanism via FTIR device. Based on the study by Ebrahimian Pirbazari (2013), it was expected that binding occurred mostly at hydroxyl (–OH) and ketone (C=O) functional groups of tea waste.

3.5 Process flow chart

Fig. 3 shows the flow chart of the study. The data observation and data recorded for duration of four weeks based on the efficiency of spent tea waste performance as well as additional of compost material together with spent tea waste.

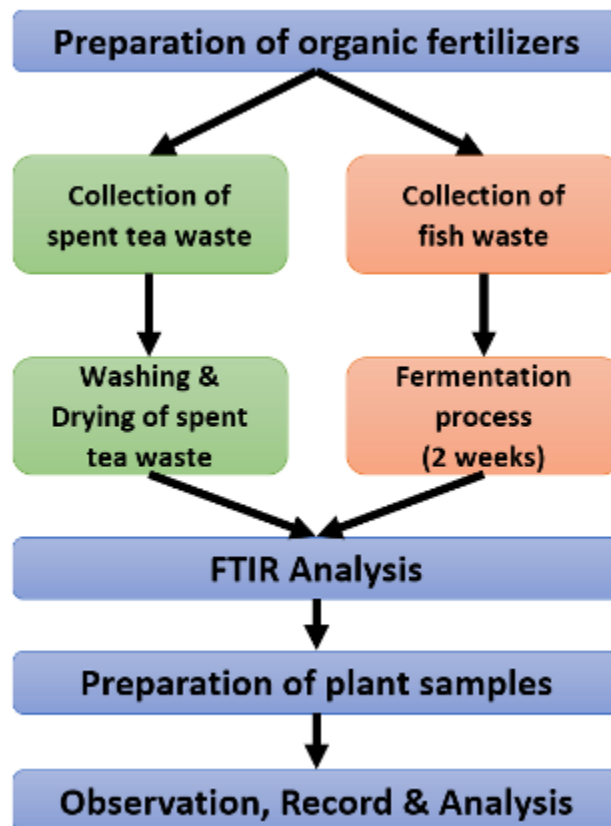


Fig. 3. Overall research workflow chart

4. Finding and Analysis

4.1 Identification of Functional Group using FTIR & pH Analysis

Three solution samples were prepared in this analysis, consists of: i) Tea Waste, ii) Fish Waste and iii) Combination Tea and Compost Fish Waste. Fig. 4 shows the FTIR analysis results.

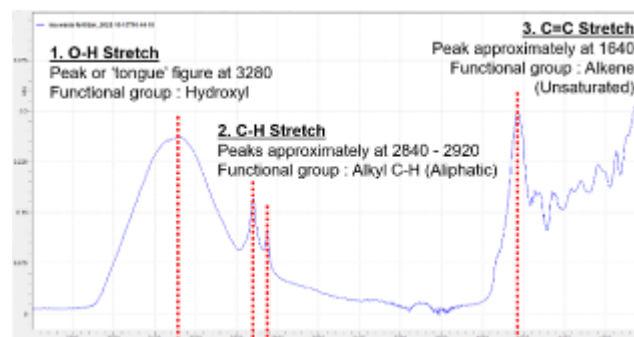


Fig. 4. FTIR spectrum of tea waste

The functional groups of tea waste were identified by the FTIR analysis. Based on the FTIR analysis of all samples, it shows almost similar FTIR spectrum of all together. Fig. 4 shown the absorption band at 3280 cm^{-1} refers to the hydroxyl (-OH) group.

It had been expected that the majority of the solution would be made up of water in its liquid state. In addition to this, the frequency range of $2840\text{--}2920\text{ cm}^{-1}$ was where the C-H bond transmission was at its peak. This can be confirmed by referring to another research done by Ebrahimian Pirbazi (2013) and Syed Draman et al., (2015). In addition, the presence of an alkene functional group can be determined from the absorption band located at 1640 cm^{-1} .

All three samples also undergo pH analysis to understand the effect of pH towards plant growth. Fig. 5 shows the pH analysis work for all sample.



Fig. 5. pH analysis procedure

All result of pH analysis was tabulated in Table 1 which consists of 3 different samples that include tea waste as well as fish waste compost.

Table 1. pH reading for all sample

Sample	pH Reading
Tea waste	5.32
Fish waste compost	3.25
Tea + Fish waste compost	2.80

Based on Table 1, all results show the pH reading towards acidic environment. The tea waste shows pH reading at 5.32 which varies on the optimum soil pH readings for plant growth well between pH range 5.5 to 6.5 (Bolan et al., 2005). The fish waste was expectedly to get pH readings in alkaline or base readings with pH between 8.0 to 11.0 (Shenbagavalli et al., 2020).

However, the pH reading of the sample that turned into an acidic solution was thought to have been affected by the brown sugar added to the compost material. Organic acids were produced as a result of the fish waste compost's initial stage's rapid rate of decomposition, which was caused by the addition of brown sugar. Additionally, one of the causes that caused the fish waste compost samples to be in an acidic solution was the oxygen restriction in the confined container.

4.2 Plant Growth (Height of Plant & Size of Leaf)

The duration of the plant growth observation was recorded for a period of two weeks. All samples plant growth results are tabulated in Table 2.

Table 2. Comparison in terms of height measurement of the *Murraya koenigii* tree

Sample \ Date	Day 1	Day 4	Day 7	Day 10	Day 13	Day 16
A (No Additional Nutrients)	15 cm	15.7 cm	16.2 cm	16.7 cm	16.5 cm	16.5 cm
B (Tea Waste Fertilizer)	15 cm	15 cm	15 cm	14.9 cm	14 cm	14 cm
C (Fish Waste Fertilizer)	15 cm	16 cm	16 cm	13 cm	18.5 cm	19.6 cm
D (Tea + Fish Fertilizer)	15 cm	13 cm	14.3 cm	14.5 cm	13 cm	13.1 cm

In comparison to the other samples, Sample C displays the highest plant height as measured based on Table 2. The nutrient-rich content of fish compost waste was thought to be a more concentrated supply of nutrients and may therefore have a greater impact on plant growth.

Fish compost waste is a rich source of nitrogen, phosphorus, and other micronutrients, making it an ideal fertilizer for promoting healthy plant growth. Nitrogen is essential to produce chlorophyll and for promoting overall plant growth. Phosphorus is also important for plant growth, particularly for the development of healthy roots, stems, flowers, and fruit.

Additionally, fish compost waste contains a substantial number of micronutrients such as iron, manganese, and zinc, which are essential for plant growth and development. These micronutrients are typically present in smaller amounts in other types of organic fertilizers in the tea waste. Fig. 6 shows the *Murraya koenigii* plant of Sample C that added with fish waste compost.



Fig. 6. Differences in terms of height of sample C

Sample A also demonstrates an overall increase in plant height with just a 1 cm variation from the 15 cm base height. The overall height measurement is decreasing in samples B and D. It was thought that the addition of composted tea waste and fish waste as fertiliser in sample D resulted in excessive soil nutrient levels, which were harmful to plant growth and the environment. However, the *Murraya koenigii* plant leaf of sample B shows among highest and widest leaf measurement as shown in Fig. 7.



Fig. 7. The *Murraya koenigii* plant leaf of sample B

In addition, all sample results in terms of leaf measurement are tabulated in Table 3.

Table 3. Comparison in terms of leaf measurement of the *Murraya koenigii* tree

Sample \ Date	Day 1	Day 4	Day 7	Day 10	Day 13	Day 16
A (No Additional Nutrients)	2.9 cm	2.7 cm	2.9 cm	2.8 cm	2.8 cm	2.8 cm
B (Tea Waste Fertilizer)	3.0 cm	3.3 cm	3.7 cm	3.6 cm	3.9 cm	3.9 cm
C (Fish Waste Fertilizer)	2.7 cm	2.7 cm	2.7 cm	2.9 cm	2.6 cm	2.8 cm
D (Tea + Fish Waste Fertilizer)	3.1 cm	3.3 cm	3.9 cm	3.4 cm	3.3 cm	3.4 cm

According to Table 3, sample B has the longest leaf measurement out of all the samples that were observed and measured. Samples A and C, on the other hand, display the lowest leaf measurements ever recorded since the first day of observations. The nitrogen in tea waste was thought to be a rich supply of the nutrient necessary for plant growth and a part of the chlorophyll molecule, which is responsible for photosynthesis. The production of chlorophyll tends to increase when plants have enough nitrogen, which can result in leaves that are bigger and greener (Zou et al., 2023).

The plant leaf measurement offers an infinite amount of information. This process also known as calculating leaf surface area gives vital information about the growth and development of plants as well as how they interact with their surroundings by measuring the surface area of the leaves (Pandey & Singh, 2011). This knowledge can be applied to increase crop output, create environmentally friendly farming methods, and comprehend how ecosystems work.

In addition, the tea waste used in this project already decomposed in order ensure that the nutrients are available to the plants and that the tea waste will not attract pests or cause disease. Tea waste leaves also contain other beneficial compounds such as antioxidants, flavonoids, and tannins, which can have positive effects on plant growth and health.

The effect of tea waste on plant growth can vary depending on the specific type of plant and the soil conditions. In some cases, the use of tea waste may result in a more balanced growth of both leaves and stem, leading to an overall increase in plant height. However, the *Murraya koenigii* plant that used in this study shows different results in terms of plant height and differ in the size of the plant leaves especially as shown in Sample C. It is possible that a number of mistakes were made during this research, or that the way fish waste interacts with the plant, could have an effect on it. To better understand how fish waste affects plant growth, more in-depth research investigations are required.

5. Conclusion

The performance study and analysis of tea waste as organic fertilizer has been successfully performed. This study evaluated the feasibility of using spent tea waste as a

valuable resource natural fertilizer for plant growth, for personal or household use. pH value of 5.32 in the spent tea waste solution significantly improve the growth of *Murraya koenigii* plant.

However, the effect on plant height can vary depending on the specific type of plant and soil conditions, which reflect to the plant performance as shown in Sample C. The performance results using tea waste can be particularly beneficial for promoting leaf growth due to its high nitrogen content, as shown in Sample B.

It can be concluded that, the efficacy of tea waste as a natural fertiliser can promote plant growth and provides an eco-friendly and sustainable solution.

Acknowledgement

The authors would like to thank the Department of Petrochemical Engineering at Politeknik Kuching Sarawak, as well as the students, staff, and lecturer from the tea waste project for their participation and assistance in data collection, progress works, and other aspects of this study.

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PKS IVASStar - An Overview of Chatbot Development

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

Over the past decade, the advancements in technologies such as artificial intelligence (AI), big data, and internet of things (IoT) have greatly influenced various industries. Among these applications, chatbots have emerged as a notable example. Chatbots like intelligent virtual assistants (IVAs) are becoming increasingly popular in various fields such as healthcare, education, and customer service. IVAs are software assistants that are able to interact with users to support meaningful tasks, identify information needs, provide relevant information, and improve their performance based on user feedback. It's like a robot that answers questions or provides information needed by users in the form of conversations or text messages. The use of artificial intelligence in chatbot enables users to quickly and easily obtain relevant information based on the information provided. PKS IVASStar is a computer chatbot programme that uses artificial intelligence and natural language processing. It was created to make it simpler for the Student Affairs Department to provide feedback to users. A research model based on rules-based chatbot that sets information and provides responses based on a set of predefined rules with the use of pattern matching algorithms. The effectiveness of a chatbot depends on several factors, such as the quality of the natural language processing algorithms. It is important to consider the level of human oversight and intervention that is necessary. In future, PKS IVASStar could involve exploring advanced machine learning techniques, such as deep learning and reinforcement learning, to enhance the performance and adaptability of AI chatbots in delivering an improved online customer experience.

Keywords: - Factory I/O, PLC programming, simulator

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1. Introduction

Traditionally, two-way communication is interpreted as face-to-face human conversation. Technological changes leading to the 4th Industrial Revolution (4IR) also changed the way of communication, which now involves humans and machines in a more effective form.

The proliferation of smart devices, social media platforms, and messaging applications has contributed to the widespread adoption of chatbots. These intelligent systems can be integrated into various applications, including customer service, e-commerce, healthcare, education, and more. Chatbots offer a range of benefits, such as round-the-clock availability, scalability, cost-

effectiveness, and the ability to handle multiple user interactions simultaneously.

In general, a bot refers to a computer system capable of executing automated tasks, and when integrated into messaging platforms, it is known as a chatbot. Chatbots function similarly to conventional messaging applications, with the distinction that one of the message recipients is a robot or computer. Essentially, it involves human interaction with a computer through conversation. This communication can occur via voice commands, text chats, graphical interfaces, or graphical widgets. Presently, chatbots have gained significant attention and are employed to assist humans in various tasks (Kumar et al., 2018). They offer numerous advantages, such as providing round-the-clock inquiry support and feedback,

as well as enhancing efficiency by handling non-essential tasks. They have found applications in diverse industries, including weather updates, flight reservations, answering educational queries (Kumar et al., 2018), and facilitating product purchases.

Regarding chatbot system development, creating a conversational interface between humans and computers involves the utilization of various design techniques. Developers commonly employ pattern matching, Cleverscript, ChatScript, Artificial Intelligence Markup Language (AIML), or language tricks (Masche & Le, 2018). Among these techniques, pattern matching is the most popular, where the bot matches phrases to keywords in a pre-specified dictionary (Masche & Le, 2018).

In line with the changes, Politeknik Kuching Sarawak (PKS) took the initiative to introduce PKS IVASStar. PKS IVASStar is a chatbot, which is a computer programme that uses artificial intelligence (AI) and natural language processing (NLP). PKS IVASStar works like a robot that answers questions or provides information needed by users in the form of conversations or text messages.

Therefore, PKS IVASStar was created specifically to make it simpler for the Student Affairs Department (JHEP) to provide feedback to users. It is more focused on common questions that users frequently ask of the management, as opposed to before, when users had to meet with JHEP during an office hour or obtain information from the frequently asked questions (FAQ) section of the PKS website. Although there is a FAQ section, occasionally the FAQ items are not updated, and occasionally the inquiries go beyond what the FAQ can answer. Most of the items asked are requirements for admission to polytechnics.

Based on that problem, a study has been carried out to replace customer service in providing responsive information, and the focus is on chatbot development. The objectives of PKS IVASStar are:

1. Develop an AI chatbot that can help users get relevant information, especially related to the affairs of the Student Affairs Department.
2. Assisting with administrative tasks in the office, such as responding to customer inquiries and making recommendations based on the guidelines set.
3. Testing the effectiveness of a chatbot against users.

The target users of PKS IVASStar generally consist of the public, especially prospective students. With this PKS IVASStar, users can ask questions related to JHEP at any time, regardless of time or location. The findings will be discussed, and conclusions will be drawn accordingly.

2. Literature Review

2.1 Overview

This section provides an overview of the research conducted on chatbot technology. The literature review focuses on the design of chatbots and the extent to which they incorporate AI and NLP elements.

2.2 Terminology

a) Chatbot

Chatbots have become increasingly popular in recent years, with various studies exploring their use in different domains. A chatbot (or chatterbot) is software (machine) that talks with a user (human); it is a virtual assistant able to answer several user questions, providing the correct responses (Colace et al., 2018).

Based on Khante & Hande (2019), the chatbot is divided into three (3) parts: responder, classifier, and graphmaster. The responder is the part that connects the bot with the user. The task of the responder is to transfer data from the user to the classifier and control the input and output. Classifier as well as controlling input and output. The classifier is the part that filters and normalizes the input and performs segmentation of the sentences that have been input. Graphmaster is the part that matches the input pattern to the facts that have been created against the facts that have been created.

There are many applications that consolidate a human appearance and are trying to reproduce human exchange, but in most cases, the information used for conversation in a bot is put in a database created by a human specialist.

Designing effective chatbots is an important area of research, and several studies have examined different aspects of chatbot design. Chatbots these days are AI-driven and powered by natural language processing (NLP) technologies that can offer sophisticated solutions to meet the language and content expectations of end-users (Jonathan Grudin & Richard Jacques, 2019). Users prefer chatbots that are easy to use, provide clear and concise responses, and have a natural conversational style.

b) Artificial Intelligence (AI)

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Jean, Sihombing & Wirapraja, 2018).

Chassignol et al. (2018) defined AI as a theoretical framework guiding the development and use of computer systems with the capabilities of human beings, more particularly, intelligence and the ability to perform tasks that require human intelligence, including visual perception, speech recognition, decision-making, and translation between languages. This involves developing systems with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience (Copeland, 2023).

AI can be classified into four groups, as outlined by Alfareza (2020): thinking humanly, which involves developing AI technology that imitates human thinking; acting humanly, where AI performs tasks typically done by humans; thinking rationally, which entails problem-solving through logical reasoning; and acting rationally,

which pertains to the creation of AI systems that systematically achieve specific goals.

By leveraging AI capabilities, chatbots can deliver more intelligent, context-aware, and personalized interactions with users. They can understand user intent, process natural language, and provide relevant and helpful responses, enhancing user satisfaction and improving overall user experience.

c) Natural Language Processing (NLP)

Natural Language Processing (NLP) has been a rapidly developing field in the past few years. Natural language processing (NLP) is a subfield of computer science that employs computational techniques for learning, understanding and producing human language content (Aleedy et al., 2019).

The use of NLP has been applied in various areas of human life. This is because NLP is easier to use as a computer interface display than learning the language of computer commands. Fig. 1 shows elements in natural language processing.

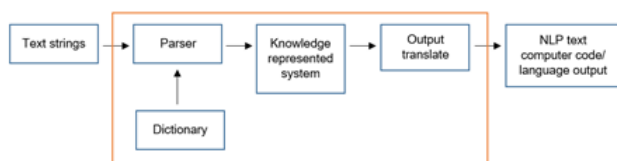


Fig. 1. Natural Language Processing (NLP) element

Based on Fig. 1, we can see that Natural Language Processing (NLP) involves a range of techniques and tools that are used to analyze, process, and understand human language using the specific elements of NLP that were mentioned by Oo (2019) in the query: parser, lexicon, understander, knowledge base, and generator.

3. Methodology

The development of PKS IVASStar uses the agile methodology. The choice of methodology is made based on the most important value of agile development, which is that it enables the team to make decisions quickly with good quality and predictability and has good potential to handle any changes.

The agile methodology is a software development approach that emphasizes iterative and incremental delivery of working software, with a focus on flexibility and adaptability to changing requirements. It involves various phases of system development life cycle (SDLC) in Fig. 2 such as planning, design, development, testing, deployment, review, and launch, which enable rapid and efficient software development within a short period of time (Valpadasu Hema et al., 2020).

The agile methodology deviates from traditional software development approaches and follows a set of practices to manage software products effectively. Agile development is a flexible and iterative approach to

software development, which also applies to AI chatbot development. It emphasizes collaboration, adaptability, and delivering incremental value to users. Applying agile principles to AI chatbot development involves the following:

1. User-centric approach: prioritizing user needs and designing the chatbot to address them effectively.
2. Iterative development: breaking the development process into smaller iterations allows for early feedback and continuous improvement.
3. Cross-functional collaboration: collaborating with individuals from different disciplines to ensure a holistic development process.
4. Continuous integration and deployment: regularly integrating new features and improvements into the chatbot and deploying them for testing.
5. Embracing change: adapting the chatbot's capabilities to evolving user needs and new scenarios.

By following these agile principles, AI chatbot development becomes a collaborative, iterative, and user-focused process that continually improves and meets user requirements.



Fig. 2. Agile development

As shown in Fig. 2, there are five (5) phases involved: brainstorm, design, development, quality assurance and deployment. The brainstorming phase involved the system development team, JHEP representatives, and Information Technology and Communication Unit (UIC) representatives. The brainstorming phase involves discussing development objectives, the system development schedule, system architecture, and a preliminary system overview. System architecture as shown in Fig. 3.

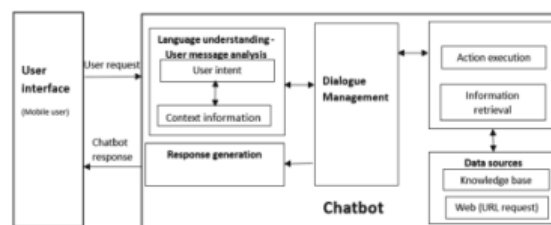


Fig. 3. General chatbot architecture (Adamopoulou and Moussiades, 2020)

Through the system development schedule, the JHEP representatives provide relevant documents, and the document analysis process begins. The draught proposal is presented, and the initial data given is divided into several parts and functions to facilitate data retrieval. The proposed flow chart is as follows:

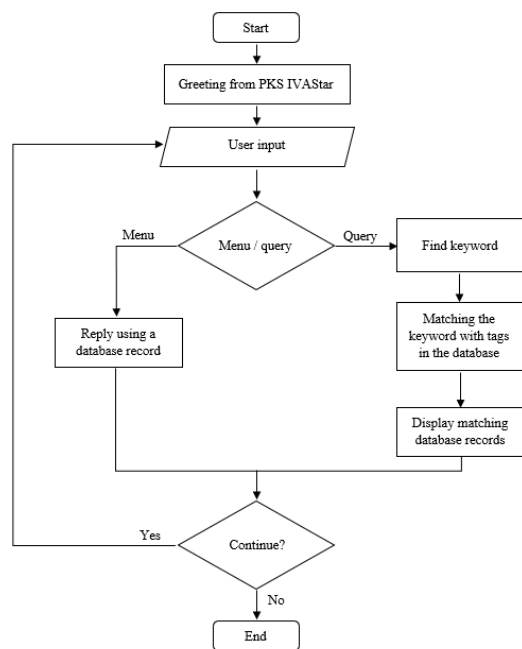


Fig. 4. PKS IVASStar flowchart

Based on Fig. 4, PKS IVASStar uses a rules-based chatbot. A rule-based chatbot processes information and provides responses based on a set of predefined rules with the use of pattern matching algorithms (Xufei Huang, 2021). Within PKS IVASStar, these rule-based chatbots can be viewed through the use of menu options, buttons and keyword recognition.

Rules-based chatbots are chosen because they are easier to build, use simple true-false algorithms to understand user questions, and provide only relevant answers. However, it has disadvantages when the questions asked are outside the scope.

Once the design phase is complete, the development phase begins and each function is tested for effectiveness. Throughout the development process, it's important to continuously test and refine the chatbot. Collect user feedback, conduct usability testing, and track key metrics to identify areas for improvement and iterate on the chatbot's features and functionality are items implemented in quality assurance.

PKS IVASStar is placed on a temporary website and tested by JHEP representatives. The temporary placement aims to evaluate its effectiveness, the accuracy of each query's result, and verify that it meets the needs and expectations of the user. This process is also known as user acceptance testing. Representatives are given an overview of the functions involved, the test scenario, and the expected test results. Every element that meets the

requirements will be marked as completed. Additionally, there is a section for comments and suggestions for improvement. Several improvements were made before the final product of PKS IVASStar was placed on the PKS website.

4. Finding and Analysis

PKS IVASStar can be accessed through the PKS website at www.poliku.edu.my. As shown in Fig. 5, PKS IVASStar is located at the bottom right of the website.



Fig. 5. PKS IVASStar embedded into the website

As shown in Fig. 6, by clicking the PKS IVASStar icon, it greets the user and requests their names to start a conversation.



Fig. 6. Using input text to start conversation

Next, PKS IVASStar gives users the option to either choose a menu from the ones listed or click other buttons. If the other button is selected, the user can enter the question to be asked. Fig. 7 shows the initial options menu, whereas Fig. 8 shows the options menu related to the categories that were chosen in Fig. 7.

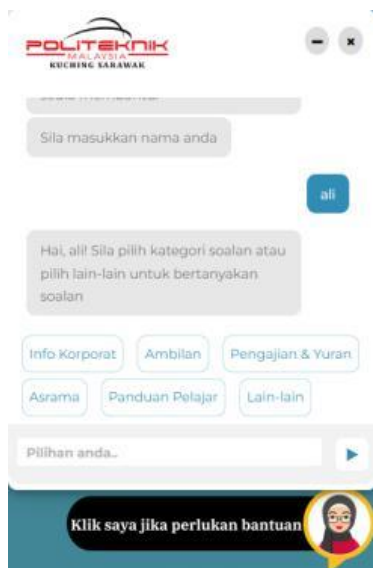


Fig. 7: Initial option menu



Fig. 8: Option menu based on category

The user's input will be analyzed by PKS IVASStar to determine intent behind the message. Intent recognition involves mapping the input to predefined categories or actions based on the patterns or keywords present in the user's message. Fig. 9 shows the backend code of the initial options menu. Once the intent is recognized, PKS IVASStar will match it with data storage. Based on the matched rule, PKS IVASStar generates a response shown in Fig. 10.

```
<select data-conv-question="Hai, {name}! Sila pilih kategori soalan atau pilih lain-lain untuk bertanyakan soalan" name="kategori" data-callback="storeState" id="kategori">
  <option value="info">Info Korporat</option>
  <option value="ambilan">Ambilan</option>
  <option value="pengajian">Pengajian & Yuran</option>
  <option value="asrama">Asrama</option>
  <option value="panduan">Panduan Pelajar</option>
  <option value="lain">Lain-lain</option>
</select>
<!--main menu-->
<div data-conv-fork="kategori">
  <div data-conv-case="info">
    <select data-conv-question="Sila pilih kategori info" name="pilihan_info">
      <option value="info_am">Info Am</option>
      <option value="visi">Visi dan Misi</option>
      <option value="piagam">Piagam Pelanggan</option>
      <option value="hubung">Hubungi kami</option>
      <option value="mainMenu" data-callback="rollbackMain">Tetapan Semula</option>
    </select>
  </div>
</div>
```

Fig. 9: Backend code of the initial options menu



Fig. 10: Search results

Once the results are displayed, there will be two buttons that the user can select. If the user has any additional inquiries, they can do so by selecting the "Ya, teruskan" button, and an option menu based on category will appear. The cycle will continue until the user selects the "Tidak, tamatkan" button, which will end the conversation.

4. Conclusion

Having a chatbot function on the website is an effective way we can use in communication with customers. In line with the rapid development of communication technology with the existence of revolution 4.0, the need to adapt human expertise and applications should be taken into consideration. The use of artificial intelligence (AI) in applications is one of the best ways to overcome this issue.

PKS successfully developed its own chatbot where it aligns with development objectives and goals. When implemented correctly, PKS IVAStar can offer a range of benefits to businesses, including increased efficiency and cost savings, improved customer satisfaction, and enhanced customer engagement. However, it is important to approach the implementation of this chatbot with care and attention to ensure that it meets the needs of both the organizations and their customers.

Overall, the effectiveness of a PKS IVAStar chatbot depends on several factors, such as the quality of the NLP algorithms, the amount and quality of training data, and the level of customization and personalization that the chatbot can provide. Additionally, it is important to consider the level of human oversight and intervention that is necessary to ensure that the chatbot is providing accurate and helpful responses. In the future, this chatbot can be enhanced with the following features:

1. Multilingual support: Users will be able to interact with the chatbot in different languages, accommodating students and parents from various regions.
2. Speech-based interaction: The chatbot will enable users to ask questions and receive responses through voice commands, making it accessible for those who cannot read or type.
3. Problem-solving capabilities: The chatbot will not only provide answers but also offer solutions to the challenges faced by students and parents. It will provide information on admission, college achievements, placements, and scholarships, helping users find appropriate solutions to their specific needs.
4. These enhancements aim to create a more inclusive and user-friendly experience for individuals seeking information and assistance from the chatbot.

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Full Paper

Article history

Received

5 August 2023

Received in revised form

5 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Seaweed Dodol (*Eucheuma Cottoni*) Processing in UKM. Cahaya Madina Nunukan and Characteristics Products Produced in Nunukan Area

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Abstract

From a biological point of view, seaweed is a primary producer producing organic matter and oxygen in the aquatic environment. From an economic standpoint, it is a potential commodity for development, given its nutritional value. Seaweed Dodol is a diversification of processed seaweed. Seaweed dodol is a type of food that belongs to the category of semi-wet food, which has low activity. The research method used is the direct practice of data collection and the results of observations carried out at UKM Cahaya Madina. In conclusion, the process of making dodol starts with preparing tools and materials, then washing the seaweed, cutting, blending, cooking, printing, dodol, drying and packaging. Seaweed dodol is a processed product that is very popular because of its soft texture, attractive colour, sweet taste and distinctive aroma.

Keywords: - Dodol seaweed, processing

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1. Introduction

Indonesia is an archipelagic nation with a vast ocean area, accounting for 70% of its territory. In Indonesian waters, a variety of marine biota exists, including seaweed. The combination of seaweed species in Indonesian waters indicates the seaweed's potential in Indonesian seawater.

From a biological point of view, seaweed is a primary producer producing organic matter and oxygen in the aquatic environment. From an economic standpoint, it is a potential commodity to be developed, given its nutritional value. In Indonesia, seaweed is a vital fishery product, both as a source of income for fishermen/seaweed cultivators and as a foreign exchange source. Apart from being an industrial raw material, seaweed can be processed into various ready-to-eat foods such as dodol, pudding, ice cream, and sweets. The widely used seaweed is from the *Rhodophyceae* class, which contains carrageenan and agar. One of the species in the *Rhodophyceae* class,

which contains carrageenan, is *Eucheuma cottonii* (Firdarini, 2016).

Dodol is a traditional food belonging to the semi-moist food group and can be found in several Indonesian regions. Dodol has a sweet and savory flavor and a soft consistency. In addition, dodol is produced from fruits and vegetables, such as lapel dodol, soursop dodol, carrot dodol, and others, making it an agricultural product (Abdullah, 2011). Dodol has plastic and solid properties, an a_w range of 0.60 to 0.90, and water content between 10% and 40%. (Haliza, 1992).

Seaweed Dodol is a diversification of processed seaweed. Seaweed dodol is a type of food that belongs to the category of semi-wet food, which has low activity. As a semi-wet food, dodol has the property of being able to preserve itself without the need for refrigeration, sterilization, and drying. Seaweed dodol is made by adding seaweed to increase the use value of seaweed. Dodol grass has good prospects for development. There are many benefits obtained from

seaweed dodol, including that it contains a lot of dietary fiber, namely dietary fiber that human digestive enzymes cannot digest. (Cokrowati, Andriani, & Marzuki, 2020; Sujana, Al Zarliani, & Hastuti, 2020).

Seaweed dodol is one of the processed varieties of seaweed made with *Eucheuma Cottoni* seaweed as the primary component. To produce high-quality seaweed dodol, high-quality raw materials are required. The ingredients that must be prepared to make seaweed dodol are essential, auxiliary, and complimentary.

Essential ingredients are the raw materials or main ingredients used in making seaweed dodol. Seaweed must be of good quality: dry, not moldy, intact, and not too much salt. The seaweed used is *Eucheuma cottoni* because there are many in traditional markets; the texture is like cartilage, so it is not too soft.

1.1 Problem Statement

So far, the harvested seaweed (*Eucheuma Cottoni*) in Nunukan Regency is only sold in dry form without having to think about the added value of seaweed such as being produced into jelly, dodol and so on. To improve the economy of Nunukan seaweed farmers, as well as develop the small and medium business sector in the Nunukan community it is necessary to develop ways to process raw seaweed into ready-to-eat processed seaweed. One of the realistic food products to be developed in the Nunukan Regency area is dodol product, for this reason, an in-depth understanding of the process of making seaweed dodol is needed so that it can produce dodol products with a consistent taste and elasticity.

2. Literature Review

2.1 The Classification of Seaweed (*Eucheuma Cottoni*)

Seaweed can be used as the main ingredient for making agar-agar, carrageenan, and alginate. The reason is that the carrageenophyte in seaweed contains many of the main ingredients, carrageenan polysaccharides. The kagarophyte is the main ingredient of polysaccharides, and both are red seaweed or Rhodophyceae. Alginophytes are brown seaweeds or Phaeophyceae, which contain many main ingredients, polysaccharide alginate. The scientific classification that exists in this seaweed plant is shown in Table 1.

Table 1. Seaweed classification

Kingdom	Plantae
Division	Rhodophyta
Class	Rhodophyceae
Ordo	Gigartinales
Familia	Solanaceae



Fig. 1. Seaweed (*Eucheumacottoni*)

Seaweed is a low-level plant because it needs roots, stems, and leaves. Consequently, these plants are typically attached to the substrate via a thallus. Additionally, seaweed is a collection of non-vascular, chlorophyll-containing plants that carry out photosynthesis (Abdurrahman, Rosdarni, & Sugireng, 2021).

In contrast, the structure of vegetative propagation in seaweed differs from that of higher-level plants. It is not possible to distinguish between the leaves, stems, and roots of seaweed. This indistinguishable structure is known as the talus.

The thallus of seaweed, for instance, is multi cellular and composed of various shapes and sizes. The talus is subdivided into two broad categories: filament and siphon. Variation of the two talus forms will result in a more complex form. These range from compact filaments to more giant filament forms, distinguishable by attachment heads, strips, and laminae (Setha, Arfah, & Pattipeilohy, 2019).

2.2 Seaweed Morphology

The morphological characteristics that exist in seaweed including (Yuliasih & Wendrawan, 2014).

a) Filaments

The cells that compose filaments are arranged and separated by sister walls. There are two distinct types of filaments: uniseriate and multiseriate. Uniseriate filaments consist of cells arranged in a single series, whereas multiseriate filaments contain cells arranged in multiple series.

The filaments in the seaweed material are obtained through a cell division process that can produce branching areas. Four types can be produced through this branching process: thallus filaments, which can branch easily, heterotric, parenchyma, and pseudoparenchyma.

b) Chiffon

The characteristics of Chiffon can be observed in green algae that do not produce a dividing wall or septum in order to form a multinucleated body. On the other hand, this septum is only present during the formation of the reproductive organs. For instance, algae with siphon characteristics, such as Caulerpa and

Codium, belong to the Siphonales division.

2.3 The Benefit of Seaweed

The use of seaweed in human life in everyday life, among others (Suparmi & Sahri, 2009; Syafitri, Hafiludin, & Chandra, 2022).

a) Lose Weight

Some types of seaweed, such as brown seaweed, contain the pigment fucoxanthin, which can help the body's metabolism so that fat can be turned into energy.

b) Accelerates Wound Recovery

The second advantage of seaweed is its ability to promote wound healing. Vitamin K is abundant in seaweed, and this vitamin can collaborate with platelets or cell types capable of clotting or blood clotting processes. Vitamin K can send chemical signals to platelets, causing them to collect blood and clots so that when the person is injured, the bleeding stops quickly.

c) Strengthens Bones and Teeth

Seaweed also contains a lot of calcium. If a person is allergic to cow's milk, he should consider foods containing lots of calcium. In seaweed and wakame there are more than 60 mg of calcium or approximately 6% of the human daily calcium requirement. Lack of calcium can harm the formation of muscles and cells that work with the nervous system.

d) Increasing Energy

Another content that exists in seaweed is iron. The benefits that can be obtained from iron are as a tool for producing the energy needed for the combustion process in the body when carrying out various daily activities.

2.4 Seaweed Cultivation Techniques

Cultivation processes in seaweed plants that need attention include the following.

a) Seaweed Breeding

Seaweed usually reproduces by producing microscopic spores from apparent breeding organs. The tissue structure for this breeding process can help group specimens because they can be seen with the naked eye.

The breeding cells produced from this breeding organ are fertile. Seaweed reproduces by sexual and asexual means. Breeding seaweed is quite complex.

b) Sexual Breeding

In sexual reproduction, two different seaweed individuals can release two gametes each. These gametes can form a new generation that contains the genetic traits

of both parents. The gametes produced for reproduction consist of several features.

Isogamy is the mixing of two gametes that are similar in size and shape. If the two gametes differ in shape and size, mixing the large ovum with the tiny moving sperm will mix, which is also called oogamy.

c) Asexual Reproduction

For many seaweed species, asexual reproduction is more common than sexual reproduction. A small part of the thallus, namely thallus granules, can grow and develop to form a new individual. Seaweed can produce various types of spores as a breeding tool. These spores have relatively high resistance to conditions that can cause the spores to spread far from the original parent and germinate in a new growing environment. The characteristics of the spore can cause the spore to have a reasonably high resistance, namely the form of a barrier wall that functions as a protective barrier for the spore. Some spores have a flagellum for movement and are known as zoospores. Spores that do not have a flagellum are known as aplanospores.

2.5 Seaweed Habitat

The habitat of seaweed is in coastal waters and on the seafloor. Therefore, seaweed can also grow in rocky, muddy, and sandy environments, on the surface of shells, wood, and trawls, and as epiphytes on other seaweed.

Seaweed attaches to the substrate when strong currents and waves strike it. Depending on the type of adhesive the seaweed uses, the substrate contains both living and nonliving things.

Substrates include marine plants, animals, rocks, and seafloors like mud and sand. Numerous factors, including sunlight, salinity, temperature, animal-plant interactions, and waves and currents, can influence the distribution of seaweed within a habitat.

2.6 Diversification of Processed Products

Several types of Seaweed products consist of (Safitri, Widiada, Swiyajaya, & Sofiyatin, 2018):

1. Seaweed Syrup is a diversification of processed seaweed products that mix Seaweed extract with fruit juice and sugar. This product is one of the innovations in seaweed processing. Various Flavors can be used to add to the taste because seaweed has no taste (plain).
2. Seaweed Crackers are snacks made from a mixture of tapioca flour and wheat flour with additional ingredients in the form of seaweed and the addition of spices as flavorings. The advantages of seaweed crackers are that they have a distinctive taste, are crunchy, and also have benefits for the health of the human body. Seaweed Crackers are marketed as ready-to-eat (cooked) or semi-finished (raw) food.

3. Seaweed jelly candy is made from fruit or plant extract and a gelling agent with a clear, transparent appearance and specific chewy texture. Seaweed jelly candy is made from extracted seaweed and accompanied by the addition of other ingredients.
4. Seaweed Stick is a diversification of the processing of seaweed culture results, where the method of making is relatively easy with ingredients that are easy to obtain at low prices and through mixing seaweed with fish meat and glutinous rice flour and other ingredients.
5. Seaweed Dodol is a diversification of processed seaweed. It is a type of food that belongs to the category of semi-wet food, which has low water activity. As a semi-wet food, dodol has the property of being able to preserve itself without the need for refrigeration, sterilization, and drying (Idrus, 1994). Seaweed dodol is made by adding seaweed to increase the use value of seaweed.

3. Methodology

3.1 Location and Time

This research was written based on the results of observations and a direct follow-up, which was carried out from 19 to 20 August 2022, located at UKM.CAHAYA MADINA, South Nunukan.

3.2 Method of Collecting Data

The types of data obtained based on the results of direct observation and research are as follows:

1. Observation is the type of data carried out by direct observation by researchers of the object to be studied directly in the field for further research recorded, noting existing events, and collecting those related to all conditions and behavior in the field. The author also participates in production directly and is involved in activities carried out at UKM CAHAYA MADINA.
2. Documentation. In addition to interview and observation data types, documentation is of equal importance, specifically the collection of documents in the form of photographs, audio recordings, and videos, as well as data sources, which are then used to interpret and corroborate data obtained in the field.

3.3 Types and Source of Data

This study's data collection method is founded on the results of observations conducted at UKM CAHAYA MADINA, which is involved in processing marine products. The various data collection approaches employed includes:

a) Primary Data

Primary data collection was obtained by carrying out and directly following observation activities from the beginning to the final process obtained from UKM Cahaya Madina. It was done through active participation, observation, and direct communication (interviews).

b) Secondary Data

Secondary data collection was obtained through a literature study, collecting data from the internet related to the processing of fishery products, especially the processing of seaweed dodol, magazines, newspapers, books, documentation data, and parties related to the processing of seaweed dodol (*Eucheuma cottoni*).

3.4 Tools and Materials

a) Tools

The tools used in Seaweed Dodol Processing are:

Table 2. Seaweed dodol processing tool

No	Tools
1	Knife
2	Basin
3	Cutting board
4	Sieve
5	Stainless Wok
6	Wooden Spoon
7	Measuring cup
8	Scales
9	Mold container
10	Blender

b) Materials

The materials used in the processing of Seaweed Dodol are:

Table 3. Seaweed dodol processing materials

No	Materials
1	Seaweed
2	Glutinous rice flour
3	Sugar
4	Coconut Milk
5	Flavoring
6	Water

4. Finding and Analysis

The results of the seaweed dodol processing can be seen in Fig. 2. Research conducted on dodol this time uses seaweed as the main ingredient with a 1:1 ratio between seaweed and sugar used, adding vanilla, salt, colouring, coconut milk and water. Making dodol includes preparing materials and tools, washing seaweed, cutting, blending, cooking, printing, cutting

dodol, drying and packaging. Seaweed contains components such as fucoidan, alginates and polyphenols. Fucoidan, the most significant component in seaweed, has been scientifically proven to produce immune cells. It helps fight viruses, bacteria and allergies and inhibits blood clots, reducing stroke risk.



Fig. 2. Seaweed product

Apart from that, other benefits include lowering cholesterol levels, high blood pressure and stabilizing blood sugar levels, relieving digestive disorders, improving liver function, maintaining skin moisture and firmness, and helping the formation of the lunkhead that is produced. The sugar solution is then added to the thick coconut milk, which has previously been boiled until the water evaporates and oil formation.

The purpose of adding sugar to making dodol is to give it a sweet taste, and pleasing aroma, as a preservative and to help the texture of dodol harden very quickly. Therefore, dodol printing has to be done very quickly. If not, the shape of the dodol will not harden evenly, and this is due to the sugar content in the dodol dough. Drying dodol is to preserve dodol to make it last longer, reduce the water content in dodol and make the resulting dodol brighter and more attractive.

The things that need to be considered in making dodol so that the dodol produced is good are as follows; namely the quality of the essential ingredients and additional ingredients, the correct processing method, the proper drying process (not too long and not too fast), the concentration of the ingredients used and molding the dough is good and as desired.

5. Conclusion

Based on the results of observations at UKM Cahaya Madina, it can be concluded that:

1. Good quality dodol has a texture that is soft enough. The outside is shiny due to the sugar coating or glazing, has a distinctive taste, and if it contains oil, it does not taste rancid.
2. The process of making dodol starts with preparing tools and materials, then washing the seaweed, cutting, blending, cooking, printing, cutting dodol, drying and packaging.
3. Seaweed dodol is a processed product that is very popular because of its soft texture, attractive colour, sweet taste and distinctive aroma.

4. The use of sugar in making seaweed dodol functions as a sweetener as well as a thickener, as well as a preservative in dodol.
5. The function of drying dodol is to preserve dodol so that it lasts longer, reduce the water content in dodol and make the resulting dodol brighter and more attractive.

Acknowledgement

The authors would like to thanks Mr. Arkas Viddy, Ph.D. the director of Politeknik Negeri Nunukan, Dr. Besse Asniwaty, M.Si, the first vice director of Politeknik Negeri Nunukan and Dr. Raqifoh, M.M., the second vice director of Politeknik Negeri Nunukan for supporting this study until it is published in Borneo Engineering & Advanced Multidisciplinary International Journal.

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Smart Monitoring System for Poultry Farming

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Full Paper

Article history

Received

30 July 2023

Received in revised form

30 July 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

The chicken poultry sector is critical to our country's long-term food supply. The coop's climate is one of the factors that ensures chickens grow in the best possible conditions. Without proper environmental management and oversight, heat stress and illness problems could possibly result in a decrease in the amount of chicken meat and eggs produced. To address the prospect of a shortage soon, it is critical to optimize chicken production through standardized farming management and practices. With the application of Wireless Sensor Network (WSN) and Internet of Things (IoT), its potential benefits to the poultry sector. It could serve as a foundation for low-cost, easy-to-implement solutions. The aim of this project is to develop a system that is linked to an application and serves as a monitoring assistance for chicken farms. This project employed a digital temperature and humidity sensor that can communicate and transmit real-time data to the ESP8266 microcontroller and display them via Android mobile phone from the Blynk Cloud system. This system also activates fans to control the air when the air quality dropped sensed using the temperature and humidity sensor module DHT22. This auto detection and monitoring system effectively implemented the quickest response time and accurate monitoring of an emergency, assisting in the speedier dissemination of the critical situation. Creating an intelligent poultry farm will make it easier to replace physical labour with poultry work. Human labour will also be reduced with this prototype, and intelligent work will be accomplished anywhere and anytime.

Keywords: - Smart monitoring system, ESP8266 microcontroller, DHT22, Blynk Cloud System

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1. Introduction

One of Malaysia's most important industries for producing a sustainable food supply is the poultry industry. In Malaysia, chicken is a substantial and reasonably priced source of protein. In accordance with Ferlito (2020), the average annual intake of chicken meat increased from 35kg to 49 kg in 2019 and is projected to increase to 50 kg by 2025, whereas the average annual consumption of eggs is close to 20 kg. As a result, Malaysian poultry producers play a crucial part in preserving the health of chickens.

The implications of managing the chicken's welfare, care, comfort, and well-being have generated a lot of debates and extensive research. There are several factors that can affect the poultry's health, including housing

design, stocking density, ventilation, temperature, and illumination (Karcher, 2021). Due to Malaysia's typical tropical environment, which includes hot, humid months throughout the year, a problem frequently occurs when temperature variations are not considered, leading to a hot day with insufficient ventilation. Very hot weather causes heat stress to the chickens. Chickens are prone to heat stress when the atmospheric temperature and humidity uncontrollably rise, which raises their core body temperatures. Because of the excessive humidity in the chicken coop, this often leads to an increase in respiratory issues. To cool their bodies, they will pant, expand their wings, drink more water, consume less food and eventually death. Additionally, the inappropriate humidity and temperature in the chicken coop may make the chickens more susceptible to illnesses like Coryza, which makes chickens' eyes swell and makes them lose their

appetite (Budiarto et al., 2020).

Each age of chicken has a different optical temperature, and a coop should not be exposed to temperatures and humidity higher than 320C and 70% respectively (Budiarto et al., 2020 and Nalendra, 2021). Proper ventilation becomes crucial to help lower the risk of heat stress and is also important for the purpose of removing moisture, removing excess heat, exchanging the gases created by the litter, and providing fresh air. However, the temperature and air quality on a chicken farm are difficult to deal with, especially in traditional farming. In traditional farming, human labors must check the temperature and humidity readings manually and regularly. The effort of maintaining the poultry farm is exhausting for them. It is also challenging to keep an eye on the farm's condition around-the clock.

Thus, extensive research has been carried out to solve this issue. One of the preventive measures to overcome the monitoring of the poultry farm environment is to use an IoT based monitoring system. The proposed software-based devices can track conditions at chicken farms, including humidity and temperature. This research puts forth a fresh approach of bringing IR4.0 technology to traditional poultry farming to make it smarter. The coop is connected to smart equipment such a microcontroller, sensor, and application programme. This enables the automation of the chicken farm to circulate or exhaust the air within the coop according to the data sensed by the sensor. The system is made to be remotely controlled by the user(s) via an Android mobile application without the need for the poultry farmers to be there. This prototype will be very helpful at the poultry farm and at the same time it will reduce expenses, time as well as human labor while doing intelligent job in the chicken farming sector.

This manuscript describes the development of an automatic smart environment sensing particularly for poultry farms. The proposed system can also automatically control the parameters while monitoring the measured temperature and humidity. Additionally, the designed system is connected to a wireless network where real-time temperature and humidity readings may be viewed on mobile devices and personal computers running the Blynk Application. The organisation of this document is as follows: The proposed system is introduced in Section I. The related study done by earlier researchers is presented in Section II. In Section III, the proposed system is outlined, and in Section IV, the findings and conclusions are presented. The conclusions and suggestions are summarised in Section V.

2. Literature Review

Heat stress is the most important problem in poultry production. Hot and humid weather, combined with ineffective management approaches, increases flock mortality, limit growth, and reduces chicken output to an unprofitable level. In addition, these problems could disrupt hired labor and staff. Thus, much research has been done to control the chicken farms' environment.

Automated chicken farms with controlled environments based on microcontrollers can help to monitor and review the air quality in place of the current monitoring technique (Nalendra et al., 2021; Ramadiani et al., 2021 and Enriko and Putra, 2021). The outcomes demonstrated that the electronic system could operate with high accuracy to record or display it in a storage device (Junaidi et al., 2022). Another study's findings, which were published in (Mitkari et al., 2019), demonstrated the use of an electronics system to track the air quality in terms of temperature and humidity. Given how crucial temperature and humidity are to chicken growth, it is imperative to constantly monitor those variables utilising an electronic based system. It is crucial to monitor closely on the chicken coop's primary indicators to lower the mortality rate of chickens, especially during the vulnerable period when the coop is in poor condition and the chicks are between the ages of one day and three weeks. It will lessen the losses experienced by farmers while boosting their profit by lowering the chick mortality rate. The research is continued to improve the monitoring of the chicken coop environment using a local network and controlling devices such as the ventilation system and moisturising devices (Mitkari et al., 2019). The study, however, revealed that implementing such method would only allow chicken farmers to statically monitor the environment variable using a specific computer.

Thus, there have been numerous research studies on the prototype of chicken coop automated mobile monitoring system using wireless technologies such Global System Messaging (GSM) and IoT technology. Ali et al. (2020) suggested detection and monitoring of air quality in chicken coop using MQ11 sensor and embedded with Arduino WeMo's D1 hardware that comes with a Wi-Fi module. Adinegoro et al. (2020) created an IoT-based chicken coop to retrieve environmental data such as temperature and humidity using the ESP8266 microcontroller. A DHT11 temperature sensor, a lamp, and a fan were used by the monitoring system as actuators for controlling reasons. In the study, Adinegoro tested the coop environment using three different treatments: light on, fan on and both on. The results showed controlled temperature and humidity in the range from 240C-320C and 61%-78%, respectively. Poultry farmers can view sensor retrieval data through Telegram in real-time and view historical data. A temperature control system for chickens was created by Sulistiyowati et al. (2019) using a gateway SMS system that provides the poultry farmer with information. The water pump and dc motor fan served as the actuators in this system, which also utilised an LM35 temperature sensor to detect changes in the coop's environment. Microcontroller Arduino UNO was used to operate the entire system. The studies showed acceptable performance through the wireless network environment. But if the battery draining curve drops below the operating voltage, the Arduino board, which has an operating voltage of 5V, may be unable to function due to running time when a battery is the power supply. In addition, the proposed prototype that employed GSM and

Telegram has no dashboard to monitor the trend of the environment in the chicken coops.

When these farms are built with highly automated systems of automatic temperature and humidity monitoring embedded with wireless technology, the atmosphere becomes more conducive to chicken production, resulting in continuous production.

3. Methodology

The main concept of developing this system is to monitor the temperature and humidity level detected by DHT22 for poultry farming. Fig. 1 illustrates the block diagram of the environment system development. In Figure 1, the developed system comprises of a DHT22 temperature and humidity sensor, a NodeMCU ESP8266 that is interconnected with the sensor and a 5V relay that is connected to fan(s) for regulating purposes.

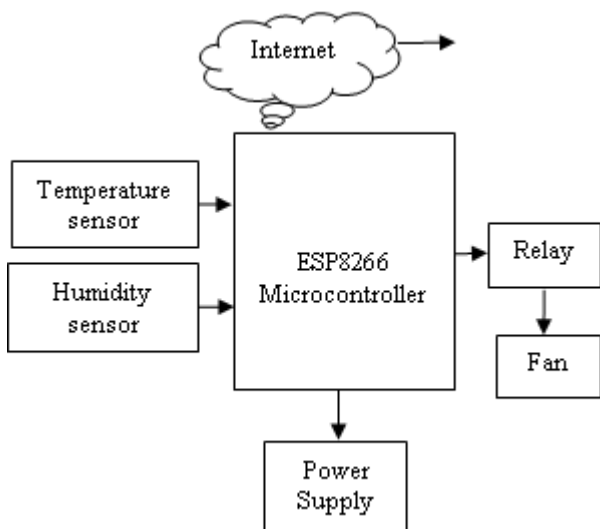


Fig. 1. Block diagram of chicken poultry farm monitoring system

This system employs DHT22 temperature and humidity sensor. It is a factory calibrated digital temperature and humidity sensor; it consists of a microprocessor that uses a capacitive humidity sensor to measure the relative humidity of the air; the closer the value is to 100%, the more humid the measured environment; it also includes a thermistor to measure the surrounding air and calculate the temperature of it; and it displays the data via a digital signal on the data pin. The benefits of these devices are their inexpensive cost and the ability to digitally perceive two analog quantities such as temperature and humidity because the sensor performs the conversions. In addition, the DHT22 is a low power consumption sensor capable of sensing 0-50°C temperature with $\pm 2^\circ\text{C}$ precision as well as 20-80% humidity measurements with 5% accuracy (Nalendra et al., 2021).

A relay is a form of circuit element that uses electromagnetic induction to work. When a current flows through it, it works as an electrical switch, allowing the attached fan to be turned on and off. The switching

concept is based on the electromagnetic principle, and the three components that comprise a relay are the coil, pallet, and contact. The coil serves as the relay's input and is not electrically connected to the pallet or contact section. The relay provides massive current and voltage control without being impacted by the load frequency by using modest currents and voltages.

In this system, NodeMCU ESP8266 is the main microcontroller unit which connects to sensor(s) and other output(s) for data logging. The microcontroller is integrated with Arduino Integrated Development Environment (IDE) as it offers a simple user interface for creating, compiling, and uploading code to an Arduino microcontroller. It is an authorised application for controlling and uploading software to Arduino boards. Input device, temperature sensor, DHT22 will sense the surrounding temperature and moisture continuously and always compare with the desired value suitable in the chicken coop. Simultaneously, the humidity sensor, DHT22 will also sense the level of moisture from the surrounding. If there is a sudden increase of heat and moisture level in the chicken coop or a location where the devices are installed, DHT22 will automatically detect and immediately send a signal to the NodeMCU ESP8266. Upon receiving the signal, the microcontroller processes the signals and sends the data to the users via Blynk Cloud system.

Blynk Cloud system is an IoT platform for iOS or Android smartphones that allows users to remotely operate devices like Arduino, Raspberry Pi, and NodeMCU. Using this application, the right address on the various widgets to construct a graphical interface or human machine interface (HMI) can be compiled. For use with the Internet of Things, Blynk was created. It can store data, visualize it, display sensor data, remotely operate hardware, and perform many other fascinating things.

In the event when the signal exceeds the predetermined threshold values of, the system will automatically activate the other external devices, consisting of fans and mobile phones, as a sign of warning to inform the users and to control the temperature and humidity level in the chicken coop. To evacuate the warm air from the coop, fans are used. It facilitates the movement of hot air about the rooms. There will also be an automatic messaging generating operation that sends and displays notifications to the predefined cellphone numbers as well as through the Blynk application.

Fig. 2 depicts the overall system's block diagram. First, the temperature and humidity values are set. The Wi-Fi connection will then be validated. The sensor is connected to the NodeMCU ESP8266 wherein the VCC pin is connected to the 3V pin on the controller, DAT pin is connected to D5 and GND pin is connected to the ground. The sensor will read and send data to Blynk as soon as the Wi-Fi is connected to the project. In this system, the predetermined range for temperature is 33°C-35°C and 60%-80% for humidity, respectively. It is shown that when the value surpasses the temperature

threshold of 35°C, the fans will switch on. The fans will switch on if the measurement reaches the humidity threshold of 80%. If either of the conditions is met, the fans will activate. Through the Blynk application, the temperature and humidity values are shown simultaneously.

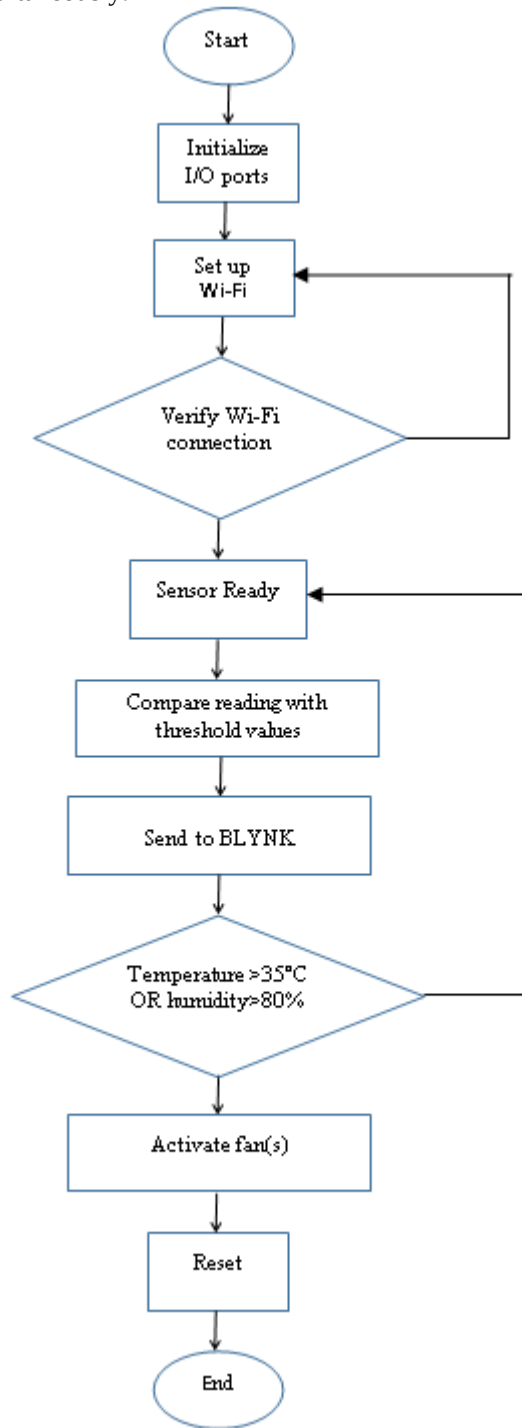


Fig. 2. Flow chart of the monitoring system

Fig. 3 shows the circuit diagram of the temperature and humidity detection system. The prototype chicken coop design incorporating sensors, fans and a NodeMCU ESP8266 is shown in Fig. 4. Different ages of chicken require different environmental conditions, such as coop size and temperature. The right temperature must be maintained to produce chicken of the highest calibre. The primary group of chickens on which attention will be paid are young chicks. For newly hatched chicks, a healthy growth range is between 33°C and 35°C. In modern chicken farming, covered coops are utilised to protect the birds from harmful weather, insects, predators, and diseases. The 33" x 20" x 20" prototype chicken coop made of wood is intended to accommodate 5 to 10 young chicks.

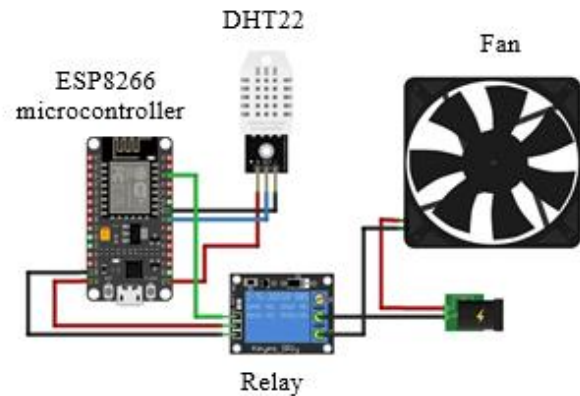


Fig. 3. Circuit diagram of the temperature and humidity detection system

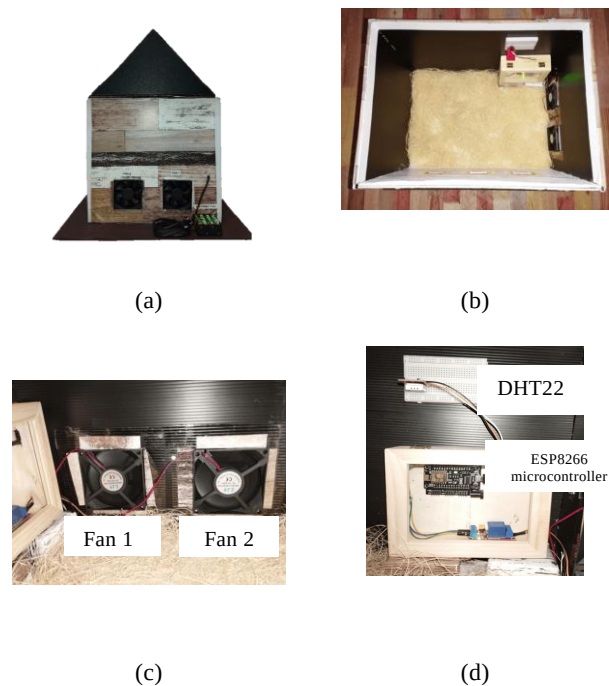


Fig. 4. (a) Prototype front view, (b) Prototype internal view I, (c) Prototype internal view II and (d) Prototype internal view III

4. Finding and Analysis

The temperature and humidity were measured using a thermometer and a DHT22 via the Blynk interface, as shown in Table 1. Every five minutes, measurements are obtained for the parameters of temperature and humidity. The thermometer serves as a reading reference for the coop's temperature and humidity. Based on the results, it can be concluded that the DHT22 sensor used in this system has a good degree of measurement accuracy because its reading is comparable to the temperature reading.

Table 1. Results of thermometer and DHT22 readings

Duration Minutes	Thermometer		DHT22	
	Temperature (°C)	Humidity (%)	Temperature (°C)	Humidity (%)
5	29	69	29.6	70
10	29	69	29.6	70
15	29	69	29.6	70
20	29	69	29.6	70
25	29	68	29.7	70
30	29	68	29.7	70

Table 2 shows the system's testing for temperature and humidity levels. Fan 1 and Fan 2 will automatically turn on in order to regulate the coop's temperature when either the temperature or humidity levels were found to be higher than the predefined range. This also applies when temperature and humidity levels exceeded the threshold values. The fans will automatically turn off when both temperature and humidity level drop to the predefined range.

Table 2. Testing of temperature and humidity level detection system

Temperature (°C)	Humidity (%)	Output (Fan)	Condition
28	86	Fan 1 and 2 activate	Humid
33	79	Fan 1 and 2 activate	Warm
33	88	Fan 1 and 2 activate	Warm and Humid
27	79	Fan 1 and 2 inactivate	Normal

When the ambient temperature and humidity are within the usual range, neither Fan 1 nor Fan 2 activated. The real-time temperature and humidity data are simultaneously transmitted to the users remotely via mobile devices and personal PCs, as shown in Fig. 5.



Fig. 5. Temperature and humidity display on Blynk application

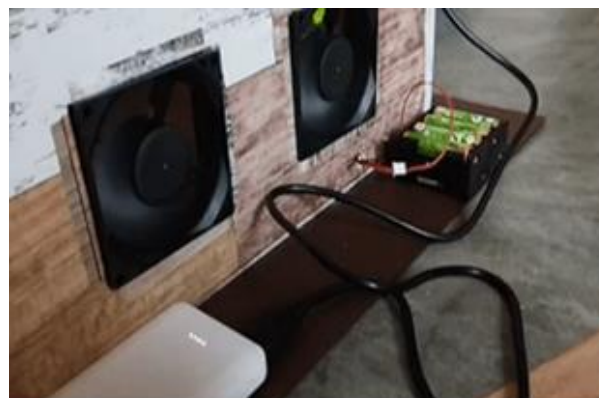


Fig. 6. Fan activation

In Table 3, chicken age of 12 days test results for a day. From Table 3, it can be seen that the temperature of the cage can be maintained between the temperature ranges of 26 to 32°C. Only in the range of 12 noon to 15 hour, the temperature of the cage reaches a temperature of 28.4°C and 32.1°C. This is due to the large value of the ambient temperature greatly affecting the temperature of the cage so that the fan cannot maintain the temperature of the cage at the specified temperature value. The fan will automatically turn on when the temperature of the cage is above 33°C as shown in Figure 6 and will turn off automatically when the temperature reaches below the temperature of 33°C.

Table 3. Temperature and humidity measurement results

Time	Temperature (°C)	Humidity (%)	Status
00:00	26.0	68	Fan Deactivate
03:00	25.5	68	Fan Deactivate
06:00	26.5	67	Fan Deactivate
09:00	28.7	69	Fan Deactivate
12:00	32.1	70	Fan Deactivate
15:00	30.4	70	Fan Deactivate
18:00	28.4	69	Fan Deactivate
21:00	27.0	68	Fan Deactivate

Fig. 5 shows the temperature and humidity display via Blynk when the DHT22 sensor is activated. Even when the users are outside, they can easily track and monitor their farm condition remotely. People have benefited greatly from this system as an early warning system against potential dangers. From data collection to the actual processing of temperature and humidity, this device runs smoothly. Under Industry 4.0, this networking environment has a mechanism that allows for the transfer of necessary information, especially emergency at today's industry communication speeds.

5. Conclusion

In conclusion, this intelligent system makes it possible to collect and track environmental data for chicken production. Maintaining chicken coops at the ideal temperature and humidity level is made possible by well-designed temperature sensing circuits. In terms of detecting the temperature and humidity, all employed sensors have performed satisfactorily. The Blynk Cloud system, an IoT platform, receives all the readings and processes them for display via personal computer and Android mobile application. Additionally, a remote actuator system has been developed to adjust temperature and humidity. The health and productivity of hens are now improved due to intelligent environmental condition monitoring via a sensor network. Poultry farmers may now remotely monitor their farms because of the system implementation and the Blynk application's capability to read temperature and humidity measurement. This system is incredibly efficient and cost-effective, which will appeal to all poultry farmers. The system can be further enhanced by integrating other devices such as automated feeding system as well as adding solar panels to provide sustainable and green energy.

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Storage Equipment for Woodstock Assembly Line

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Full Paper

Article history

Received

1 August 2023

Received in revised form

1 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This addition storage design proposal aims to improve the efficiency of the Woodstock production line by reducing cycle times through the implementation of new storage equipment and material handling systems. The current process is plagued by delays and inefficiencies in material handling, leading to longer cycle times and reduced productivity. The proposed design is expected to reduce cycle times by up to 10%, resulting in increased productivity and cost savings. In the proposed design for storage equipment and material handling, worker safety is of utmost importance. The use of tin shoulder, scissor, and air pressure gun can pose potential hazards to workers if not properly managed. Therefore, the design will incorporate several safety features to mitigate any risks. Overall, the new storage and material handling system will help the Woodstock production line remain competitive in the market and better serve customer demands.

Keywords: - Manual material handling, material handling, cycle time, storage equipment

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1. Introduction

1.1 Background

The manufacturing industry has been hit hard by the COVID-19 pandemic, which has led to production restrictions and closures due to its high reliance on the workforce and complex supply chain. However, companies can still innovate and pivot to overcome these challenges by making process improvements, managing their supply chains better, and investing in automation and information technology. This is crucial for their survival in these difficult times. The automotive industry is a vital contributor to the economies of both developed and emerging nations, and its performance can impact a country's economic development. Before the pandemic, the automotive industry was expected to grow steadily. WSA Engineering Sdn. Bhd. is a top supplier of automotive parts to Proton, Perodua, and other automakers in

Malaysia. They have two product categories: automotive parts and interior design services. They have produced headliners, door trims, and floor carpets for various automotive components. Their main customers include Proton, Perodua, Honda, Hyundai, Toyota, Volkswagen, and Volvo. Additionally, they have also produced commercial carpets for interior design sectors, which have been used in the interior design of various buildings.

Due to the high demand for automotive parts, particularly D51A, this study aims to design a storage equipment for Woodstock assembly line while analyse its impact for the line. Storage equipment in manual material handling can significantly improve production efficiency. By utilizing appropriate storage equipment, workers can store and access materials quickly and easily, reducing the time spent searching for materials and improving productivity. Efficient storage also helps to prevent damage or loss of materials, reducing waste and costs. Additionally, storage equipment can help to organize materials and create more space in the work

environment. This reduces the risk of accidents and injuries due to cluttered or cramped working conditions, improving overall safety in the workplace.

1.2 Objectives

1. To identify the problem regarding storage equipment in workstation.
2. To design the material handling new storage equipment (Manual Handling - Storage Equipment) in WSA Engineering Sdn. Bhd.
3. To analyse the impact of storage equipment for Woodstock Line

1.3 Production Plant Layout

The most appropriate production layout for manufacturing large quantities of standardized goods or services is the assembly line, also known as repetitive manufacturing. This involves producing the same item multiple times in order to achieve a specific production rate. The assembly line is typically a dedicated production line that operates continuously throughout the year, producing identical products. The speed of the production process can be adjusted to meet the specific needs of individual customers.

1.4 Process Flow Headlining P213A

There are 5 workstations in process forming of headlining. The technique on the assembly line has been chosen based on the bike timetable. Fig. 1 below shows the product that being produce at Woodstock line.

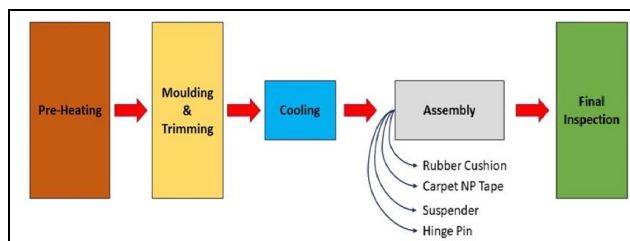


Fig. 1. Product produced at Woodstock line

2. Literature Review

2.1 Material Handling

Material handling is a critical component of any manufacturing process, and recent research has focused on improving the efficiency and safety of these operations. One study by Song and Lee (2021) examined the impact of various material handling methods on productivity and efficiency in manufacturing operations. The authors found that automated material handling systems were more efficient than manual methods, particularly for high-

volume production processes. The use of automated systems also reduced the risk of worker injury and improved overall safety in the workplace. Another study by Etebari et al. (2020) investigated the impact of material handling on supply chain management. The authors found that effective material handling systems can improve supply chain efficiency by reducing lead times, inventory costs, and transportation costs. The study also emphasized the importance of integrating material handling systems with other supply chain technologies, such as warehouse management systems and transportation management systems.

In a study by Yao et al. (2021), the authors developed a simulation model to optimize material handling in manufacturing operations. The model was used to evaluate the impact of different layout designs and material handling methods on production efficiency and overall costs. The authors found that an optimal material handling system could reduce production costs by up to 23%. Finally, a study by Yousuf et al. (2021) focused on the role of material handling in sustainable manufacturing. The authors emphasized the importance of reducing waste and improving resource efficiency in material handling operations, and highlighted the potential for automation and other technologies to improve sustainability.

2.2 Manual Material Handling

Manual material handling refers to the process of moving, lifting, and carrying materials and products by workers, without the use of automation or mechanical equipment. This process can be physically demanding and can increase the risk of work-related injuries. Recent literature has focused on improving manual material handling practices and reducing the risk of injury. A study by Park et al. (2020) investigated the impact of a manual material handling training program on worker safety and productivity. The authors found that the training program improved worker knowledge of safe material handling practices and reduced the number of work-related injuries. The training program also led to improved productivity and efficiency in manual material handling tasks.

In another study, Chung et al. (2021) investigated the impact of ergonomic interventions on manual material handling tasks. The authors found that ergonomic interventions, such as adjusting workstations and providing lifting aids, reduced the risk of musculoskeletal disorders and improved worker comfort and productivity. A review by Ayoub and Mabrouk (2021) highlighted the importance of effective manual material handling practices in the healthcare industry. The authors emphasized the need for healthcare workers to use proper lifting techniques and to have access to appropriate lifting equipment. The review also emphasized the importance of training programs and ergonomic interventions in reducing the risk of work-related injuries in healthcare settings.

In a study by Kim et al. (2021), the authors developed a wearable device to monitor worker posture and movements during manual material handling tasks. The device was designed to provide real-time feedback to workers and supervisors, with the goal of improving worker posture and reducing the risk of injury. The authors found that the device improved worker posture and reduced the risk of musculoskeletal disorders. Finally, a study by Lee et al. (2020) investigated the impact of age and experience on manual material handling tasks. The authors found that older workers and less experienced workers were more likely to experience work-related injuries during manual material handling tasks. The study emphasized the need for targeted training and ergonomic interventions to reduce the risk of injury in these populations.

2.3 Cycle Time

Cycle time is an important metric used in manufacturing to evaluate the efficiency of a production line. In woodstock production, cycle time refers to the time it takes to complete one cycle of production, from the start of one piece of wood entering the production line to the completion of one finished woodstock product. This metric is important because it directly affects the overall production capacity and can be used to identify opportunities for process improvement.

In a study by Li et al. (2020), the authors evaluated the impact of different production factors on cycle time in a wood-based panel manufacturing plant. The study found that the type of wood material used had a significant impact on cycle time, with thicker and harder woods resulting in longer cycle times. Additionally, the study found that equipment maintenance and production speed were important factors in reducing cycle time and increasing production capacity. Another study by Wang et al. (2018) investigated the impact of automation on cycle time in a wood furniture production line. The study found that implementing automated material handling systems and robotic equipment resulted in a significant reduction in cycle time and increased production efficiency.

In a more recent study by Alam et al. (2021), the authors evaluated the impact of lean manufacturing principles on cycle time in a wood furniture manufacturing plant. The study found that implementing lean manufacturing practices, such as reducing waste and optimizing production flow, resulted in a significant reduction in cycle time and increased production efficiency.

2.4 Storage Equipment

Material handling is an essential aspect of many industries, including manufacturing, construction, and warehousing. Various tools and equipment are used in material handling operations, including scissors, shoulder, and air pressure guns. Efficient storage and management of these tools and equipment are crucial to enhance productivity and reduce the risk of injuries.

Scissors are commonly used in cutting operations, and they come in different sizes and designs. According to the Occupational Safety and Health Administration (OSHA), scissors should be stored in a secure and easily accessible location to prevent accidents. Wall-mounted scissor racks are a popular storage solution, as they allow easy access and minimize the risk of injuries. Scissor racks come in various designs, including magnetic racks and sliding racks, depending on the size and number of scissors to be stored (OSHA, 2019).

Shoulder and air pressure guns are used for lifting and moving heavy loads, and they require specialized storage equipment. Shoulder gun holders are designed to hold the gun securely, and they come in various sizes and shapes, depending on the type of gun. The holder should be mounted in a location that is easily accessible and does not obstruct other operations (Sentry Protection Products, 2021).

Air pressure guns are commonly used in material handling operations, and they require specialized storage equipment to ensure their safety and longevity. According to the Canadian Centre for Occupational Health and Safety (CCOHS), air pressure guns should be stored in a clean, dry, and secure location to prevent damage and accidents. Wall-mounted gun holders and cabinets are popular storage solutions, and they come in different sizes and designs, depending on the number and size of guns to be stored (CCOHS, 2021).

In conclusion, the storage and management of scissors, shoulder, and air pressure guns are crucial aspects of material handling operations. Proper storage equipment, such as wall-mounted racks and gun holders, should be used to ensure the safety and longevity of these tools. Employers should also ensure that their employees receive adequate training on the safe use and storage of these tools to minimize the risk of accidents and injuries.

2.5 Impact and advantages of material handling

Material handling is an essential component of manufacturing operations as it ensures the smooth flow of raw materials, work-in-progress (WIP), and finished goods within the factory. Material handling is defined as the movement, storage, and control of materials within a manufacturing facility (Muther, 2011). Effective material handling techniques and equipment have a significant impact on the overall efficiency and productivity of a manufacturing plant.

a. Advantages of Material Handling

- i. **Improved Efficiency:** Material handling equipment and techniques improve efficiency by reducing the time and effort required to move materials within the factory. Automated equipment such as conveyor belts, robotic arms, and AGVs (Automated Guided Vehicles) can perform material handling tasks more efficiently than manual labor, reducing production cycle times (Srinivasan et al., 2020).
- ii. **Cost Reduction:** The use of material handling equipment such as conveyor systems, forklifts, and pallet jacks, reduces labor costs and improves material flow within the factory. Automated equipment reduces labor costs and reduces the risk of workplace injuries, which can be costly for the company in terms of medical bills, workers' compensation, and lawsuits.
- iii. **Increased Safety:** Proper material handling equipment and techniques enhance workplace safety by reducing the risk of workplace injuries. Automated equipment reduces the risk of injuries caused by manual handling of heavy loads and repetitive motion injuries (Muther, 2011).
- iv. **Improved Quality:** Efficient material handling processes and equipment can improve product quality by reducing product damage, contamination, and defects. Automated equipment such as robotic arms and AGVs can handle materials more precisely and delicately than manual labor, reducing the risk of product damage (Srinivasan et al., 2020).

b. Impact of Material Handling

- i. **Production Cycle Times:** The use of material handling equipment reduces production cycle times, resulting in increased productivity and reduced lead times. Automated equipment such as conveyor belts and AGVs move materials faster and more efficiently than manual labor, reducing production cycle times (Muther, 2011).
- ii. **Inventory Management:** Effective material handling techniques improve inventory management by ensuring the smooth flow of raw materials, WIP, and finished goods within the factory. Automated

equipment such as pallet jacks and forklifts can move materials more efficiently, reducing inventory holding costs and improving inventory control (Srinivasan et al., 2020).

- iii. **Capacity Utilization:** Material handling equipment and techniques enable manufacturers to utilize their production capacity more efficiently. The use of conveyor systems, robotic arms, and AGVs ensures that materials are moved quickly and efficiently within the factory, reducing bottlenecks and idle time (Muther, 2011).
- iv. **Customer Satisfaction:** Efficient material handling processes and equipment can improve customer satisfaction by reducing lead times, increasing product quality, and ensuring on-time delivery. Effective inventory management and material flow ensure that products are delivered on time and meet customer quality standards (Srinivasan et al., 2020).

Effective material handling techniques and equipment have a significant impact on the efficiency and productivity of manufacturing plants. Proper material handling equipment and techniques reduce labor costs, increase safety, improve product quality, and reduce lead times. Automated material handling equipment such as conveyor systems, robotic arms, and AGVs provide significant advantages over manual labor in terms of speed, precision, and efficiency. The impact of effective material handling includes improved production cycle times, inventory management, capacity utilization, and customer satisfaction. In conclusion, material handling plays a vital role in the success of manufacturing operations, and manufacturers should invest in proper material handling equipment and techniques to optimize their operations.

3. Methodology

3.1 Observational Research

Observational research is a type of research design that involves observing and recording the behavior of individuals or groups in their natural environment. This research design is often used to gain insights into behavior that cannot be studied using experimental methods. In an observational research study, researchers observe and record behaviors, actions, and events without manipulating any variables (Loria, Sancho & Ruiz-Olabuénaga, 2021). Observational research is a valuable tool for researchers in various fields as it allows them to gain insight into real-world behaviors without interfering with them (Gelso & Hayes, 2018). However, observational research also has limitations, such as potential biases and limitations in generalizability. Nonetheless, the insights gained from observational research can provide a foundation for future research and inform practical applications. Fig. 2 below shows the overall research methodology for this study.



Fig. 2. Overall research methodology

3.2 Data Collection

Based on observations and survey, the most significant problem that needs to be solved is in the Woodstock assembly line which requires improvement in safety and material handling at the area. Efficient material handling and safe working practices are essential for industries such as the Woodstock line, which produces Package Tray Trim for Perodua Myvi (D51A). However, accidents can still occur if proper procedures are not in place. One such risk factor is inadequate storage for sharp and hot items, which can cause injuries if left lying around.



Fig. 3. Woodstock line and targeted area

In addition to this, another risk factor is the improper setup of tools for assembling the Package Tray Trim. The tools, which include a shoulder, scissor, and air pressure, need to be set up carefully and correctly to ensure safe and efficient operation. If not set up properly, workers may take the wrong actions, leading to accidents and injuries as can be seen in Fig. 4.

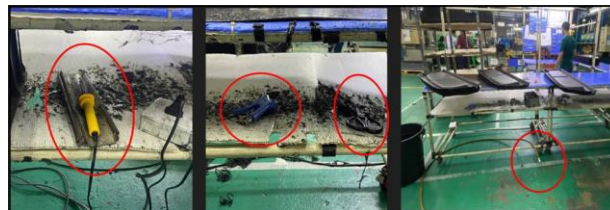


Fig. 4. Woodstock assembly table condition

4. Discussion

The Woodstock line must implement appropriate storage practices for sharp and hot items, such as labeling and organizing containers, to reduce these risks. Additionally, workers should receive sufficient training on how to set up assembly tools correctly as well as how to use them safely and effectively. Worker training properly can lower the risk of accidents and increase productivity. Making new shoulder, scissors, and air gun storage equipment can benefit industries that use these tools for material handling and assembly operations in a number of ways.

First off, having specialized storage equipment made just for these tools can keep them well-organized and accessible. Workers won't have to waste time looking for the right tool, which can help save time and increase productivity. Second, using the right storage tools can help keep the tools from getting damaged, extending their lifespan and lowering the frequency of replacements. Inadequate tool storage can result in loss or damage, which can cause production to be delayed and increase costs for the business. Thirdly, the safety of workers can be enhanced with storage equipment made for these tools. The storage apparatus can be made to allow for proper labeling and grouping of tools according to their use and any potential dangers, like hot or sharp edges. This can lessen the likelihood of workplace accidents by preventing employees from inadvertently using the incorrect tool or coming into contact with hot or sharp surfaces. This gave rise to the concept of designing a tool storage system, as shown in Fig. 5.

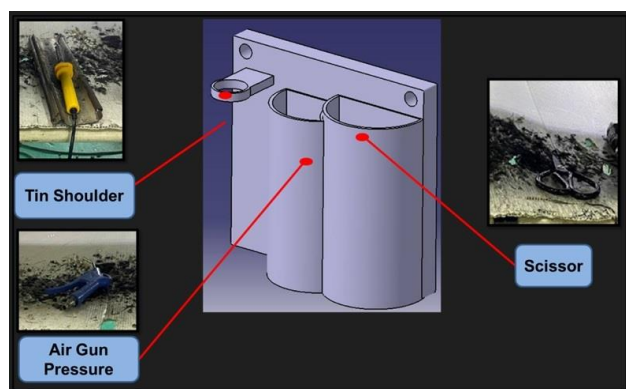


Fig. 5. Design for storage equipment at Woodstock assembly workstations

A typical style of container used to store a variety of substances, including compressed gases, liquids, and powders, is cylindrical storage equipment made of stainless steel. Due to their strength and resistance to corrosion and other forms of damage, these containers are frequently used in industrial and laboratory settings.

Cylindrical stainless steel storage equipment is a great choice for safely storing scissors, shoulder, and air gun pressure. A variety of equipment can be stored safely and effectively in these containers, which can also be equipped with specialized fittings and valves. For instance, a pressure relief valve can be added to a stainless steel storage container in the form of a cylinder that is intended to hold air gun pressure in order to prevent overpressurization and ensure secure storage. Similar to this, special racks or compartments can be added to a container made to hold scissors safely in order to safeguard the blades and ensure proper handling. Overall, stainless steel storage equipment in the form of cylinders is a great option for securely keeping scissors, air gun pressure, and shoulders. These containers can be tailored to meet particular storage needs and offer durability and corrosion resistance.

4.1 Before Improvement Made

The workers at Woodstock line had to spend a significant amount of time searching for tools before storage equipment was implemented on the assembly line. It took them over 5 seconds to locate a single tool. When you consider that the production line churns out approximately 200 pieces per day, this lost time quickly adds up. In fact, workers were wasting around 1,340 seconds or roughly 22 minutes per day searching for tools. This was an inefficient use of time and impacted the overall productivity of the operation. Table 1 shows the collected cycle time to find the equipment tools before the implementation of storage equipment.

Table 1. Overall cycle time of process including to find equipment tools (before)

No.	D51a Package Tray Trim	Time Measurement Cycle Time Process			
		1	2	3	Average
1	Pre- Heating	64s	66s	63s	64.3s
2	Molding & Trimming	86s	87s	84s	85.6s
3	Cooling	126s	125s	122s	124.3s
4	Rubber Cushion Assy	37s	34s	39s	36.7s
5	Carpet NP Tape Assy	30s	29s	28s	29s
6	Suspender Assy	68s	65s	67s	66.7s
7	Hinge Pin Assy	36s	37s	38s	37s
8	Searching for Tool	6s	9s	5s	6.7s
9	Final inspection	57s	58s	55s	56.7s
TOTAL					570s

4.2 After Improvement Made

The implementation of storage equipment on the assembly line helped to alleviate this issue by providing a dedicated location for tools to be stored. This made it easier for workers to locate the tools they needed, reducing the time spent searching and increasing overall efficiency. This completely erase the time taken to search the tools. Table 2 shows the Cycle time to find the equipment tools after the storage equipment being made.

Table 2. Cycle time overall process (after)

No.	D51A Package Tray Trim	Time Measurement Cycle Time Process			
		1	2	3	Average
1	Pre- Heating	64s	66s	63s	64.3s
2	Molding & Trimming	86s	87s	84s	85.6s
3	Cooling	126s	125s	122s	124.3s
4	Rubber Cushion Assy	37s	34s	39s	36.7s
5	Carpet NP Tape Assy	30s	29s	28s	29s
6	Suspender Assy	68s	65s	67s	66.7s
7	Hinge Pin Assy	36s	37s	38s	37s
8	Final inspection	57s	58s	55s	56.7s
TOTAL					563.3s

5. Conclusion

The study begins with the importance of proper equipment for material handling and storage. This is crucial in industries that store compressed gases or liquids in specialized containers. To ensure safety and efficiency, storage equipment must be designed for the substance. Procedures boost production, which is the second point. This streamlined Perodua Myvi package tray trimming process increased production. This emphasizes the need for well-designed procedures that optimize workflow and minimize time and effort.. To reduce injury and ensure equipment safety, proper training and safety procedures should be implemented. Proper storage equipment helps identify equipment. In industries that require equipment storage, this is important. Using easy-to-identify storage equipment saves time and reduces errors during equipment retrieval. By emphasizes problem-solving when identifying material handling and storage issues, its

creating workflow-optimizing and cycle-time-reducing solutions requires creativity. The sixth point emphasizes new design to reduce cycle time and motion. To maximize efficiency, material handling and storage practices must be evaluated and improved. Seventh, a new storage design reduces operator movement. This underscores the importance of designing material handling and storage practices to minimize movement and reduce injury and accident risk.

Finally, the Woodstock assembly line's 5S implementation indirectly addresses material handling and storage efficiency. Sorting, organizing, cleaning, standardizing, and maintaining a workplace is the 5S principle. This method can create a tidy, productive, and safe workplace. The study concludes that manufacturing material handling and storage must be efficient. It emphasizes proper equipment, well-designed procedures, user and employee protection, creative problem-solving, new design, and 5S. These practices improve workflow, productivity, and safety in businesses.

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Students' Acceptance of CIDOS 3.5 Utilisation (Facilitating Conditions) for Learning Communicative English During the COVID-19 Pandemic

Full Paper

Article history

Received

31 July 2023

Received in revised form

31 July 2023

Accepted

11 August 2023

Published online

30 September 2023

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Abstract

The COVID-19 Pandemic has led to the change of traditional teaching and learning methods to fully online learning. Curriculum Information Document Online System (CIDOS) is one of the web-based applications to facilitate online learning. However, the usage of CIDOS during the Pandemic needs to be better understood. Thus, this research explores the impact of facilitating conditions on students' acceptance of CIDOS 3.5 for learning communicative English amidst the COVID-19 Pandemic. By investigating this relationship, the study aims to shed light on the factors that promote the successful adoption and utilization of technology for effective online learning. In this study, 100 fourth-semester students who were enrolled in the 'Communicative English 3' course and utilized CIDOS 3.5 as a learning tool during the COVID-19 pandemic were selected to participate. The research yielded positive results, indicating that facilitating conditions significantly influence students' acceptance of online learning platforms. Based on the positive results of the study, it is recommended that online learning platforms be designed to prioritize user-friendliness, with easily accessible technical support to ensure a positive user experience.

Keywords: - Covid-19, CIDOS 3.5, facilitating conditions

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1. Introduction

The widespread impact of COVID-19 on a global scale has greatly affected various aspects of life, including education, and Malaysia has not been exempted from this effect. Due to the COVID-19 pandemic, approximately 91.3 percent, or over 1.5 billion of the world's learners, are unable to attend school (Ardiansyah, 2020). Alternative approaches, such as e-learning from home, were developed to ensure that students could continue their education during this time. To thrive in an uncertain and demanding environment, learners must be prepared to excel in 21st-century skills and actively engage in problem-solving. This shift to online learning demonstrates how the use of the internet has altered habits and behaviors that were previously considered routine in face-to-face interactions.

Students would suffer emotionally and psychologically if they are abruptly cut off from their friends, educators, and the normalcy they rely on (Chung, Subramaniam, & Dass 2020). However, the current tertiary student population belongs to the Generation Z cohort, which comprises individuals born between 1995 and 2015 and has been significantly shaped by technological advancements. These students possess distinct learning preferences compared to earlier generations, as they prefer a more hands-on and personalized approach to learning. As a result, educators opt for interactive platforms and online forums to facilitate their involvement in the learning process.

The Curriculum Information Document Online System (CIDOS), an open-source learning management system (LMS), was introduced and is currently being utilized in polytechnics as an e-learning tool. The Ismail

et al., (2014) study found that the document management platform is fully automated and provides a range of functions, such as uploading, updating, and sharing digital content. Additionally, the platform enables online communication between instructors and polytechnic students, which promotes interaction and engagement in the learning process. Students can determine their learning methods when they have access to digital devices and the internet.

Online learning is particularly beneficial in catering to the specific learning needs of students, as highlighted by Norliana et al., (2020) and supported by Sukendro et al., (2020), who found that the availability of good facilities such as financial resources, infrastructure, human resources, and educational materials influences students' acceptance of online learning. This addresses a gap in the literature on students' perceptions and acceptance of online learning. Venkatesh & Bala (2008) define a facilitating condition as an individual's perception that an organizational and technical infrastructure exists to support the use of a system. When individuals perceive that the necessary resources are available and accessible, they are more likely to view the system as practical and easy to use, increasing their intention and willingness to use the system.

In an online learning environment, students have more responsibilities in their learning and must participate more actively, while instructors take on a more facilitative role. According to Rochyani & Arif (2020), students' concerns about teacher performance in online courses are centered on communication, with fast responses from instructors being the most valued interaction. Another study by Toquero (2020) and Mo et al., (2020) found that students prefer online courses that provide high-quality materials, offer professionally meaningful assignments, and deliver high-quality feedback.

To meet the needs of students using CIDOS 3.5, it is important to explore ways to enhance online learning effectiveness. This includes investigating how facilitation factors can impact the ability of CIDOS to function effectively for Communicative English students during the Pandemic. Mailizar et al., (2020) emphasize the importance of gathering students' perspectives. Future research should focus on assessing students' viewpoints on remote learning to understand their challenges better.

2. Literature Review

2.1 The Utilisation of CIDOS in Polytechnics.

The Malaysian government initiated the first phase of the Movement Control Order (MCO) on March 18, 2020. As a result, all educational institutions, including primary and secondary schools, were urged to adopt online tools such as Google Classroom, Zoom, and Microsoft Teams for remote teaching and learning. To ensure that schooling could continue uninterrupted, alternative methods such as e-learning from home were introduced.

CIDOS, an open-source learning management system (LMS), was introduced in 2011 and was initially used as an e-learning medium in polytechnics (Ahmad &

Mohamed, 2017). Despite its goal of preparing students for self-directed learning, its practical application remains limited (Seman et al., 2019). However, CIDOS has been included as one of the online tools available for assisting online learning in polytechnics throughout Malaysia. As a result, CIDOS 3.5 has been updated with BigBlueButton Plugins, which were officially implemented in April 2020. BigBlueButton is an open-source web conferencing tool designed for online learning, which enables users to share audio, video, slides, a whiteboard, chat, and a computer screen in real time. Adam et al., (2020) agree that CIDOS 3.5 is a flexible platform enabling teaching and learning to occur anytime and anywhere without being restricted by the class schedule or physical presence. This feature is handy during the Covid-19 pandemic when students and teachers cannot attend classes in person; educators can deliver instruction and engage with students remotely, ensuring that learning can continue uninterrupted despite physical or time constraints.

According to Bangga et al., (2021), the features of CIDOS 3.5 make it easier for students to access their learning materials and complete their assessments. Furthermore, facilitating conditions are crucial for lecturers and students, as Al-Rahmi et al., (2021) and Adam et al., (2021) noted. CIDOS 3.5 facilitates online teaching and learning by enabling efficient control over curriculum documents, teaching and learning materials, and interactive communication between lecturers and students (Mohamad et al., 2021; Razali & Shahbodin, 2014). These studies demonstrate that the use of CIDOS 3.5 has resulted in significantly favourable facilitating conditions in terms of learning resources, flexible and personalized learning, and learning schedules.

2.2 Social-Constructivism Theory

Socio-constructivism is a learning theory that emphasizes the social and cultural aspects of learning based on the work of Lev Vygotsky, a Soviet psychologist, and his idea that learning occurs through social interactions and collaborative processes. According to socio-constructivism, knowledge is not something that is simply transmitted from teacher to student. Instead, it is constructed through the interaction between individuals and their environment.

The zone of proximal development (ZPD) is a concept introduced by Vygotsky (1978) in his socio-constructivist learning theory. It refers to the difference between what a learner can do independently and what they can do with guidance or assistance from a more knowledgeable person, such as a teacher or peer (Kurt, 2020). ZPD is the area where learning occurs, as it is the gap between a learner's current level of knowledge or ability and their potential to learn with support. Vygotsky believed teachers and more knowledgeable peers could scaffold a learner's progress by providing guidance and support in the ZPD.

It is still relevant and applicable to the modern age, even with the increasing use of technology in learning. The learner is "taught" by technology. Online tools can provide personalized learning experiences that adapt to

each student's needs, interests, and learning styles. Teachers can still play a critical role in facilitating learning by using technology to identify areas where students need additional support and guidance and then providing the necessary assistance. The learner is "taught" by technology, which makes them capable of learning (or know-how), but that information is then lost —though it can be recovered and enabled again at any time (Mattar, 2018).

From the theoretical framework in Fig. 1, the Zone of Proximal Development (ZPD) is shown to facilitate learning. The learner's independent actions are represented in the inner circle, while the outer circle illustrates what the learner can learn from peers. Interaction with knowledgeable others, along with the use of technology and resources, can enhance the learner's abilities and expand their knowledge beyond what they can achieve on their own. The theory of constructivism suggests that students' academic performance can be improved by engaging with knowledgeable individuals, such as teachers, parents, or peers, as well as using technology and tools like CIDOS 3.5, which is an online platform that provides various teaching materials to enhance learning for Communicative English students. By accessing the resources on CIDOS 3.5 and working with knowledgeable individuals, students can better understand the subject matter.



Fig. 1. Vygotsky's zone of proximal development (ZPD) adapted from Steve Wheeler (2015)

2.3 Motivational Theory

Intrinsic motivation is the desire to participate in a particular activity just for the pleasure of learning (Ryan & Deci, 2000a). In other words, a person is motivated by their inherent enjoyment or interest in the task rather than any external reward or pressure. For example, someone might find studying using CIDOS enjoyable, challenging, or fulfilling. At the same time, Self-determination theory is a theory that is related to intrinsic motivation. Intrinsic motivation is situational and shifts over time (Schunk, 2014). In other words, learners are more likely to be motivated when they feel that they have some control over their learning, feel confident in their abilities, and feel connected to others.

In this paper, social motivation refers to social situations and collaborations that may encourage students to participate in the Communicative English course. According to Ryan & Deci (2000b), social support and social contexts can significantly positively or negatively affect motivation. Wentzel (1999) claimed that socio-

motivational processes are vital in motivating people to pursue specific social goals. Students' academic results may be influenced by social motivation in addition to intellectual drive (Wentzel, 1999). Nasaruddin (2021) discovered that one of the features of CIDOS 3.5 that inspired learners to play a part was a pleasurable social experience in addition to obtaining subject matter knowledge and skills in his research on CIDOS 3.5. As a result, the social elements of the CIDOS 3.5 learning experience, such as the discussion board, forum, and participants' usage of social networking, may play a significant role in students' motivation. Social motivation in the CIDOS 3.5 setting includes students' feelings of connectedness to their classmates. This connectedness is consistent with research on "social presence" in online collaborative learning scenarios (Norliana et al., 2020; Zhonggen & Xiaozhi, 2019; Mohd Fahmi, 2018).

In online contexts, Hartnett (2011) found that self-regulation (recognizing the value of activity) is just as important as intrinsic motivation. His study was supported by Musa et al., (2021); Hakimi et al., (2017) that self-directed learning can increase students' motivation in learning. Learners are more motivated when they believe they can succeed at a task and value the outcomes of that task. As a result, it is vital to provide students with meaningful assignments and to lay the groundwork for open communication between educators and students. Cebi & Güyer (2020) discovered a link between students' motivation and the degree of their involvement with course material, whereas their choice of materials did not affect motivation.

Overall, motivational theories in learning provide insights into the factors that influence learners' behavior and performance. By understanding these theories, educators can create learning environments that are more engaging and motivating for their students.

2.4 CIDOS 3.5 is Beneficial for Learning Communicative English During Covid-19

The importance of facilitating conditions regarding lecturers and students engaging in online learning cannot be overstated, especially during the Covid-19 Pandemic. According to studies conducted by Al-Rahmi et al., (2021) and Adam et al., (2021), facilitating conditions are crucial in facilitating the use of CIDOS 3.5 among lecturers and students. Their research showed that the utilization of CIDOS 3.5 in Politeknik Mukah, Sarawak was significantly positive due to facilitating conditions. Therefore, CIDOS 3.5 provides various benefits for polytechnic lecturers and students in teaching and learning, particularly during the Covid-19 Pandemic.

By choosing to use CIDOS 3.5, institutions can enjoy several benefits, such as access to a broader range of teaching methods, reduced costs, and the ability to notify lecturers and students in emergencies quickly. Additionally, CIDOS 3.5 enables users to work from anywhere and anytime, providing increased flexibility and convenience (Razlina, 2016). Online language learning platforms can be cost-effective, as they often offer free or low-cost courses, saving learners money compared to traditional language courses or private tutoring.

During the Pandemic, students can learn at their own pace regardless of unforeseen occurrences, especially when they are under quarantine and cannot follow up with the teaching and learning lesson (Nasaruddin, Anuar, Kadimin & Sabli, 2021). Besides, the user-friendly features also ease students in attaining their learning material and completing their assessments (Bangga, Nanson & Ruzaini, 2021). Hence, the platform allows learners to study at their own pace and at a time that suits them best, making it a flexible and convenient option for those with busy schedules.

Nadia (2020) suggests that students are interested in learning English in informal settings such as Facebook, Instagram, YouTube, and WhatsApp. These social media platforms allow students from around the world to connect and engage in discussions on various topics. CIDOS 3.5 includes features like a chat box, forum, and discussion board that allow students to interact with their peers and receive prompt instructor feedback. By using these tools, learners can communicate with each other through chat rooms, discussion forums, or video conferencing, which provides them with an opportunity to practice their language skills in a more natural and realistic environment.

3. Methodology

3.1 Research Design

The research methodology employed in this study involves the use of a quantitative approach to gather data through purposive sampling. Data was collected using a questionnaire that employed a 5-point Likert scale. The data collected were analyzed to understand the behavior and patterns of the participants, which can be used to inform policies and interventions and contribute to a better understanding of the world.

3.2 Research Samples

This research study used a purposive sampling method to select a specific subset of participants. Specifically, the study focused on 100 students in their fourth semester who were enrolled in the 'Communicative English 3' subject and had used CIDOS 3.5 as a learning tool for Communicative English during the Covid-19 Pandemic. These students were selected to participate in the research.

3.3 Research Instruments

The research study utilized a 5-point Likert scale questionnaire of 11 questions divided into two sections. The first section, Section A, gathered demographic information from the participants, such as age, gender, semester, department, e-learning experience, and availability of high-speed internet. The second section, Section B, focused on the construct of Facilitating Conditions, adapted from Sukendro et al., (2020), which was relevant to the study's context in a Malaysian higher

education institution, specifically Politeknik Mukah. The questions were chosen based on their relevance to all research participants, as Creswell (2012) recommended. Before distribution to respondents, the questionnaire underwent a rigorous validation process to ensure its accuracy and validity.

3.4 Pilot Study

To ensure the questionnaire's clarity, comprehensibility, and effectiveness, a pilot study was carried out prior to administering it to the target population. The pilot test involved the distribution of an online questionnaire (Google form) to 30 polytechnic students who were users of CIDOS 3.5. Out of the 30 questionnaires that were distributed, 24 were returned. Under Connelly's (2008) literature, the sample size for a pilot study should be 10% of the more extensive parent study's expected sample size. Since this study included 100 purposive samples, a pilot test of 20 students was appropriate. Hertzog (2008) noted that a pilot study with 20 to 40 participants is sufficient for instrument development. The pilot test helped identify potential issues and shortcomings with the questionnaire, allowing researchers to refine and improve the instrument before administering it to a larger sample.

3.5 Validity and Reliability

This study assessed the questionnaire items for both content and face validity. The term "reliability" in research refers to how consistent a measure is across time, similar samples, and different uses of the same instrument. Cronbach's alpha was used to assess the internal consistency of the questionnaire, and the Likert Scale score from the pilot test was employed for this analysis. The researchers used Alias' reliability classification to interpret the Cronbach Alpha values. Results indicate that the Cronbach Alpha values for this construct were more significant than 0.80, which is considered very strong.

4. Result and Discussion

The setting of this study was one of the polytechnics in Sarawak. Participants in the survey were 100 students who enrolled in Communicative English during the Covid-19 epidemic and used CIDOS 3.5 to study Communicative English 3.

The demographic profile of the 100 survey respondents is shown in Table 1. According to Table 1, 28 (28%) respondents were male, whereas 72 (72%) were female. In terms of age, 8 (8%) were 19 years old, 72 (72%) were 20 years old, 13 (13%) were 21 years old, 5 (5%) were 22 years old, and the last 2 (2%) were 23 years old. The Civil Engineering Department provided 30 (30%) of the 100 responses. Meanwhile, the Commerce Department was represented by 70 (70%) of the respondents.

Table 1. Respondents' gender, age, and department

Demographic Profile	Number of Respondents	Percentage (%)
Gender		
Male	28	28
Female	72	72
Age		
19	8	8
20	72	72
21	13	13
22	5	5
23	2	2
Department		
Civil Engineering Department	30	30
Commerce Department	70	70

Table 2 presents descriptive information on students' perception of CIDOS 3.5 based on System Characteristics. When evaluating the advantages of CIDOS 3.5 based on the concept of Facilitating Conditions during the Covid-19 epidemic, item B1–B6 has an overall mean of 4.27 0.73, suggesting a very high score.

According to the data collected, 87% (n=87) of respondents stated that during the Covid-19 epidemic, their instructors would assist them in addressing their doubts when utilizing CIDOS 3.5. Furthermore, 85% (n=85) of respondents agreed that they received assistance from their classmates when using CIDOS 3.5. The uploaded videos also assisted students in reliving their lectures, as 83% (n=83) of respondents agreed. During the Covid-19 epidemic, 81% (n=81) and 85% (n=85) of respondents agreed that the institution provided e-learning spaces and computers to aid e-learning, respectively. Finally, 82% (n=82) of respondents stated they have the resources needed to use CIDOS 3.5 for Communicative English learning throughout the epidemic.

Table 3. Level of mean interpretation

Mean Value	Level of Interpretation
1.01-1.80	Very Low
1.81-2.60	Low
2.61-3.20	Medium
3.21-4.20	High
4.21-5.00	Very High

Descriptive analyses are utilized to provide a concise and informative summary of data, highlighting any trends or patterns that may be present. This study used descriptive analyses to calculate the frequency, percentage, mean, and standard deviation. Moidunny's (2009) interpretation of the mean score was used to interpret the findings. The level of mean interpretation is displayed in Table 3.

CIDOS 3.5 provides Communicative English students with the facilities they need to perform their tasks in teaching and learning during the Covid-19

Pandemic. Thus, students will require help desks and online support while using CIDOS 3.5, especially when they face technical problems. Therefore, Adam et al., (2020) proposed that facilitating conditions were one of the factors affecting the adoption of CIDOS 3.5 in their institution. The term "facilitating conditions" refers to a user's ability to accomplish a task (Venkatesh & Bala, 2008).

Facilitating conditions in an e-learning system are obtained from organizational support (staff), which assists learners in overcoming difficulties, and system architecture (tools) provide knowledge on how to use the system (Sukendro et al., 2020). However, CIDOS 3.5 implementation is more complex than it appears. Without the direction and manual offered by the trainer and courses, there will be misunderstandings or misconceptions in the delivery and use of the system.

In this study, respondents found that using CIDOS 3.5 was beneficial in Communicative English learning, especially during the Covid-19 Pandemic. When they received support through online technical help and feedback from lecturers, classmates, and institutions during the Pandemic, they perceived learning through CIDOS 3.5 to be easy to use. The encouragement from their classmates and lecturers also pushed them to utilize CIDOS 3.5 during the institution's closure.

Findings revealed that accounting students at Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS) and Jitra Kedah accept the use of CIDOS but that the system requires assistance from lecturers to be effective (Razlina, 2016). Ali Azeez et al., (2020) proved that the Facilitating Conditions had both direct and indirect effects on the actual use of technology, considering the Behavioral Intention and Perceived Ease of Use of the technology.

Moreover, this was supported by Sukendro et al., (2020); during the Covid-19 pandemic, the availability of organizational support and technological resources in facilitating e-learning impacted Perceived Ease of Use. Other studies also reported that facilitating conditions were the main element that determined technology acceptance during the Pandemic (Adam et al., 2021; Lin et al., 2021; Norliana et al., 2020). Therefore, an organization that wants to promote adopting and using a particular technology should ensure that the necessary facilitating conditions are in place. This can involve providing adequate technical and organizational support, offering training and resources, and creating a user-friendly interface, among other things. By doing so, the organization can enhance the individual's perception of the system and increase their likelihood of using it effectively.

Table 2. Students' perception of facilitating conditions

Items	SD	D	N	A	SA	Mean	SD	Interpretation
When I need help using CIDOS 3.5 in learning Communicative English during Covid-19 Pandemic, my lecturers will help me to clarify my doubt.	0	0	13 (13%)	40 (40%)	47 (47%)	4.34	0.70	Very High
When I need help using CIDOS 3.5 in learning Communicative English during Covid-19 Pandemic, my classmates will help me to clarify my doubt.	0	0	15 (15%)	40 (40%)	45 (45%)	4.30	0.72	Very High
When I need help using CIDOS 3.5 in learning Communicative English during Covid-19 Pandemic, the uploaded videos will help me to revisit the lesson.	0	0	17 (17%)	42 (42%)	41 (41%)	4.24	0.73	Very High
Generally, I think the utilization of CIDOS 3.5 in learning Communicative English during the Covid-19 Pandemic would be supported by the institution by providing some room for e-learning.	0	0	19 (19%)	37 (37%)	44 (44%)	4.25	0.76	Very High
Generally, I think the utilization of CIDOS 3.5 in learning Communicative English during the Covid-19 Pandemic would be supported by the institution by providing computers for e-learning.	0	0	15 (15%)	43 (43%)	42 (42%)	4.27	0.71	Very High
I will have the resources necessary for using CIDOS 3.5 in learning Communicative English during Covid-19 Pandemic	0	0	18 (18%)	40 (40%)	42 (42%)	4.24	0.74	Very High
Overall						4.27	0.73	Very High

SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree

5. Conclusion

Online learning can offer benefits beyond improving students' enthusiasm, engagement, and knowledge retention during the Covid-19 outbreak. It can also improve their comprehension, cognitive activities, adequate levels, positive reinforcement, motivation, and quick feedback. CIDOS 3.5 has proven to be beneficial in polytechnics. It allows students to easily access learning materials and promotes flexible learning. They can learn on their own and what they can do with supervision or aid. This social interaction and connectedness in using this platform also contributes to students' motivation and involvement in the learning process. Education systems should increase motivation and collaboration among learners to promote online learning more successfully through online class activities. Facilitating conditions, such as ease of use, technical support, and access to necessary hardware and software, play a significant role in students' acceptance of online learning platforms. Institutions should provide adequate training and support for students to ensure they have the skills and confidence to use online learning platforms effectively. As online education continues to grow, educators and institutions should prioritize facilitating conditions to help students succeed. It is recommended that online learning platforms be designed to be user-friendly and that technical support be readily available to ensure a positive user experience.

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The Adoption of Microsoft Teams Among Lecturers of Polytechnic Kuching Sarawak

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Full Paper

Article history

Received

25 July 2023

Received in revised form

25 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

As a Technical and Vocational Education and Training (TVET) institution, Polytechnic Kuching Sarawak (PKS) has made use of Microsoft Teams (MT) to create a virtual learning environment for its teachers. The utilisation of MT as a virtual learning environment has the potential to completely revolutionise the way that lecturers at PKS teach and interact with their students. This study aims to measure the adoption as well as evaluating the effectiveness of MT among PKS lecturers to get recommendations regarding the adoption of MT for future improvement. The 5-point Likert scale survey, which includes 30 variables focusing on analysing MT use in education and the effectiveness of it was analysed using SPSS Version 27. The result shows that MT is highly adopted among PKS lecturers in not only teaching and learning but also for other tasks because it is easily accessible, interesting interface, design and the support provided by the institutions which helps in navigating the platform and fully utilise the features. Hence, the utilisation of MT should be maintained and further improved in parallel with the improvement of the campus internet connection and should not be simply dropped in replacement with other online platform without considering the values it had brought us these few years.

Keywords: - Microsoft Teams, utilisation, platform, interface, access

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1. Introduction

In the past few decades, there has been a sizable movement towards the use of digital technology in the field of education. As a result of the advancement of online learning environments, educators now can interact with students in unique ways, which paves the way for the exchange of resources, feedback, and knowledge (Abuhassna et al., 2020). Microsoft Teams (MT), a cloud-based collaboration tool that supports real-time communication, file sharing, and video conferencing, is one of these platforms that has attracted extensive interest in the education industry. MT was developed by Microsoft. Educators all around the globe have rapidly adopted MT as a platform for use in a range of teaching and learning contexts, and its usage has become widespread as a result (Almodaires et al., 2021).

As a Technical and Vocational Education and Training (TVET) institution, Polytechnic Kuching Sarawak (PKS) has made use of MT to create a virtual learning environment for its teachers. On the other hand, it is still unknown whether PKS lecturers have accepted and are successfully using MT. This research intends to address this gap by quantifying the adoption of MT among PKS lecturers, evaluating its efficiency in supporting virtual learning and collaboration, and making suggestions for future development.

The utilisation of MT as a virtual learning environment has the potential to completely revolutionise the way that lecturers at PKS teaching and interact with their students. The platform offers the lecturer with a variety of tools to enhance teaching, such as the capability to exchange lecture materials, administer quizzes and polls, and enable group discussions. Other capabilities include the capacity to conduct polls and group

conversations. In addition, MT makes it possible for lecturer to have real-time conversations with their students, regardless of where they are physically located. This makes it much simpler for students to maintain a connection with their education and remain involved in it.

Although using MT as a virtual learning environment may have some potential advantages, there is also the possibility that certain difficulties may occur (Wijayanto et al., 2021). Problems with the effective use of the platform, challenges with the technology, and worries about the privacy and safety of users' data may also increase the concern on the safe use of MT in learning (Microsoft Teams Security, 2020).

The objective is to measure the adoption as well as evaluating the effectiveness of MT among PKS lecturers to get recommendations regarding the adoption of MT for future improvement. In general, the findings of this research will hopefully give insightful information on the use of MT as a virtual learning environment among PKS lecturers as well as the degree to which it is successful in meeting their needs. The results will offer insights on the advantages as well as the obstacles of employing MT in a vocational education environment, which will be of interest not only to the institution, but also to the larger education community. In the end, this research will contribute to the current debate that surrounds the use of digital technology in the classroom and will guide future advancements in the deployment of virtual learning environments and acquire the significance of MT adoption among PKS lecturers for further improvement.

2. Literature Review

2.1 Microsoft Teams and Its Use in Education

Currently, there are lack of data suggested which online learning platform is better than another, however research suggested that online learning platform (Moodle, Microsoft Teams and Zoom platforms) needed to have a more strategic design to contribute more towards student self-study and their academic performance (Alameri et al., 2020).

MT is an online platform that allows any organisation to communicate with one another using the key feature that it offers which includes video conferencing, file sharing and messaging as well (*Intro to Microsoft Teams: Get Started with Microsoft Teams*, n.d.). The use of MT could be accessed on different platforms such as computers and smartphone devices. It enables its user to engage in any discussion, conference, or lecture at anytime and anywhere if the surrounding has an active internet coverage.

MT is a platform for collaboration that has not only gained a lot of attraction in the commercial world but has also seen significant adoption in the educational sector (S. Ismail & S. Ismail, 2021). There is a wide variety of functionality available inside MT that may improve communication, cooperation, and academic achievement between educators and their pupils. Virtual classrooms

are one use of MT that may be seen in educational settings. Lecturers can build up online classrooms with the help of Teams (AlAdwani & AlFadley, 2022). These online classrooms allow teachers to hold online courses, provide course materials, assign assignments, and provide feedback. Moreover, they can utilise Teams to engage with kids and parents, respond to queries, and supply educational materials such as lecture notes (Wijayanto et al., 2021). A total of 224 PKS lecturers from eight academic departments took part in this study.

2.2 Effectiveness of MT in Education

The outbreak of the *novel coronavirus* (COVID-19) has totally changed the whole viewpoint of the education system in which online remote learning has been introduced and use widely in the educational sector. For instance, the effectiveness of MT use in education has been highlighted in an article published by (Wijayanto et al., 2021) stated that MT may be utilised to facilitate distance education in the wake of the epidemic. The research looks at how the platform is utilised, and what features are most popular, at a university in Indonesia. The paper concludes that MT is a useful tool for distance learning, and that its implementation has improved both the student and teacher experiences.

In addition, (S. Ismail & S. Ismail, 2021) has also discussed the benefits of utilising MT in an e-learning setting. The authors delve into how one university class in the Philippines used MT for online lectures and student-instructor interaction. This research looks at how happy students are with the platform, as well as the challenges both instructors and students have while utilising it for online instruction. The research finds that using Microsoft Teams in an online learning environment may lead to high levels of student satisfaction; but there are also substantial impediments to its implementation, including technical challenges, lack of digital skills, and restricted internet connection.

Furthermore, the effectiveness of MT in education can be seen and analysed using the Technology Acceptance Model as first propounded by Davis (1998). This model uses two parameters to measure the effectiveness of a platform, which are namely, perceived usefulness (PU) and perceived ease of use (PEOU) of the platform, which respectively measures the effectiveness of conveying message through the platform, and the user friendliness and comfort level in relation to its use.

This is because if MT is chosen and selected as a learning platform, it should be able to provide accessible facilities and learning opportunities to all users, or at least, as many users as possible, and should be able to convey most of the learning objectives effectively. During COVID-19 period, movements of students and locomotion of teachers are restricted, face-to-face teaching and learning environment are impossible or difficult to achieve, therefore, the platform chosen to conduct learning and teaching must be able to convey message effectively and should have as little obstructions

as possible in terms of simulating the physical teaching environment.

Microsoft team's effective use in learning process is seen in its design. For one, the main page and display screen of MT is displayed and accessible both through web browsers as well as mobile applications. The mobile version of screen for MT is designed in such a way that only a simple layout with the basic features appears on screen, while the other features are accessible by pressing further shortcuts. Having a complex and complicated user interface while entering meetings and class sessions with MT will pose a problem to the users, especially those with less familiarity and skills to utilise ICT platforms for learning. As such, the simple user interface not only adds to the ease of using the same in learning, but also reduce distractions and provide a larger display screen for the students to better see and receive inputs from the teachers and lecturers.

This is due to the constrain in screen size for mobile users, whereby the learning process is also available to students who do not necessarily have a laptop or desktop at home, which shows convenience as well as user-friendliness and ease of use in terms of its accessibility (Lazim, et. al. 2021). This user friendliness would increase and improve as the user familiarizes himself or herself with the interface of MT (Kortum & Johnson, 2013)

3. Research Design and Methodology

The target populations for this research are the lecturers of Politeknik Kuching Sarawak (PKS). According to Krejcie and Morgan (1970), the determining sample size for a given population sample size of 464 lecturers are at 214 across all eight academic departments in PKS, however we manage to acquire 224 samples. This includes lecturers from Mechanical Engineering Department, Civil Engineering Department, Petrochemical Engineering Department, Electrical Engineering Department, Information Technology and Communication Department, Commerce Department, Mathematics, Science and Computer Department, and General Studies Department. The questionnaires were distributed to all lecturers using google form within a month period. The set of questionnaires was modelled from Unified Theory of Acceptance and Use of Technology (UTAUT) is an acceptance and adoption model created by (Venkatesh, Morris & Davis, 2000) using a 5 Likert Scale. The survey includes 10 demographic questions and 20 variables focussing on the Microsoft Teams Utilisation (MTU), Infrastructure Access (IA), and Technology System in analysing MT use in education and the effectiveness of it. The 5-point Likert scale is used in the survey from agree, fully agree, neutral, disagree, and fully disagree. This study utilised a few common statistical tools to analyse the data. SPSS Version 27 was used for this purpose. The reliability tests on the identified variables for this study were found to be acceptable and reliable as the Cronbach's Alpha values

for all the variables are above 0.60. The survey was distributed to 32 samples for pilot test before it was executed to the bigger sample numbers, where the reliability test result for Cronbach Alpha is at 0.934 for all 30 items in the survey.

4. Analysis and Findings

4.1 Respondents' Demographic Profiles

Table 1. Respondents' demographic profiles

Characteristics		N	(%)
Age	21-25	0	0
	26-30	7	3.1
	31-35	63	28.1
	35-40	87	38.8
	>40	67	29.9
Gender	Male	49	21.9
	Female	175	78.1
Marital Status	Married	183	81.7
	Single	41	18.3
Department	Civil Engineering (JKA)	62	27.7
	Electrical Engineering (JKE)	21	9.4
	Mechanical Engineering (JKM)	44	19.6
	Petrochemical Engineering (JKPK)	33	14.7
	Information Technology & Communication (JTMK)	5	2.2
	Commerce (JP)	39	17.4
	Mathematics, Science & Computer (JMSK)	12	5.4
	General Studies (JPA)	8	3.6
Grade	DH41	49	21.9
	DH42	7	3.1
	DH44	98	43.8
	DH48	70	31.3
	DH52	0	0
	DH54	0	0
Education Level	Diploma	0	0
	Degree	133	59.4
	Master Degree	91	40.6
	PhD.	0	0
Years of teaching	< 1 year	5	2.2
	1-3 years	10	4.5
	4-6 years	35	15.6
	7-9 years	104	18.8
	10-12 years	42	46.4
	>12 years	28	12.5
ICT Knowledge	Poor	0	0
	Moderate	88	39.3
	Good	119	53.1
	Very Good	17	7.6
Internet	Yes	214	95.5

Subscription	No	10	4.5
Mobile Internet Access	Yes	224	100
	No	0	0

A total of 224 respondents participated in the survey. The survey response rate is 48%. Table 1 presents the respondents' demographic profiles. The majority of our respondents were female (78.1%) and male respondents were 21.9%. Overall, about 38.8% of the respondents were between 35 and 40 years old, and about 46.4% of them reported teaching experience between 10 to 12 years. Regarding the distribution of survey respondent according to the teaching department, the study obtained feedback from the Mechanical Engineering Department (19.6%); the Commerce Department (17.4%); the Electrical Engineering Department (9.4%); the Information Technology and Communication Department (2.2%); the Mathematics, Sciences and Computer Department (5.4%); the General Study Department (3.6%); and the Civil Engineering Department (27.7%). Also, 59.4% of the respondents obtained first degree and the remaining (40.6%) of the respondents have master's degree. About 53.1% of the respondents have good ICT knowledge, another 39.3% considered themselves to be moderate while 7.6% are very good at it. Among the respondents, 95.5% said to have internet subscriptions, while only 4.5% did not subscribe to the internet. However, 100% of respondents have mobile internet access.

4.2 MT Utilisation, Infrastructure Access & Technology and Systems

In this study, we aimed to identify MT utilisation with infrastructure access, and technology and systems. Table 2 below presents data about means and standard deviation values for twenty identified variables in this study, namely, MT utilisation, Infrastructure Access & Technology and Systems.

Table 2. Mean and standard deviation for MT Utilisation, infrastructure access & technology and systems

Item	Mean	SD
Microsoft Team Utilisation (MTU)		
I use MT extensively in teaching because the access infrastructure is good.	3.86	.359
Using MT is better than the traditional method.	2.83	.766
Because the MT system design is good, I use MT extensively.	2.69	.786
Because MT has many functions that are useful for my teaching, I use MT extensively.	2.75	.779
Because of my ICT skills, I use MT extensively.	2.41	.775
Because of my ICT knowledge, I use MT extensively.	2.52	.781

Because there is training provided, I can use MT effectively.	2.76	.697
Because of the good support, I can use MT effectively.	3.83	.396
Infrastructure Access (IA)		
I am reluctant to use MT due to poor Internet connection.	2.28	.916
I can access MT anywhere because the infrastructure is everywhere.	3.83	.384
I can access MT anytime because it is easily accessible.	3.74	.439
My satisfaction with infrastructure access (such as the internet) leads me to use MT extensively.	2.74	.699
Because I have good internet access at home, I can use MT effectively.	2.83	.602
Because I have good internet access at the office, I can use MT effectively.	2.89	.528
Technology And System (TS)		
Because the MT systems interface is very user-friendly, I use MT extensively.	2.96	.481
Because the MT systems interface is very interesting, I use MT extensively.	3.89	.316
Because the MT systems interface allows interactions with my class participants, I use MT extensively.	3.89	.316
Because the MT systems design enables me to access information (e.g. tasks, assignments, tests) easily, I use MT extensively.	3.49	.510
Because MT access is fast, I use MT extensively.	2.82	.699
Because MT provides me with information credibility, I use MT extensively.	2.80	.633

As shown in Table 2, MT Utilisation in teaching among the lecturers is highly depend on its infrastructure access with the mean score at 3.86. It shows that lecturer preference in using MT is high when good infrastructure is provided. The lecturers also chose MT because of the support received from the organization; hence the platform could be used more effectively. This variable score 3.83 mean during the survey. However, the least mean is at 2.41 whereas the requirement of ICT Knowledge among the lecturers caused them to use MT more. So long as they have the support from the institution in terms of training and continuous assistance, ICT knowledge is not highly required when utilising the platform.

The result also shows a high mean at 3.83 in Infrastructure Access (IA) where lecturers opt for the platform because it could be accessed everywhere they go. Whether during or post-pandemic, this is still relevant considering technological advancement and towards making education facilities more accessible while promoting the online education platform to the students. The lecturers also prefer to use MT because it is easily accessible with the mean score at 3.74, while the fact that poor internet connection does not affect this choice as it shows in the mean scores at only 2.28. This is because the notes and lecture materials uploaded in MT and the live online class streaming can still go on with mobile internet

access even though the campus internet access might not be helpful.

Lecturers also favor MT systems design where they were able to access information (e.g., tasks, assignments, tests, etc.) easily where this scores a high mean at another 3.49, and followed by the preference in MT systems interface which allows interactions with class participants with mean score of 3.89, and they also think that the interface is very interesting to use. Fast access, information credibility and user-friendly interface are among other factors affecting the lecturers' preferences in adopting MT in their teaching and learning.

5. Conclusion and Recommendations

The result shows that MT is highly adopted among PKS lecturers in not only teaching and learning but also for other tasks because it is easily accessible, interesting interface, design and the support provided by the institutions which helps in navigating the platform and fully utilise the features. The lecturers find MT to be effective for them to use, especially with the interesting interface which allows them to interact with their class participants and enable information access and sharing easily. Despite poor internet access, MT is still utilize using mobile internet access because of its popularity among lecturers and students in accessing notes and assignments. However, the improvement in campus internet access could improve the utilisation of the online platform further and use of more of its many features. There are several reasons to utilise MT, including collaboration where MT allows us to collaborate with our team members in real time by sharing files, co-authoring documents, and holding virtual meetings. MT integrates with other Microsoft apps like OneDrive, SharePoint, and Outlook, making it easy to access and share files and also offers a variety of communication options, including chat, video and audio calls, and screen sharing. MT can be customised to fit our team's needs by adding apps and integrations from the Teams app store. Finally, MT is built on the secure Microsoft 365 platform, ensuring that our data is safe and protected. Hence, the utilisation of MT should be maintained and further improved in parallel with the improvement of the campus internet connection and should not be simply dropped in replacement with other online platform without considering the values it had brought us these few years.

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The Development of Engineering Science App for Engineering Science Course

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Full Paper

Article history

Received

27 July 2023

Received in revised form

27 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This research paper discusses the stages in the development of the application software named Engineering Science App. The main purpose of its development is to establish an online platform that can facilitate the implementation process of the lab work for students taking the Engineering Science course (DBS10012). The application is designed to cater for both online and face-to-face learning modes, is compatible with both Android and iOS platforms, is easily shared, and is user-friendly, especially for first-time users. The application is developed to be platform-independent, thus making it accessible from any type of device. The Engineering Science App was designed as an interactive application that guides students through the correct steps to perform the experiments and produce comprehensive lab reports. The development of the application focuses on the management of lab reports by students as well as the lecturers monitoring of the on-going progress to ensure a meaningful and quality output is achieved as the product. The implementation of engineering science lab work has been rather challenging in the absence of a centralized management system in place. In this study, we have succeeded in building application software that proves to be effective based on the high scores achieved on the user satisfaction survey. The results show that the Engineering Science App has significantly improved the Engineering Science lab work implementation process.

Keywords: - Online application, software, lab work, lab report, Engineering Science

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1. Introduction

Mobile learning, mobile voice, and instant messaging are just a few of the interactive multimedia networks that have emerged in recent years because of the Internet's and wireless communication technology's rapid advancement. Utilizing the convenience and popularity of the Internet for deploying digital teaching materials and accomplishing the purpose of national competitiveness would replace traditional teaching (Lin et al., 2017). After the pandemic hit around the globe by the end of 2019, most education institutions adopted various online learning methods. Nowadays, educators and students, especially at higher institutions, are becoming more familiar with digital learning, and it continues to become a popular method for delivering lessons and teaching materials.

The idea of developing an online platform is an initiative to help students taking the Engineering Science course carry out the Lab Works coursework assessment during the Movement Control Order (MCO) phase. The app was designed to provide reference materials to facilitate students' writing of quality lab reports as well as for lecturers to manage the submission of the reports during the online teaching and learning phase. Producing a well-organized, quality report has been a long-standing problem for the lecturers teaching the Engineering Science course at Politeknik Mukah. Therefore, the app was developed to solve this problem.

Students' opinions about technology in all parts of their lives are largely influenced by its usefulness and ease of use (Edmunds et al., 2012). Thus, we have designed the app with a user-friendly interface that is easy to navigate. Instructions are easy to understand, considering the student's level of mastery of English as a second language. The Engineering Science App would

also be accessible through various types of devices, and it is also compatible with both Android and iOS platforms. Effective use of online apps in science education requires careful selection and implementation of appropriate tools and strategies, as well as consideration of factors such as student access and technological literacy (Wen et al., 2019).

1.1 Problem Statement

Lab work is a part of the coursework assessment for polytechnic students taking the Engineering Science course. Prior to the MCO phase, lab work was carried out in the science laboratory. Lecturers would demonstrate the steps to carry out the experiments followed by the students carrying out the experiments in small groups. The lab sheets are distributed for the students to record the details and result from the experiments to produce lab work reports. However, during the MCO phase, where classes were fully conducted online, all face-to-face learning activities were prohibited. Hence, the lab work experiments could not be implemented which makes it difficult for the students to produce quality lab reports. Furthermore, the course lecturers faced a problem managing the online submission of the reports. Therefore, an online platform which serves as a report submission management system is required. The online platform would also facilitate the implementation of the Engineering Science Lab Works and produce comprehensive lab reports that can be used for both online and face-to-face learning modes.

1.2 Objective of Study

To develop an online application that can perform as a tool to perform the following:

1. Lab work report online submission management system.
2. Reference guide for students taking the Engineering Science (DBS10012) course to carry out lab work.
3. Online referrals point to produce comprehensive and quality Lab Work reports.

2. Literature Review

The usage of ubiquitous and networked mobile devices in educational settings is rising, including 3G mobile phones, PDAs, and pocket PCs. Multipurpose software, cutting-edge hardware, and network technologies open up new opportunities for fostering innovative forms of communication, learning, and collaboration (Wang et al., 2012). Most students require efficient and engaging activities that will inspire them to actively engage in the learning process (Behnamnia et al., 2020). Compared to traditional teaching and learning methods that rely on lectures, today's youth are more driven to learn something new through technology (Suryaningtyas et al., 2019). The success of online app-based learning activities depends on the quality of the instructional design, as well as the technical functionality

and reliability of the apps themselves (Rotellar et al., 2016). Thus, the design of this app incorporates the materials required for students to carry out the experiments step by step via instructional videos. In addition to that, the app contains reference guides such as tutorial videos for students to produce quality reports.

The study "Development of a Web-Based Learning Platform for Engineering Education" by Shen et al., (2020) aimed to design and develop a web-based learning platform for engineering education and evaluate its effectiveness in improving students' learning outcomes. The authors found that the web-based learning platform significantly improved students' learning outcomes and was positively perceived by the students. However, the study involves a small sample size and the fact that the study was conducted in only one university in China. The authors acknowledged that more research is needed to further validate the effectiveness of the web-based learning platform in different contexts and with larger samples.

The study "Developing Online Laboratory Experiments for Teaching Engineering Science Courses" by Abdulrazzaq et al., (2020) investigates the development and evaluation of a series of online laboratory experiments for teaching an engineering science course. The authors aimed to explore whether the online laboratory experiments were effective in improving students' understanding of engineering science concepts, and their ability to apply them to real-world problems. The study employed a mixed-methods approach, using both quantitative and qualitative data collection methods. Data was collected through surveys, pre- and post-tests, and interviews. The authors found that the online laboratory experiments were effective in improving students' understanding of engineering science concepts and their ability to apply them to real-world problems. Students also found the online laboratory experiments engaging and informative. The study also identified some limitations. The authors note that online laboratory experiments may not be suitable for all engineering science courses and that there are technical and logistical challenges to developing and implementing them. Additionally, the authors acknowledge that online laboratory experiments cannot completely replace hands-on laboratory experiences, which are still an important part of engineering education.

The study "Using an Online Platform for Collaborative Learning in an Engineering Science Course" by Kock et al., (2021) explores the effectiveness of an online platform for promoting collaborative learning among engineering science students. The authors aimed to investigate whether the online platform could improve students' understanding of course material and enhance their problem-solving skills. The study found that the online platform was successful in achieving these objectives. However, there are limitations in this study. Firstly, the sample size was small, limiting the generalizability of the findings. Secondly, the study was conducted during the COVID-19 pandemic, which may

have influenced the results due to changes in the learning environment. Additionally, the study did not compare the effectiveness of the online platform to traditional classroom learning methods.

The study "Online Learning for Engineering Students: Evaluating the Effectiveness of an Interactive E-Learning Platform" by Ng et al., (2021) aimed to evaluate the effectiveness of an interactive e-learning platform in enhancing the learning outcomes of engineering students. The study employed a quasi-experimental design to compare the learning outcomes of a group of students who used the e-learning platform with those who received traditional classroom teaching. The study suggests that the e-learning platform significantly improved students' understanding of engineering concepts and knowledge retention compared to traditional classroom teaching. The e-learning platform also provided a flexible and convenient learning environment for the students, allowing them to study at their own pace and time. The students reported positive perceptions of the e-learning platform, with many indicating that they would prefer to use it in future courses. However, the study has certain limitations, including the small sample size, the short duration of the study, and the lack of a control group. Therefore, the authors suggest further research with a larger and more diverse sample, longer study duration, and control groups to further validate the findings.

The study "An Online Platform for Teaching Engineering Ethics" by Adams et al., (2020) evaluated the effectiveness of an online platform for teaching engineering ethics. The study suggests that interactive features, such as case studies and discussion forums, can be effective in promoting ethical reasoning and decision-making skills in engineering students. The study also found that the online platform was effective in promoting collaboration and peer-to-peer learning. While the study demonstrated the effectiveness of the online platform, it also had some limitations. The sample size was relatively small, and the study was conducted at a single institution. Therefore, the generalizability of the findings to other contexts may be limited.

In our study, we intend to build an online application that is meant for facilitating students to conduct lab work and produce quality lab work reports by providing reference materials for the course in the app. The app would also allow proper submission management of lab reports. Overall, the Engineering Science App would be a relevant online learning tool suitable for both remote and face-to-face learning mode.

3. Methodology

The Engineering Science App was developed using the available online applications such as Google Docs, Google Sheet, AppSheet, and Autocrat. Fig. 1 shows the flowchart for the development of the Engineering Science App. The flowchart shows how the components (online apps) are incorporated to form the Engineering Science App. The flowchart starts with

designing the Lab Sheets which would be the report template (output). Three Lab sheets were designed to produce three different types of labs reports: Linear Motion, Archimedes Principle and Energy in Thermal System. The database is designed using Google Sheets based on the input fields in the Lab Sheets. A google add-in component, Autocrat is added to the database to enable PDF file generation from user input. Finally, the app is created using AppSheet. This part will be the front end of the app where it serves as the online platform for students to key in and update data for the lab reports. The app also includes videos on the lab procedures for students' reference.

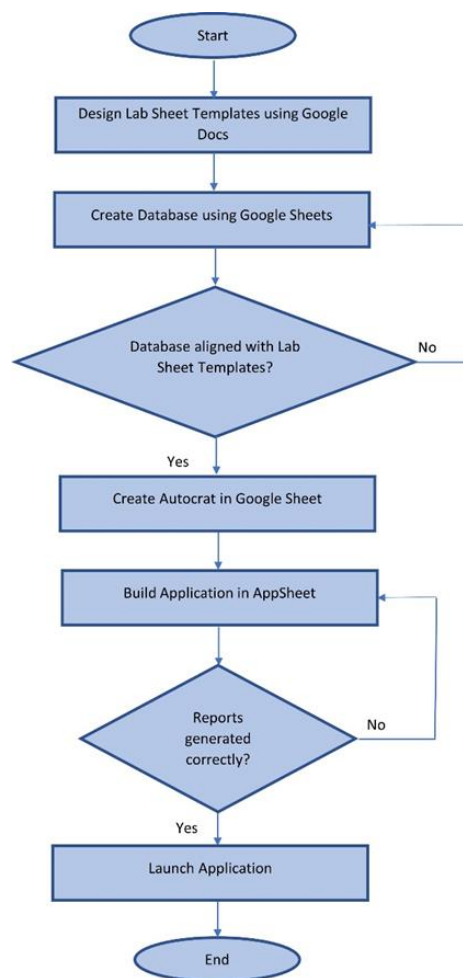


Fig. 1. Flowchart for the development of the Engineering Science App

The Software Development Life Cycle (SDLC) implemented for the development of the Engineering Science App is the Iterative Model (Fig. 2). This approach was the most suitable due to the requirements being already established prior to the design and development phase. The first prototype of the app was built during the MCO phase and tested by the students taking the Engineering Science course via online teaching and learning mode. Feedback from students was taken via

google survey which will be further discussed in the Finding and Analysis section. Comments and feedback were reviewed and taken into consideration for continuous improvements on the app functionalities and features.



Fig. 2. Iterative model

The development process starts by designing the Lab Sheet templates. Tags are added to the templates where they will later be mapped to the corresponding fields in the database. The database is designed using Google Sheets. The required fields in the lab sheet templates must match those in the database to ensure that data will be mapped correctly once the report is generated. After the database is finalized, Autocrat is launched into the Google Sheet. Autocrat is a Google Sheet add-on which will merge the information in Google Sheet into PDF format reports. The final process of development is building the front-end of the app that will function as the interface for user interaction. The features included in the design of the interface are data input, update and delete, display report and related materials. The interface is built using AppSheet, a Google application that provides development platform for application software. The database created in Google Sheet becomes the source data for building the interface in Appsheet.

The sequence diagram shown in Fig. 3 explains the interaction of the user with the app. In the diagram, there are two actors involved, Student and the Database Admin. When students launch the app, the menu screen is displayed. There are three types of interaction between users and the app; 1. Key-in data, 2. Update/delete report and 3. Generate reports. The database admin can be appointed from any of the course lecturers or coordinator. The students will be granted access as app users. To use the app, the student must have a google account/email, which will be registered into the app. Once access is granted, the student must install the app on his mobile phone or launch the app in a google browser. The app is accessible if the user is signed in to his google account. Once the app is launched, students can view the Menu page. In the first process, the Lab Work data input page will be displayed upon selection of a Lab Work from the Menu. Students then will be able to key in the data into

the Lab Work page. The data will be updated into the database. The process of Updating Lab Work will be triggered when student selects the Update Lab Work menu. Students select to update their own data which will be automatically updated into the database. The process of generating reports is triggered in the database environment where the admin runs Autocrat in the Google Sheet. The report will be available once the merging process is triggered.

The following are hardware/software requirements to access the Engineering Science App:

- Mobile phone/Laptop/Desktop Computers (any other devices).
- Internet access.
- Google account.

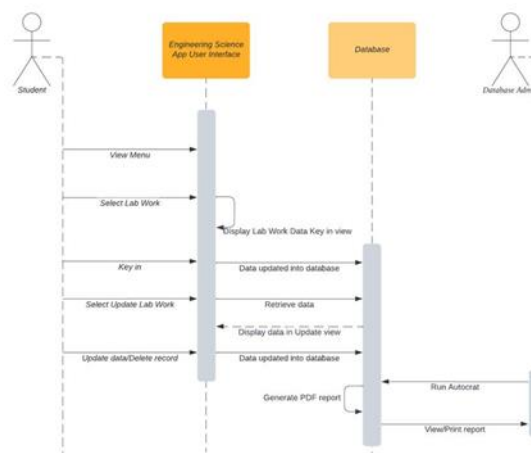


Fig. 3. Sequence diagram for Engineering Science App

4. Result and Discussion

The Engineering Science App was successfully built and launched to carry out Engineering Science (DBS10012) Lab Works. The app contains reference materials for performing the experiments, helps students to key in the data into the report properly, displays the report and enables them to update the report online. Course lecturers can manage the reports easily. The Engineering Science App produces proper and organized reports in PDF format.

Upon launching of the Engineering Science App, the menu page will be displayed (Fig. 4) where students can select the Lab Work desired. Selecting a Lab Work will take them to the Lab Work input view where they can watch online video showing step by step procedure to perform the experiment (Fig. 5). Fig. 6 shows the data input view for the Lab Work (Linear Motion).

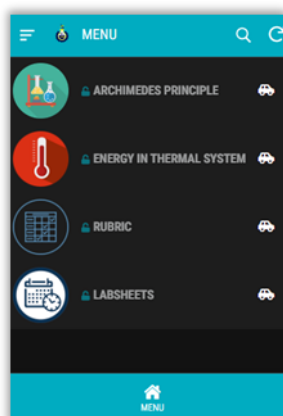


Fig. 4. Engineering Science App menu

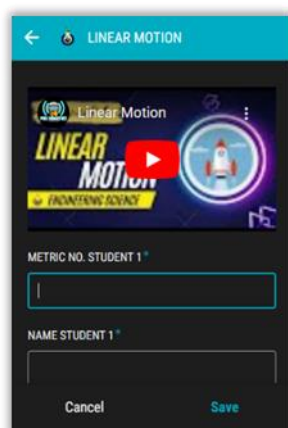


Fig. 5. Video showing steps to perform experiments in the Lab Work input view

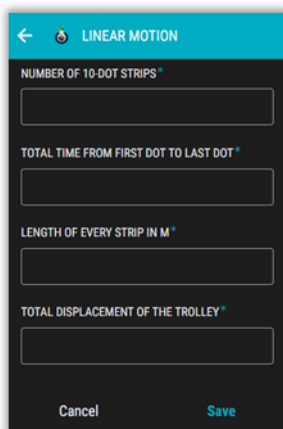


Fig. 6. Lab Work (Linear Motion) data input view

The data key-in by the students will be updated into the database (Google Sheet) as shown in Fig. 7. The database is only accessible by the admin. Students will only be able to update or delete the record via the Update detail's view (Fig. 8) from the app's menu. The updated data will be automatically synced into the database. Students are

allowed to make amendments to their reports until the submission due date (as advised by course lecturers). This feature allows proper management of reports by lecturers before the reports are generated.

NAME OF STUDENT	NUMBER OF 10-DOT STRIPS	TOTAL TIME FROM FIRST DOT TO LAST DOT	LENGTH OF EVERY STRIP IN M	TOTAL DISPLACEMENT OF THE TROLLEY	NAME STUDENT 1	NAME STUDENT 2	NAME STUDENT 3	NAME STUDENT 4
1. Not an appropriate use of paper for								
2. The experiment is not done about								
3. The experiment is not done about								
4. The experiment is not done about								
5. The experiment is not done about								
6. The experiment is not done about								
7. The experiment is not done about								
8. The experiment is not done about								
9. The experiment is not done about								
10. The experiment is not done about								

Fig. 7. Google Sheet (database) view.



Fig. 8. Update detail's view.

Once the report is finalized, the database admin (lecturer) will run Autocrat in the Google Sheet which will merge the records to generate PDF documents, the Lab Work reports (Fig. 9).

X	Y	Z	AA	AB
Merged Doc ID - LAB1	Merged Doc URL - LAB	Link to merged Doc - L	Document Merge Status - LAB1	
12JQINReSLF_oNcBUY	https://drive.google.com/	1V11_IKLIHAN MAKSIS	Document successfully created; Docu	

Fig. 9. Document merged to PDF format report.

Fig. 10 shows the front cover of the report while Fig. 11 shows some parts of the report content after the document is merged in Google Sheet.

The design of the Engineering Science App user interface is purposely made to be simple and easy to navigate. The app's functionality and ease of use are also critical factors in user satisfaction. Apps that are

difficult to use or do not perform well are likely to be abandoned by users. Navigation design is crucial in ensuring that users can easily access app features and content. Clear and intuitive navigation design can enhance user satisfaction and engagement (Ahmed et al., 2020). According to Ullah et al., (2021), an app's interface should be simple, intuitive, and easy to navigate. Users should be able to quickly access the information they require without being overwhelmed by complex features or jargon.

POLITEKNIK MALAYSIAN POLYTECHNIC MATHEMATICS, SCIENCE AND COMPUTER DEPARTMENT DBS10012 - ENGINEERING SCIENCE EXPERIMENT: LINEAR MOTION			
(To be filled up by Student)			(To be filled up by Lecturer)
No	Registration Number	Student's name	Score
S1	200002291002	ALIHAN MAKSES ANAK GERAMONG	/ 20
S2	200002291009	SILBERT CLAY ANAK ABENG	/ 20
S3	200002291012	DANIAL HARITH NAQQUDIN BIN KHAIRI, ANNUR	/ 20
S4	200002291006	MUHAMMAD AFRIKMAAL BIN ROSZAINI	/ 20
Class			JHE1A
Lecturer's Name			TERMINI HIDAYAT
Date of Submission			9-Sep-2022
(To be filled up by Lecturer)			
Lecturer's Comment:			

Fig. 10. Front Cover of PDF report

PROCEDURES

1. Set up apparatus as in Figure 1a
2. The runway is inclined about 1m-2m, so the trolley will roll down freely from rest without any applied force
3. Attach the ticker tape to the trolley using cellophane tape
4. Switch on the ticker timer and release the trolley freely
5. Mark and number every 10th dot as Figure 1b
6. Cut and paste ticker tape into 10-dot strips on the graph paper as Figure 1c

DATA ANALYSIS

Number of 10-dot strips	7 strips
Total time from first dot to last dot = number of strip/time for each strip	0.14s
Length of every strip in M	0.024, 0.058, 0.094, 0.129, 0.166, 0.201, 0.268
Total displacement of the trolley = total length of strips	0.94m
Average velocity of the trolley = Total displacement/Total time	6.71m/s
Initial velocity, u = Length of first strip/Time for each strip	0.12m/s
Final velocity, v = Length of last strip/Time for each strip	1.34m/s
Time for acceleration, t = (number of strips - 1) $\times$ (time for each strip)	1.2m/s

Fig. 11. Report content

The Engineering Science App has been utilized by the Science Unit in the Department of Mathematics, Science and Computer to facilitate the implementation and management of the Lab Work coursework assessments since the MCO phase. The app has proved

to be user friendly and easy to use by students and managed by the course lecturers.

Other than using the app for remote learning, the Engineering Science App continues to become a useful learning aide for both lecturer and students in the current setting of face-to-face learning mode. According to Chen et al., (2017), online apps can be used to enhance student engagement in classroom instruction by allowing students to interact with course content and with each other in new and meaningful ways. It can also be used to promote active learning in the classroom by providing opportunities for students to collaborate on projects, participate in discussions, and engage in hands-on activities.

To measure the effectiveness of the app, a testing phase was carried out by selecting a group of students taking the Engineering Science course to use the Engineering Science App. A total of 44 students from the Mechanical Engineering department and Civil Engineering department of Politeknik Mukah were chosen to use the app to produce and submit their Lab Work reports. The students' feedback was collected through a questionnaire containing their perspectives on the app's contents and interactive features. A total of 10 questions requiring feedback on the app's content while 10 questions were asked on the app's interactivity. The questionnaire was assessed using a five-point Likert format: Strongly Disagree (5), Disagree (4), Moderate (3), Agree (4) and Strongly Agree (5). Responses were collected online via Google Form. The results for the average overall mean score for Engineering Science App's content is 4.33 while the average overall mean score for its interactivity is 4.34. These results indicate the user's high satisfaction level with the Engineering Science App.

Table 1. Mean and standard deviation for application's content.

No	Item	Mean	Standard Deviation
1	The content of the application corresponds to every lab work.	4.34	.479
2	The details are easy to understand.	4.34	.479
3	The demonstration video were shown are in order.	4.43	.501
4	The demonstration video shown are easy to follow.	4.30	.553
5	The details of the demonstrated video are arranged in systematic way.	4.32	.471
6	All the details provided are sufficient.	4.30	.462
7	This application's language is simple to understand.	4.32	.471
8	All the details are well presented and interesting.	4.41	.497
9	Data/ Reports are easy to submit.	4.30	.509
10	This application is facilitate the submission process.	4.25	.438

Table 2. Mean and standard deviation for application's interactivity.

No	Item	Mean	Standard Deviation
1	This application is easy to install.	4.34	.479
2	This application can be used by android and iOS systems.	4.34	.479
3	This application is user friendly.	4.36	.487
4	This application can be installed by using smartphone, tablet and laptop.	4.45	.504
5	The application interface is good.	4.32	.518
6	This application is useful during COVID-19 pandemic.	4.45	.504
7	The instructions in the application make it easy for the user to explore the content of the application.	4.34	.479
8	The icons available on this application are easy to use.	4.34	.526
9	The elements contained in this application are interactive.	4.23	.476
10	Overall, this application is easy to use.	4.32	.471

Overall, the Engineering Science App appears to be a useful tool for students who are facing challenges in completing their coursework assessments. By leveraging online applications, the app provides a flexible and accessible platform for students to carry out their assessments remotely.

5. Conclusion

The Engineering Science App is an online application that is user-friendly and easily accessed on any type of device. It was developed using combinations of *Google* online applications. The main components of the app consist of *Google Doc*, *Google Sheet*, *Autocrat* and *AppSheet*. The Engineering Science App facilitates the Lab Work implementation process for the Engineering Science (DBS10012) course as well as the coursework management system. The product of this app is quality Lab Work reports by students taking the course as well as to enhance their learning process through an accessible online platform. Students can access the app using any type of device at any time with the presence of the Internet.

However, we do note that there are some limitations

in our study. Firstly, the app developed covers a small part of the Engineering Science curriculum, which is the coursework assessments covered in the three topics: Linear Motion, Archimedes Principles and Energy in Thermal System. Secondly, the app is built using a free version of the app development tool (prototype version) which limits the user to a small group of students. We hope to enhance the app in the future by expanding the usage and incorporating other useful features and references into the app to improve the user experience.

Acknowledgement

We would like to express our sincere gratitude to the Head of Department of Mathematics, Science and Computer, Course Leader and the lecturers of Science Unit and the Course Coordinator of Engineering Science for the continuous support in development of the Engineering Science App and for providing useful feedbacks.

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The Effectiveness Study of DBS10012 Engineering Science Mobile Application Development

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Full Paper

Article history

Received

2 August 2023

Received in revised form

2 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Due to the Covid-19 outbreak and Movement Control Order (MCO), which was put in place to stop the potentially fatal outbreak, all higher education institutions across the country were forced to close. As a result, all the instruction, learning and assignment submission for students is done online. It might be difficult for students to submit their finished assignments to their lecturer, especially for those who live in rural areas and struggle with internet connectivity. Students may have to pay a high cost and drive to the city to obtain an internet connection. Images are the sole way to upload students; however, sometimes the pictures are too large, and sending them to the lecturer may take a day. Therefore, smart educational application for Engineering Science course was developed to provide high quality and effective learning and submitting lab work report to Polytechnic students. This application was created using the AppSheet platform's user-friendly features and can be used on a range of platforms, including phones, tablets, and web browsers. This application compiles all relevant learning materials, including videos of demonstrations, lab sheets, rubrics and others for students reports. Lecturers can get student reports in the form of spreadsheets, but they must autocrat spreadsheets to get student reports in the form of PDF files. There are 44 students from the Mechanical Engineering Department and Civil Engineering Department who are participating in this survey. This effectiveness study of a development DBS10012 Engineering Science Mobile application show that the content and interactive application is interesting, and the information provided is very helpful to students, the average overall mean score is 4.33 and 4.34 respectively. From this study, it was discovered that the goals for creating this application were successfully met. As a result, Students will be motivated to learn more in this course and submit their reports on time by this clever educational application.

Keywords: - Mobile application, Covid-19, Engineering Science DBS10012

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1. Introduction

All higher education institutions across the nation had to close because of the Covid-19 epidemic and Movement Control Order (MCO), which was implemented to stop the dangerous outbreak (Sabli et al., 2021). Due to this circumstance, the teaching, learning process and turn in students' assignment are entirely conducted online. But now the issue arises. Students find it challenging to turn in their completed assignments to lecturers especially for those who living in rural locations have the difficulty of their internet

connectivity (Sabli et al., 2021). Students might need to travel to the city to get internet line and it might require a hefty price. Students can only be posted by taking images, but occasionally the pictures are too big, and sending them to the teacher might take a day. Some students struggle to turn in their assignments on time. As a result, using information technology in the teaching and learning process is crucial given the current circumstances (Kapasias et al., 2020). To provide high quality and efficient lab work submission to Polytechnic Students, Smart Educational App to Submit Lab Work of Engineering Science was developed.

This application was developed to provide high quality, effective learning and submitting reports to all Mukah Polytechnic students who are taking Engineering Science (DBS10012), especially in their first semester. DBS10012 is a compulsory course that must be taken by students of engineering at Mukah Polytechnic. This course introduces the physical concepts required in engineering disciplines. Students will be able to perform experiments to mastery physics concepts. This application gathers all related learning tools, such as demonstrations videos, lab sheets, rubrics, and others for student's report. The use of demonstrative videos has grown in importance because they allow students to comprehend the procedures of the practical work but not only through text (labsheets) but also through verbal, visual explanations and illustrations.

This application was developed to provide high quality, effective learning and submitting reports to all Mukah Polytechnic students who are taking Engineering Science (DBS10012), especially in their first semester. DBS10012 is a compulsory course that must be taken by students of engineering at Mukah Polytechnic. This course introduces the physical concepts required in engineering disciplines. Students will be able to perform experiments to mastery physics concepts. This application gathers all related learning tools, such as demonstrations videos, lab sheets, rubrics, and others for student's report. The use of demonstrative videos has grown in importance because they allow students to comprehend the procedures of the practical work but not only through text (lab sheets) but also through verbal, visual explanations and illustrations.

This Smart Educational Application has several benefits. The application's ability to be used on a range of devices, including phones, tablets, and web browsers, is its initial advantage. Students can conveniently access all the course-related information in a single location using an application. It was created using user-friendly features of the AppSheet platform. Before entering the lesson, students can view the demonstrations video. It can be beneficial to have a better understanding of what to accomplish in the practical class. Hence, before their practical class, students can be better prepared. Students just input their data into the app after class and submit it to their lecturer. There is no need for students to submit their work in hard copy, which saves paper and cost savings. In addition, before the due date for submission that was specified by their lecturer, students may alter their work at any moment. Besides that, lecturers can easily upload and distribute the most recent course content or requirements to the students.

2. Literature Review

In the era of advanced technology, mobile learning has been widely used in all sectors especially in the

educational sector (Furió et al., 2015). Mobile learning is denoting learning that involves the use of mobile devices. The term is fully defined as "learning in multiple contexts using personal electronic devices through social and content interaction" (Shraim & Crompton, 2015). This is mainly because the mobile learning environment can offer a wide range of new and exciting learning opportunities via wireless technology (Bernacki, Greene, & Crompton, 2020). According to Wee (2020), this learning is much more interactive and involves more exposure, exchange and cooperation with others. It can deliver educational materials and content to users of personal pocket devices like iPads, smartphones, tablets, and personal digital assistants (PDAs).

Over the past two decades, mobile learning has been implemented. Yet, most high education sectors do not adopt to this learning method, and their personnel is unaware of its components (Mahyoob, 2020). Students require specialized social support throughout the transfer to a new educational environment to increase their focus and motivation for online learning during this critical crisis (Eccles et al., 1997; Roeser & Eccles, 1998).

While the Mobile applications are running on a small handheld mobile devices like computer, iPad and tab which is portable, easy to use (R. Islam, R. Islam & Mazumder, 2010). They have become ubiquitous in everyday life (Baran, 2014). By using these mobile applications, students can explore and revolutionize their thinking by using mobile devices to enhance the abilities and talents of students to access the world. Students can get facility of mobile application like contact friends, browse internet, file content management, document creating and handling entertainment (R. Islam, R. Islam & Mazumder, 2010).

3. Methodology

This smart application is developed by using Appsheet Platform was utilised to integrate the data and create the app with the platform's most well-liked features. All the application's data was stored in the cloud. Google Drive (specifically, Google Sheet) was chosen as the database storage design. While Autocrat was added to database to generate the students' report in PDF file. Instantly publish the application and distribute it to students and instructors. This software may support a range of devices, including smartphones, tablets, and web browsers. While lecturers can obtain student reports using spreadsheets, they must autocrat spreadsheets to obtain student reports in PDF files.

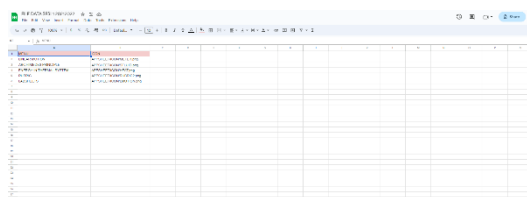


Fig. 1. Google spreadsheet was used to store the data in cloud (google drive)

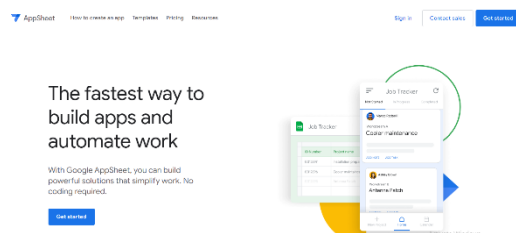


Fig. 2. Appsheet was selected as application development platform for this study application

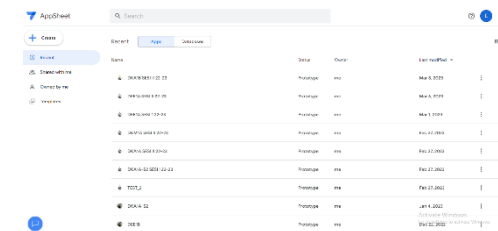


Fig. 3. Appsheet interface for this mobile application study by connecting to Google spreadsheet data storage

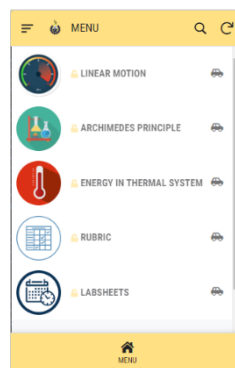


Fig. 4. Appsheet interface for this mobile application study by connecting to Google spreadsheet data storage

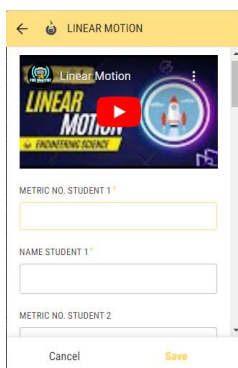


Fig. 5. Students have to fill in data (For example, Lab work 1-Linear motion) in this interface

4. Result and Discussion

Following the submission of students' reports via a mobile application. Purposive sampling was used to pick 44 students in Mechanical Engineering and Civil Engineering from Mukah Polytechnic in Sarawak, and

they were asked to fill out a questionnaire. A questionnaire survey was given and collected to know the result of students' perceptions. The questionnaire contains three sections. The first section focused on obtaining students' demographic profiles such as gender, programme and semester. The second section in the questionnaire is related to this application content. There were 10 questions in this section to determine students' perception. The questions were slightly modified to suit this application contents and it is adapting from Wee (2020). While the third section is related to the interaction of the application to users. This questionnaire was adapted from Sabli et al., (2021). The questionnaire was assessed by a five-point Likert format: Strongly Disagree (5), Disagree (4), Moderate (3), Agree (4) and Strongly Agree (5). All the responses were collected online through Google Forms.

Table 1. The reliability test item

Reliability Statistics	
Cronbach's Alpha	No of Items
0.89	10

From the analyzed questionnaire, the results are as follows. The reliability of data was processed by using SPSS software which was tested by using Cronbach's Alpha method. The result of the Cronbach Alpha reliability test score was 0.80, which is above 0.60 at a satisfactory level. This shows respondents comprehend the question of the disseminated survey.

According to Table 2, there were 41 students from semester 1 and 3 students from semester 2 took DBS10012 course as respondents.

Table 2. The demographic profile of the respondents

Demographic Profile	n=40	%
Gender		
Male	21	47.73
Female	23	52.27
Programme		
DKM	22	50
DKA	22	50
Semester		
1	41	93.18
2	3	6.82
Gender		
Male	21	47.73
Female	23	52.27

The Table 3 demonstrates that the respondents use this mobile application frequently and the mean ranges from 4.25 to 4.43. According to the findings above, it shows that respondents are very satisfied with the application created. This demonstrates that there is a great deal of student interest in using mobile application for online learning and submitting their Lab Work report for DBS10012 course. The demonstration videos shown are in order has the highest mean rating of 4.43 for this aspect, and it is crucial for before

students attend their practical class. This findings from (Yahaya & Salam, 2014) that the issue of user acceptance rely on how easily users feel and can be followed when using any form of application are supported by the results. In general, most respondents concurred that using mobile applications to support their learning and report submission was pleasurable. However, this application is facilitating the submission process is associated with the lowest mean value in this aspect which is 4.25. Students may be quite unfamiliar with this application, and they are still adapting. This high-level usability is also consistent with the find of Seels, et al., 1994 study, which also have to consider how long a user uses an application before becoming accustomed to it.

Table 3. Mean and Standard deviation for application contents

No	Item	Mean	Standard Deviation
1	The content of the application corresponds to every lab work.	4.34	.479
2	The details are easy to understand.	4.34	.479
3	The demonstration videos were shown are in order.	4.43	.501
4	The demonstration video shown are easy to follow.	4.30	.553
5	The details of the demonstrated video are arranged in systematic way.	4.32	.471
6	All the details provided are sufficient.	4.30	.462
7	This application's language is simple to understand.	4.32	.471
8	All the details are well presented and interesting.	4.41	.497
9	Data/ Reports are easy to submit.	4.30	.509
10	This application is facilitating the submission process.	4.25	.438

Table 4 demonstrates that respondents use this mobile application at a reasonably high rate, with mean values ranging between 4.23 and 4.45. The greatest mean value for this aspect indicates that this application can be installed by using smartphone, tablet and laptop and this application is useful during COVID-19 pandemic. AppSheet serves as a framework for developing apps, and Google Sheets serves as the data repository. This app has emerged as a brand-new hub for collecting all relevant teaching and learning resources, and its adaptability was demonstrated by the fact that it can be used on a wide range of devices, including an iPhone, an Android phone, a tablet, and even a PC web browser (Wee, 2020). Mobile application learning is made possible by computing and communication tools like smart phones, laptops and PDAs that are connected to wireless networks (Sarrab, Elgamel & Aldabbas, 2012). The most recent communication technology, not only makes life easier for people on a daily basis but also helps teachers improve their instructional strategies (Abachi & Muhammad, 2014). Mobile learning gives students the

chance to practise skills and make use of the best technical resources to attain learning objectives (Samad et al., 2021). The primary factor that must be stressed is the importance of thinking about a design that makes sure mobile devices and educational applications generate chances to improve student learning rather than complicate or obstruct learning sessions (Samad et al., 2021). In general, most of the respondents agreed that this application is easy to use. While the elements contained in this application are interactive, according to the lowest mean value in this aspect, which is 4.23. As a result, it can be concluded from this study that the goals for developing this application were met.

Table 4. Mean and Standard deviation for interactive of application

No	Item	Mean	Standard Deviation
1	This application is easy to install.	4.34	.479
2	This application can be used by android and iOS systems.	4.34	.479
3	This application is user friendly.	4.36	.487
4	This application can be installed by using smartphone, tablet and laptop.	4.45	.504
5	The application interface is good.	4.32	.518
6	This application is useful during COVID-19 pandemic.	4.45	.504
7	The instructions in the application make it easy for the user to explore the content of the application.	4.34	.479
8	The icons available on this application are easy to use.	4.34	.526
9	The elements contained in this application are interactive.	4.23	.476
10	Overall, this application is easy to use.	4.32	.471

4. Conclusion

Google sheets was used as the application data storage platform and Appsheet as the application development platform to create a successful smart educational application for the Engineering Science course. This application has emerged as a brand-new hub for collecting all relevant learning resources and its adaptability was demonstrated by the fact that it can be used on a wide range of devices, including iPhone, an Android phone, a tablet and even a PC web browser. This application was designed with user friendly features, including icons for every lab work, rubrics and lab sheet. Lecturers can obtain their students' report through spreadsheets, and they must autocrat the spreadsheets in order to obtain students reports in PDF files. Finally, users may occasionally provide

suggestions on how to improve this application-to-application creators.

Acknowledgement

We would like to express our sincere gratitude to the Head of the Department of Mathematics, Science, and Computer, the Course Leader, the lecturer of the Science Unit, and the Engineering Science Course Coordinator for their ongoing assistance in the development of the Engineering Science App. Lastly, I would like to thank the 44 respondents for their insightful comments.

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The Factor Affecting Academic Staff Satisfaction at TVET Institutions

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Full Paper

Article history

Received

9 August 2023

Received in revised form

9 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Despite the importance of academic staff satisfaction, there is limited research on the factors that affect their job satisfaction in TVET institutions. It is crucial to identify and address the factors that impact academic staff satisfaction to ensure a high quality of education and training. Furthermore, TVET institutions often face unique challenges that can affect academic staff satisfaction, such as the lack of resources and the difficulty in attracting and retaining skilled staff. Therefore, this study aims to identify the factors that affect academic staff satisfaction at TVET institutions and provide recommendations for improving staff satisfaction and retention. Therefore, this paper aims to identify the factor affecting job satisfaction among academic's staff at Politeknik Mukah Sarawak (PMU). Several factors that contribute to job satisfaction differ among employees. This study adopts Herzberg's Motivation Hygiene Theory of Job Satisfaction includes Organizational Leadership Style and Supervision, Organizational Communication, Promotion Opportunities, Job Security, Remuneration, and Employee benefits. A total of 189 respondents were involved in the study from five main departments and two support departments. Data is collected using the questionnaire method, Google Form as a study instrument, and distributed to respondents. The data was analyzed using the Partial Least Squares Structural Equation Modeling technique. According to the data processing results, only Organization Communication is not significant in academic staff job satisfaction at PMU. The outcome of this research can help the decision makers to increase job satisfaction among PMU (Politeknik Mukah Sarawak) staff.

Keywords: - Job satisfaction, organizational leadership style and supervision, working condition

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1. Introduction

Malaysia's education system is considered quite competitive, owing to the proliferation of universities in recent years (Ahsan, Abdullah, Yong, & Alam, 2009). Malaysia's Higher Education Institutions (HEIs) include public universities, private universities, branch campuses of foreign universities, polytechnics, and community colleges. Polytechnics, as part of Malaysia's institutions of higher learning, have been utilizing the blended learning approach through its self-developed learning management system - Curriculum Online Document Information System (CIDOS) (Saharudin, Hamzah & Rahman, 2020). Romli (2016) claimed in her study that the respondents

(polytechnic commerce diploma students) well received CIDOS as a blended learning method. Malaysia's education system has undergone remarkable changes and rapid transformations since independence as the country strived to improve educational standards. The initial system's purpose was simply to assist people in coping with daily life. However, as time passed, people began to believe that education would also lead to a better way of life (Zain et al., 2017). During the post, Covid 19 pandemic, the hybrid teaching, and learning method is still used in PMU. The shift back to face norms resulted from lecturers and students having difficulties adapting to the new environment. Lecturers need to record and teach online if any students are affected by Covid 19. This has

resulted in the lecturer having to make two methods at once. Besides teaching in a minimum of 16 credit hours, the lecturer also needs to perform other side tasks and needs high commitment. Due to this commitment, the academic staff can be exposed to stress and workloads. Hence this paper aims to identify the factor affecting job satisfaction among academic staff at PMU. According to Alam (2009), Job satisfaction is undoubtedly one of the hottest issues in management research, and it has been studied in various industrial environments and at various levels of employee roles and responsibilities dimensions.

Employee job satisfaction is critical to the success of a higher education institution because high quality education and positive student learning outcomes can be sustained and achieved by paying special attention to factors influencing job satisfaction (Hee et al., 2019). Performance evaluations should consider job satisfaction (Wahi et al., 2021). Employees who are contented at work are more productive and more likely to stick to the organization longer Sarker et al. (2013) than those who are unhappy. High rates of employee turnover place stress on academic staff members at PMU because of changes in organizational management, including procedures and rules. The evidence for this comes from studies (Noordin & Jusoff, 2009) that demonstrate a reasonable level of job satisfaction among Malaysian universities' academic staff members. Based on Herzberg's Motivation Hygiene Theory, job satisfaction will be evaluated with the following factors: organizational leadership style and supervision, working conditions, organizational communication, opportunities for advancement, job security, compensation, and employee benefits. This study was motivated by how crucial job satisfaction is for educators Researchers are drawn to this topic by inconsistent results and a dearth of studies. The research findings may aid in developing facilities or implementing rewards for educators or the government. This paper is structured as follows. In the beginning, it offers a summary of pertinent literature. Second, it describes the methodology and design of the study. It then presents and discusses the research's findings before offering a conclusion.

The Motivation-Hygiene Hypothesis is another name for Herzberg's dual-factor theory (1959). The central idea of this theory is the separation of motivational and hygiene variables. These two factors influencing job satisfaction are divided into two categories. In determining job satisfaction, motivational factors are regarded as more important than sanitary factors. The desire to avoid unpleasant experiences is linked to hygiene factors. Because of "the individual's desire for self-development and self-actualization," motivation factors contribute to job satisfaction. Motivational elements include organisational communication, promotion opportunities, and job security, while hygienic elements include organisational leadership style and supervision, working conditions, remuneration, and employee benefits. According to (Smerek & Peterson, 2007), motivators are factors that inspire employees to work. These motivators result in job satisfaction.

Motivational elements are based on an individual's desire for personal development. When motivational factors are present, they can aid in the active creation of job happiness. If they are effective, they can motivate people to give above-average effort or performance (Sureshchandar et al., 2002). Receiving recognition, opportunities for advancement, responsibility, status, a sense of personal accomplishment, and personal growth in the workplace are all motivating factors. Motivational factors contribute to increased job satisfaction (Chu & Kuo, 2015). As hygiene factors, factors that reduced job dissatisfaction were identified. The foundation for hygiene factors is an organization's desire to reduce unpleasantness in the workplace. Employee dissatisfaction happens when an employee believes that these factors are insufficient. Company policy and administration, feelings of job security, financial pay, supervisory quality, and the quality of human relations and the working environment are typical hygiene variables (Hee et al., 2019).

Job satisfaction is defined as an individual's behavior concerning their work duties and their motivation. Positive behavior leads to a balanced level of job satisfaction, whereas negative behavior leads to job discontent (Scott et al., 2005). Employees who are happy with their jobs are more likely to stay with the company in the long run, because they care more about the quality of their work and are more loyal to the company (Subardjo & Tentama, 2020). It is impossible to overestimate the importance of job satisfaction in terms of performance. People who are happy with their jobs are more motivated, put in more effort, and are more likely to perform well than those who are unhappy (Lam et al., 2022). Given the importance of job satisfaction among PMU's academic staff. According to previous research, the existence of various factors and associations between variables becomes a reason to conduct this research.

2. Methodology

The Partial Least Square-Structural Equation Modeling (PLS-SEM) technique is used in this study to test the relationship between variables using a quantitative descriptive method. SEM is used as an analytical technique to confirm whether a particular model is valid or not. The PLS-SEM model is evaluated in two steps: evaluating the model (the outer model) and evaluating the structural model (evaluating the inner model). The outer model's evaluation includes the value of outer loading, average variance extracted (AVE), and composite reliability (CR), while the inner model's evaluation includes the value of path coefficients and R-square (R²) (Chuan, 2006). The Motivation-Hygiene Hypothesis is another name for the questionnaire based on Herzberg's dual-factor theory (1959). The participants in this study were PMU academic staff. The sample size for this study was 189 respondents, which were successfully collected through efforts to distribute as many questionnaires as possible during the Covid-19 pandemic, which occurred in the third quarter of 2022.

3. Result and Discussion

3.1 Descriptive Statistic

Table 1. Demographic respondent profiles

Categories	Items	Frequency	%
Gender	Male	100	52.9
	Female	89	47.1
Marital Status	Single	36	19.1
	Married	153	80.9
	Widowed	-	-
	Divorced	-	-
Do You Live Far from your family?	Yes	111	58.7
	No	78	41.3
Age	<20	-	-
	21-25	-	-
	26-30	24	12.7
	31-35	35	18.5
	36-40	50	26.5
	>40	80	42.3

Table 1 displays information about the demographic profiles of lecturers. The survey included 52.9% male lecturers and 47.1% female lecturers. More than half of the respondents (81.0%) were already married, with the majority (56.3%) living far away from their families. Nearly half of those polled were over the age of 40, with the majority being Muslims (83.6%) and Malay (68.8%). The Department of Commerce employs the majority of the lecturers (19.6%), and 57.1% have been with the department for at least 12 years. Finally, it is worth noting that 75% of lecturers work 15-19 hours per week.

3.2 Validity and Reliability Test

Table 2 summarizes the score information from factor loading, VE, CR, and Cronbach's Alpha for the modified SEM model. This test was used to assess discriminant validity, and the results on CR were positive. Table 6 displays the factor loading, CR, and Cronbach's alpha values for construct investigations. The modified SEM model's factor loading, VE, CR, and Cronbach's Alpha values are all excellent. All factor loadings are still above the cut-off value (0.50). The reliability obtained is good because all variance extracted (VE) values are greater than 0.50, construct reliability (CR) is greater than 0.70, and Cronbach's Alpha is greater than 0.60. (cut-off values). Furthermore, Cronbach's alpha values for Organizational Leadership Style and Supervision (OLS), Organizational Communication (OC), and Promotion Opportunities Job Security and Remuneration and Employee Benefit (REB) were 0.925, 0.946, 0.941, 0.935, and 0.929, respectively. The SEM model is good based on the overall suitability test results.

Table 2. The validity and reliability measurements for all constructs

Item Description	Factor Loading	VE	CR	Cronbach's Alpha
OLS1	0.861	0.712	0.925	0.899
OLS2	0.834			
OLS3	0.844			
OLS4	0.871			
OLS5	0.808			
OC1	0.824	0.779	0.946	0.926
OC2	0.902			
OC3	0.898			
OC4	0.885			
OC5	0.902			
POJS1	0.869	0.762	0.941	0.921
POJS2	0.874			
POJS3	0.915			
POJS4	0.898			
POJS5	0.804			
REB1	0.772	0.742	0.935	0.912
REB2	0.885			
REB3	0.868			
REB4	0.906			
REB5	0.872			
PJS1	0.827	0.723	0.929	0.904
PJS2	0.857			
PJS3	0.846			
PJS4	0.855			
PJS5	0.867			

3.3 Goodness of Fit

Based on the information provided in Table 3, the final structural equation model (SEM) appears to have a good overall goodness of fit. The APC and AARS indices, which measure the absolute and relative fit of the model, respectively, both show significant and good fit at a p-value of less than 0.001. The AVIF index, which indicates the amount of variance explained by the model, is acceptable since it is less than 5 and ideally less than 3.3. The GoF index, which provides an overall assessment of the fit, is considered large since it exceeds the threshold of 0.36 for a large effect size. This suggests that the model fits the data well. The SPR index, which measures the standardized parameter estimate, is acceptable since it is greater than 0.7 and ideally equal to 1. This indicates that the model's parameter estimates are reliable and accurate. The RSCR index, which measures the model's ability to reproduce the correlations among the variables in the sample, is acceptable since it is greater than 0.9 and ideally equal to 1. This indicates that the model reproduces the correlations in the data accurately. The SSR index, which measures the amount of variance in the observed variables explained by the model, is acceptable since it is greater than 0.7. This indicates that the model explains a reasonable amount of variance in the observed variables. Overall, the results of the goodness-of-fit indices suggest that the final SEM is a good fit for

the data and that the model provides a reasonable explanation of the relationships among the variables included in the analysis.

Table 3. Overall goodness of fit for final SEM

Goodness of Fit	Result	Model Requirement	Testing Decision
APC	0.244	$P < 0.001$	good fit
AARS	0.598	$P < 0.001$	Good fit
AVIF	3.374	acceptable if ≤ 5 , ideally ≤ 3.3	acceptable
GoF	0.671	small ≥ 0.1 , medium ≥ 0.25 , large ≥ 0.36	large
SPR	0.857	acceptable if ≥ 0.7 , ideally = 1	acceptable
RSCR	0.993	acceptable if ≥ 0.9 , ideally = 1	acceptable
SSR	1.000	Acceptable if ≥ 0.7	acceptable
NLBCDR	1.000, ac		

3.4 Interpretation of Path Coefficients in SEM

The coefficient of determination (R-Square, R^2) is 0.66, indicating that 66% of the diversity of the PJS constructs can be explained by the OLS, OC, POJS, and REB constructs combined, while the remaining 44% is explained by other constructs not included in the SEM model. The hypothesis testing results are shown in Table 4. Table 4 displays the results of hypothesis testing in the direct relationship of several constructs. Three of the four hypotheses are significant with p-values of 0.05.

Table 4. The Relationship Path among the Constructs.

Hypothesized Paths	Estimate	P	Result
H1: OLS→PJS	0.120	0.047***	Significant
H2: OC →PJS	0.013	0.429	Not Significant
H3: POJS →PJS	0.507	<0.001***	Significant
H4: REB →PJS	0.277	<0.001***	Significant

Note: ***, **, and * denote the two-tail statistical significance at 1%, 5%, and 10% respectively Source: Data Processing, 2022

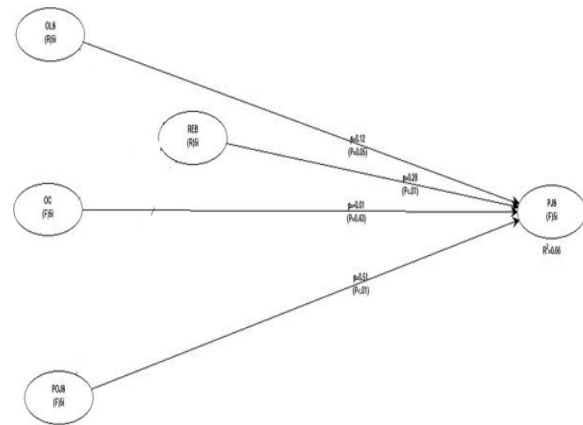


Fig.1. The Path Coefficient

$$PJS = 0.12OLS + 0.01OC + 0.51POJS + 0.277REB + e \quad (1)$$

A significant direct effect of Organizational Leadership Style and Supervision (OLS) on Personal Job Satisfaction (PJS) of 0.12 is obtained. The higher the value of Organizational Leadership Style and Supervision, the higher the value of Personal Job Satisfaction; conversely, the lower the value of Organizational Leadership Style and Supervision, the lower the value of Personal Job Satisfaction. It is also obtained a significant direct effect of Promotion Opportunities Job Security (POJS) on Personal Job Satisfaction (PJS) of 0.51. Personal Job Satisfaction increases as Promotion Opportunities Job Security increases; conversely, as Promotion Opportunities Job Security decreases, Personal Job Satisfaction decreases. Additionally, it is determined that the direct effect of remuneration and employee benefits (REB) on Personal Job Satisfaction (PJS) is 0.708. The higher the remuneration and employee benefits value, the higher the Personal Job Satisfaction value; conversely, the lower the remuneration and employee benefits value, the lower the Personal Job Satisfaction value. There is no significant direct effect of Organizational Communication (OC) on Personal Job Satisfaction (PJS). The higher/lower the Organizational Communication value has no effect on the Personal Job Satisfaction value. According to the findings of this study, Organizational Leadership Style and Supervision, Promotion Opportunities, Job Security, Remuneration, and Employee Benefit have a positive and significant effect on Personal Job Satisfaction.

4. Conclusion and Recommendations

As stated previously, the goal of this study is to identify the factors influencing job satisfaction among academic staff at Politeknik Mukah Sarawak (PMU). Based on the findings, three of the four independent variables, namely Organizational Leadership Style and Supervision, Promotion Opportunities, Job Security, Remuneration, and Employee Benefits, have a significant and positive influence, and Interface Issues, are significant and in accordance with the theory. Meanwhile, the variable Organizational Communication has no effect on personal job satisfaction. Although this research is appealing, there have been critics and suggestions for improvement of the organizational communication scales developed in Western organizations to make them applicable to collectivist culture-based organizations. Despite the fact that the current study confirmed earlier studies, caution should be exercised when extrapolating the results due to the complex relationship between communication and work satisfaction in organizational settings. One of the most challenging issues for the discipline of corporate communication is applying theories and models created in one part of the globe while trying to comprehend a phenomenon that occurs in another part of the world (Abu Bakar & Mustaffa, 2013). The complex and dynamic evolution of communication and its relationship with job satisfaction in organizational environments will be better understood and clarified with more research. Because successful communication enables them to accomplish the organizational goal, managers and supervisors must ensure and promote effective communication flow in their businesses. However, the scope of this study is limited to the academic staff of Politeknik Mukah, and the findings do not reflect the overall results of the academic staff of Politeknik Malaysia. This study's respondents are also bound by Malaysian government circulars and policies that cannot be implemented at the institutional level. Some of the questionnaires were not returned to the researcher due to time constraints and costs, which was one of the study's limitations and setbacks. The study also underscores the unique challenges that TVET institutions face, such as the lack of resources and the difficulty in attracting and retaining skilled staff. To address these challenges, the study recommends that TVET institutions prioritize the development of policies and practices that promote job security, provide opportunities for professional growth and recognition, and support work-life balance. Furthermore, it is crucial for TVET institutions to foster a positive and supportive work environment that values the contributions of academic staff and promotes a culture of collaboration and innovation. Overall, the findings of this study have important implications for the management of TVET institutions and provide insights into the factors that impact academic staff satisfaction and retention. By addressing these factors and creating a supportive work environment, TVET institutions can

improve the quality of education and training provided to students and contribute to the development of a skilled and competent workforce.

Acknowledgement

The authors acknowledge the Politeknik Mukah Sarawak, Malaysia for motivation, support, and provision of enabling working environment. Also appreciate the conference organizer (TECHON 2023) giving the opportunity for us to join the conference.

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The Factors Influencing Consumer Attitudes Towards Brand Extension: A Case Study of Engine Oil Lubricants

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Full Paper

Article history

Received

3 August 2023

Received in revised form

3 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

In today's world, brand extension is more important than ever as companies are constantly seeking to expand their customer base, increase revenue, and remain competitive in an ever-changing business landscape especially during this post COVID-19 pandemic. The study of consumer attitudes toward brand extension has been greatly discussed by researchers previously. However, in this particular research, researchers attempted to narrow down and scrutinize the scope of consumer attitudes study towards the brand extensions of engine oil and determine the antecedents which formed the consumer attitudes. The attitude-toward-object model established by Martin Fishbein in 1967 was adopted in this study. Variables examined in this research are brand loyalty, and consumer involvement. Survey methods were employed by distributing 165 sets of self-administered questionnaires to prospective respondents and convenience sampling was operated. The findings of the study provide evidence on the elements significantly shaped the consumer attitudes towards brand extensions with regards in selecting engine oil for cars. The findings of this study can be exploited to further enhance the brand extension approaches conducted by the related industries to ensure the effectiveness of the strategy. It is recommended that in future study, to take into consideration the other variables that not tested in this study.

Keywords: - Brand extension, consumer attitude, engine lubricant

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1. Introduction

COVID-19 pandemic started in 2019 has caused major downturn in many businesses regardless the industry. Lubricants companies were also impacted by the global outbreak as many market surveys reported that the COVID-19 pandemic had an unprecedented impact on the sales and production of engine oil manufacturers (Reuters, 2020; Li et al., 2021). According to a report by ResearchAndMarkets.com (2021), the global engine oil market size is expected to decline by \$5.22 billion during 2020-2024 due to the impact of COVID-19. The report states that the pandemic has caused a decline in automotive production and sales, leading to a decrease in demand for engine oil.

Nevertheless, Mordor Intelligence (2021) has projected that the ASEAN lubricant market will witness a

Compound Annual Growth Rate (CAGR) exceeding 3%, despite the adverse impact of the COVID-19 pandemic. Recognizing the need to bounce back in the post-pandemic era, lubricant companies are reformulating strategies to maintain their market relevance and sustainability. One of the marketing strategies to remain competitive in the market is through the introduction of product extension or brand extension as a competitive advantage. Firms use brand extensions to influence consumers' brand choices. Brand extension is a part of the marketing strategy to break the entry barriers between product categories through the carryover of a brand's reputation (Kushwaha, 2012). Before implementing a brand extension strategy, it is crucial for companies to identify the key factors that must be emphasized to ensure the strategy's success. Studies have shown that brand extension has a significant impact on customers' purchase intentions. In simpler terms, when a well-established

brand introduces a new product that is related to its existing products or services, customers are more likely to consider purchasing it (Abdel-Aziz, AL-Haddad, Judeh, & Al-Badawi, 2022). However, the success of brand extension also depends on how well the new product or service fits with the existing brand image and whether it meets customers' needs and expectations. Vahdat et al., (2020) focused their research on how emotional brand attachment contributes to attitude toward brand extension which the impact of customer satisfaction on attitude toward the brand extension is noticeable. However, Ahmad et al., in 2011 exploited a single factor which was the brand loyalty impacts on brand extension. The effects of perceived quality, brand extension incongruity, involvement and perceived risk were examined tremendously to determine their influences towards consumer attitudes of brand extension (Srivastava & Sharma, 2013). Srivastava & Sharma (2013) applied the antecedents in testing their stated hypothesis in the comparison of fast-moving consumer goods, durable goods, and services. Hence, this current study is particularly aimed at investigating the effects of brand loyalty and consumer involvement which formed consumer attitudes towards engine oil brand extension. The aim of this study is to gain an understanding of consumer attitudes towards brand extension of engine oil and to explore the relationship between brand loyalty, consumer involvement, and consumer attitudes towards brand extensions. As a result, the following hypotheses are proposed:

H1: There is a significant and positive relationship between brand loyalty and consumer attitudes towards brand extensions.

H2: There is a significant and positive relationship between consumer involvement and consumer attitudes towards brand extensions.

2. Literature Review

2.1 Consumer Attitudes Towards Brand Extension

Brand extension is a marketing strategy that involves using an existing brand name to launch a new product or product line in a different market or category. The purpose of brand extension is to leverage the existing brand equity and increase the chances of success for the new product by capitalizing on the positive associations and loyalty that consumers have towards the parent brand. According to Shabbir (2020), brand extension can have a significant impact on customer's purchase intention. This means that if a consumer has a positive attitude towards a particular brand, they are more likely to purchase a new product that is introduced under that brand. On the other hand, if a consumer has a negative perception of the brand, they may be less likely to purchase the new product.

Asshidin et al., (2016) explained consumer attitudes as a person propensity towards an idea or an object, and his or her value assessment and feelings about something. According to Hultman et al., (2021) brand extension is viewed as having more value when consumers are loyal to

the parent brand, which can enhance market share. Retailer performance may be improved by branding and clear positioning using customer and competitive oriented strategies. (Ramakrishnan, 2010; Reinartz et al., 2011). In this current study, the researcher proposes to employ the attitude-toward-object model established by Martin Fishbein in 1967 (Schiffman & Kanuk, 2010) to study and investigate the consumer attitudes towards brand extensions. As suggested by this model, the consumer's attitude toward a product or specific brands of a product is a function of the presence (or absence) and evaluation of certain product-specific beliefs and/or attributes. It is simply understood that consumers generally have favorable attitudes toward those brands that they believe have an adequate level of attributes that they evaluate as positive, and vice versa.

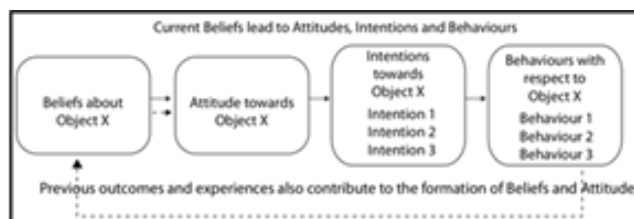


Fig. 1. Fishbein's attitude-toward-object model

Basically, brand extension is a strategy which is conducted by many organizations with the main objectives of benefiting from the brand knowledge achieved in the current market of existing brands. It is generally defined as "the use of an established brand name to enter new product categories or classes" (Aaker & Keller, 1990). Aaker & Keller (1990) claimed the success of a brand extension usually rely on several theories such as: consumer hold positive beliefs and favorable attitudes toward the original brand in memory, these positive associations facilitate the formation of positive beliefs and favorable attitudes toward the brand extension, and negative associations are neither transferred to nor created by the brand extension. This research proposition is consistent with Fishbein's theory of consumer attitude-toward-object model.

2.2 Brand Loyalty

According to Ozretic-Dosen et al., (2018) brand loyalty is a consequence of customers' favorable perceptions and emotions towards the brand. When considering brand extension, loyal customers are particularly important because they have made a substantial investment in the brand and consider it to be a reliable partner (Spiggle, Nguyen, & Caravella, 2012). Anwar et al., (2011) suggest that customer loyalty has a positive impact on their attitude towards brand extension. Therefore, the key to a successful brand extension is to cultivate a positive attitude towards the extension among customers, which is largely influenced by their loyalty to the brand (Shujie, 2017). Marketing concept of brand loyalty build-up of a consumer's commitment to repurchase or continuously using the brand and this behavior are indicated by repeated buying of a product or service or other positive behaviors such as word of mouth promotion (Dick & Basu, 1994; Ghorbani & Madani, 2012). However, Choi et al., (2010) and Hansen et al., (2004) used

affective commitment to describe brand loyalty. They stated that most research has found the affective kind of commitment to be a major determinant of customer loyalty. The goal of the business must be to keep all sorts of clients loyal to the brand because acquiring new ones really costs five to ten times more than keeping existing ones. (Oh & Park, 2020; Penefit 2015).

The notion of commitment has been an important aspect of studies on customer relationships over the last decades. Numerous studies have identified affective commitment as a key determinant of customer loyalty, while the effects of other types of commitment remain ambiguous (Kumar, Hibbard & Stern, 1994). If a customer's affective commitment to a brand is strong, it is expected to lead to a desire and motivation to maintain the relationship. This is consistent with Vahdat et al., (2020) recent study, which found that high brand commitment among customers results in a desire and motivation to maintain the relationship, making them less susceptible to newly introduced brand products and more resistant to brand extension. This study suggests that consumers with high affective commitment to a supplier are less likely to be receptive to newly introduced products in that category. In terms of brand extension, this implies that the intention to purchase a new product will decrease as the level of commitment to an incumbent brand increase.

Hem & Iversen (2003) used this notion to investigate the relationship between brand loyalty and brand extensions in 2003. The outcome of their study resulted that highly affective relation towards the parent brand might result in favorable consumer attitudes towards brand extensions, and loyal behavioral intention towards the parent brand is a crucial antecedent for achieving positive evaluation of the extension. In 2012, a study conducted by Zohreh et al., hypothesized the relationship between brand loyalty and consumer attitudes towards brand extensions. Adopting Reast (2005) and Volckner & Sattler (2006), the attitude toward an extension is better when the consumer trusts the brand, buy the brand's products regularly and shows a commitment to repurchase them. In the latest broad and extensive study by Kothari & Maindargi (2019) and Catic & Poturak (2022) brand loyalty has positive and significant impact on consumer behavior.

2.3 Consumer Involvement

Consumer involvement is considered as an individual difference variable, and it is a causal or motivating variable with several consequences on consumer's purchase and communication behavior. Consumers have established and maintain relationship with the product to some extent, where its play an important role in explaining how to establish and realize this relationship (Shen et al., 2019). It is defined in terms of relevance, pleasure, sign-value, risk importance and risk probability. The degree to which an individual is involved in a particular issue can have an impact on their decision-making process, and in general, a positive correlation exists between involvement and attitude. Consumer's level of involvement will influence the purchase decision (Bravo et al., 2013). As a result, individuals who perceive an issue as important and relevant

to them personally tend to have more favorable opinions about objects related to that issue (Eren-Erdogmus et al., 2018). If consumers are engaged with the introduced product category, this favorable attitude may extend to new brand extensions in the form of positive evaluations and attitude. Zaichkowsky in 1985 describes involvement as "a person's perceived relevance of the object based on inherent needs, values and interests" (Laurent & Kapferer, 1985).

The relationship between involvements with brand extension evaluation is because the difference in response between highly involved and less involved consumers reflects, to some extent, differences in risk-taking tendency. Highly involved consumers tend to have less risk avoidance than other consumers (Hansen, Hem, & Administration, 2004). The statement was observed from Steenkamp and Baumgartner's work where individuals with high in perceived involvement are more venturesome and likely willing to try new brands. The positive attitudes towards brand extensions were enhanced by higher involvement with them. It can be suggested that high involvement increases the tendency to think about benefits and detriments of new products and consumer's willingness to process more information, which result in favorable evaluation (Srivastava & Sharma, (2013). A recent study by Levesque & Pons (2021) suggested that involvement facilitates the intention-behaviour relationship which leads to encouraging consumer attitudes. This was also supported by the prior study of consumer involvement and consumer behavior (Jeseviciute-Ufartiene, 2019).

3. Methodology

The respondents of this study are the consumers who have the experience of buying or using engine lubricating oil. Data was collected from the consumers aged 18 and above who lived in Kuala Lumpur. The sampling size for this study was adopting Roscoe's rules of thumb as cited in Sekaran & Bougie (2013) which proposed the right sample size must be larger than 30 and less than 500 samples. The rule also stated that in this multivariate research, the sample size can be determined by times the number of variables by ten, or the number of items time by five. Therefore, as this research was investigating 4 variables with 23 items in total, 115 samples are considered appropriate. However, 160 samples from respondents were managed to be collected.

For measurement of scale, Likert scale is used which requires respondents to indicate the degree of agreement or disagreement with each of a series of statements about the variables. Each scale item consists of five response categories ranging from "strong disagree" to "strongly agree". The sampling technique to be employed in this study is a convenience sampling, as it refers to the collection of information from members of the population who are conveniently available to provide it (Sekaran & Bougie, 2013). This study utilizes IBM SPSS as the statistical tools to analyse the data. The reliability tests conducted on the variables were found to be acceptable and reliable as the Cronbach's Alpha values for all the variables are more than 0.60. The following are the outcomes from the reliability tests: Consumer Attitudes towards Brand

Extensions (4 items; Cronbach's Alpha= 0.779); Brand Loyalty (10 items; Cronbach's Alpha= 0.948); and Consumer Involvement (4 items; Cronbach's Alpha= 0.806).

4. Finding and Analysis

4.1 Respondents' Demographic Profiles

Table 1. Respondents' demographic profiles

Profile	Frequency	Percentage (%)
Gender		
Male	98	59.4
Female	67	40.6
Age		
16 – 20 years old	20	12.1
21 – 25 years old	54	32.7
26 – 30 years old	42	25.5
31 – 35 years old	19	11.5
36 – 40 years old	18	10.9
More than 40 years old	12	7.3
Occupations		
Student	63	38.2
Government	35	21.2
Own Business	21	12.7
Private	25	15.2
Others	21	12.7
Monthly Income		
RM 1,000 and below	61	37.0
RM 1,001 – RM 2,000	5	3.0
RM 2,001 – RM 3,000	34	20.6
RM 3,001 – RM 4,000	19	11.5
RM 4,001 – RM 5,000	38	23.0
RM 5,001 and above	8	4.8
Academic Qualification		
SPM / STPM	25	15.2
Diploma	74	44.8
Bachelor	55	33.3
Masters	7	4.2
PhD	2	1.2
Others	2	1.2

Table 1 shows the frequency and percentage of demographic profile for the total 165 respondents. 59.4% of the respondents who answered the survey were male, while the other 40.6% were women. Out of 6 predetermined group of age, most of the respondents were aged between 21 – 25 years old, which represents the largest age group among the total respondents. The survey also showed that most of the respondents are employed by total up the percentage for government, own business and privately employed which covers 49.1% out of total respondents. Monthly income levels for the respondents vary accordingly. The monthly income level of RM 1,000 and below represents the largest percentage which is 37.0%. For the academic qualification, most of the respondents are diploma level which involved 44.8% of the total 165 respondents.

The respondents were also asked several general questions which provide insight of the consumer attitudes and behaviors pertaining to the engine oil preferences, usage behavior and priority in choosing the right engine oil.

Table 2. General questions

General Questions	Frequency	Percentage (%)
Q1: How many time(s) do you service your car?		
Once in a year	8	4.8
Twice in a year	22	13.3
3 times in a year	36	21.8
4 times in a year	18	10.9
5 times in a year	33	20.0
More than 5 times in a year	48	29.1
Q2: Do you care about the brand of engine oil used for your car?		
Yes	110	66.7
No	55	33.3
Q3: Do you loyal to a specific brand of engine oil?		
Yes	81	49.1
No	84	50.9
Q4: Which other brand of engine oil that you use for your car?		
Mobil1	14	8.5
Total	24	14.5
Shell	50	30.3
Eneos	8	4.8
Nasa	7	4.2
Castrol	14	8.5
Petronas	39	23.6
Hyrax	6	3.6
Original Equipment Manufacturer (OEM)	39	23.6

Based on the above table, most respondents service their car more than 5 times in a year which represented 29.1%. The frequency or number of times car services in a year is also determined by many other factors, some of them are the type of base oil used, age of the car engines as well as the usage of the car and others. Most of the respondents, which is 66.7% claimed that they care about the engine oil used for their car. However, when it comes to the loyalty question, the percentages show a slight difference where only 49.1% considered themselves loyal to a specific engine oil brand meanwhile the remaining are not. Next, question 4 asked respondents to select the brand of engine oil they used for their car. Respondents may choose more than one brand in this question. To sum up the result, 30.3% respondents used Shell for their car, the next 23.6% respondents used Petronas, and same goes to Original Equipment Manufacturer (OEM). Only a few numbers of respondents, which is 3.6% used Hyrax engine oil for their car.

Table 3. Mean and Standard Deviation (SD) for dependent and independent variables

Variables	Mean	Std. Deviation
Consumer Attitudes	3.8106	.62904
Brand Loyalty	3.4345	.85587
Consumer Involvement	3.5909	.66723

The descriptive table above shows the figure of mean and standard deviation for each variable. Mean for the dependent variables of the research which is the consumer attitudes is 3.8106 and 0.62904 for standard deviation. For brand loyalty, the mean is 3.4345 and the standard deviation is 0.85587. For the independent variable consumer

involvement, the mean is 3.5909 and 0.66723 for standard deviation. From the above result, it can be concluded that most of the respondents agreed with all the items in the brand loyalty and consumer involvement variables as they mostly choose between 3 to 5 in the Likert scales, which are from neutral to strongly agree.

Table 4. Relationship between independent variables with consumer attitudes towards brand extension

Variables	Significant value (p)	Pearson Correlation (r _s)
Brand Loyalty	0.000	0.702
Consumer Involvement	0.000	0.604

Note: Significant value with $p \leq 0.05$

By using the Pearson Correlation Coefficient test, this study found that all the identified factors have significant relationships with the Consumer Attitudes towards Brand Extension. In this case, Table 4 shows that the correlation coefficient obtained was 0.702 for brand loyalty and 0.604 for consumer involvement, and the p-value for all this correlation was smaller than 0.05. This shows that there is a significant and positive relationship between brand loyalty and consumer involvement with the consumer attitudes towards brand extension in engine oil products. This also means that the consumer attitudes towards brand extension in engine oil products can be increased when brand loyalty and consumer involvement increased. Beside the correlation value shows the independent variables and dependent variable is positively related, brand loyalty and customer involvement indicated a high correlation with r value of 0.702 and 0.604 respectively. Thus, the hypotheses proposed are all accepted.

Table 5. Coefficient table of the regression analysis

Model	Unstd Coefficients		Std Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (constant)	1.746	.260		6.717	.000
BLmean	.310	.069	.422	4.497	.000
CImean	.197	.083	.209	2.382	.018

Dependent Variable: CAmean

Output generated in the correlation analysis of brand loyalty and consumer attitudes towards brand extension shows there is a significant and positive relationship. To further prove this annotation, regression analysis explained that brand loyalty is the most significant and influential factor among others in determining consumer attitudes towards brand extensions as the Beta value for this coefficient was the highest (.422). All the items suggested to be used in measuring the variable were valid and totally significant since the factor analysis proved that.

5. Conclusion

Though consumers show the care for their car engine maintenance, the respondents of the study were split when it comes to the loyalty to specific brands. It might be driven by many other factors such as price, accessibility and others which were not examined in this study. The outcomes resulted from the investigation of relationship between brand loyalty and consumer attitudes towards brand extension was clearly supported by Volckner & Sattler (2006); Kothari & Maindargi (2019) and Catic & Poturak (2022) studies where it shows a positively and significantly relationship between both variables. The same output was produced for consumer involvement and the dependent variable. This was aligned with previous studies by Srivastava & Sharma (2013); Jeseviciute-Ufartiene, (2019); and Levesque & Pons (2021).

Despite the eagerness of companies in implementing multiple marketing strategies to dampen the effect of COVID-19 Pandemic, based on the result obtained, it is recommended for the company or other related firms to thoroughly looking into the importance of observed subset antecedents to activate the favorable attitudes of consumer towards the brand extension of any products. As stated factors significantly influenced consumer attitudes towards brand extensions, strategies which could emphasize and exploit those factors might need to be activated.

This study is useful and significant not to the lubricant manufacturing companies merely, but also can be used by other related industries such as automotive companies, workshops, and other parties. Appropriate sales and marketing activities might need to be conducted to capture larger market share as this study will provide clearer picture of consumer attitudes and behaviors towards their products. Companies can find the outcome of this research resourceful for the basis or foundation in revising and constructing relevant sales and marketing programs that would trigger the favorable attitudes of consumers towards their brand extensions literally. Thus, the traditional focus on aggressive selling merely should be reviewed by looking into the importance of consumer attitudes which encompasses multiple elements as discussed in this study.

Besides, for future research, it is suggested to broaden the scope of the study beyond a specific location since data collected as well as the result obtained from the analysis might only be significant in that specific area. Having broader scope may produce different results. It is also recommended to researchers in future to take into consideration the variables not studied in this study. Since consumer attitudes towards brand extensions not only comprise of brand loyalty and consumer involvement, other variables such as product feature similarity, consumer innovativeness, self-image, experience and so on might also be operated and further studies are encouraged.

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The Factors Influencing Entrepreneurs' Performance among MADA Entrepreneurs

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Full Paper

Article history

Received

3 August 2023

Received in revised form

3 August 2023

Accepted

3 September 2023

Published online

30 September 2023

Abstract

Entrepreneurship is recognized as a crucial factor in the transformation of nations politically and socio-economically. Despite growth in MSME contribution to Malaysia's GDP, the pandemic has reversed the trend, and various government agencies are working to revitalize the MSME ecosystem. This study aimed to investigate the relationship between market network, family support, government policy, and entrepreneurs' performance among MADA entrepreneurs. Data were collected through a survey questionnaire from 145 entrepreneurs operating in MADA region. Correlation and multiple regression analyses were conducted to analyze the data. The results showed that market network, family support, and government policy had a significant positive relationship with entrepreneurs' performance. Among these factors, government policy had the highest impact on entrepreneurs' performance. These findings suggest that policymakers and entrepreneurs should pay attention to the role of government policy in supporting and promoting entrepreneurship. Furthermore, this study provides a basis for future research to investigate other variables that may influence entrepreneurs' performance, such as education, experience, and financial factors.

Keywords: - *Entrepreneurs performance, Dasar Keusahawanan Negara 2030, COVID-19, MADA*

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1. Introduction

Dasar Kemakmuran Bersama 2030 introduced by the Malaysian Government in 2019 lays the foundation for the nation to be a developed country sustainably in line with fair, equitable and inclusive economic distribution at all levels of society with the main pillar of strengthening business and industry ecosystem especially among micro, small, medium enterprises (MSME). Entrepreneurship scholars mutually agreed that entrepreneurship activities generate employment, create wealth, and stimulate developing economies (Ahmad & Xavier, 2012). Realising the significant contribution of MSME towards national development, *Dasar Keusahawanan Nasional*

2030 launched by the Ministry of Entrepreneurs Development in 2019 outlined one of the strategic pillars which is to strengthen the ability and the performance of local MSME. However, the catastrophic effect of COVID-19 Pandemic has severely impacted the nation path towards developed country via empowerment of entrepreneurs. Hazim in 2021 reported the Youth Co:Lab survey which co-led by the United Nations Development Programme (UNDP) and Citi Foundation found that series of lockdowns and the falling in customer demand has forced young entrepreneurs to fully if not partially close their business as the last resort after the shrinkage of cash flow and even laying off some of the workers subsequently. In a larger perspective, despite the positive

and continuous increment in MSME contribution to Malaysia's GDP from 37.0% in 2015 to 38.9% in 2019 which was amounted RM 553.4 billion, COVID-19 Pandemic has reversed the trend where contribution of MSMEs' GDP to national GDP only marked at 38.1% in 2020 and continues to fall in 2021 with only 37.4% which was RM 518.1 billion (Department of Statistics Malaysia, 2022). Recognizing the need to revitalize the MSME ecosystem in Malaysia, various government agencies related to the entrepreneur's development have initiated several strategic agendas to rejuvenate entrepreneurial mindset especially the among the young generation. However, government initiatives alone cannot determine the entrepreneur's ultimate success as it is defined by many other factors that need to be accessed simultaneously. Therefore, this study aimed to scrutinize the critical success factors which impact entrepreneurs' performance.

The factors determining the performance of entrepreneurs have been greatly debated recently as entrepreneurial performance can be accessed by looking into several distinction of theories and knowledge and disciplines. Entrepreneurial performance can be defined as the capacity to accomplish predetermined entrepreneurial objectives. This entails leveraging available business opportunities to maximize efforts (Sariwulan, 2020). Performance is associated with meeting business objectives by capitalizing on available opportunities. Such circumstances entail quantifiable risks that an entrepreneur must analyze and anticipate. There are several factors that need to be considered while preparing for entrepreneurship.

Niu (2023) clearly stated entrepreneurial performance encompasses both financial and non-financial aspects. Financial performance comprises corporate revenue and profits, while non-financial performance includes corporate innovation capabilities, market share, and customer satisfaction. Additionally, entrepreneurial performance can be categorized into financial performance, survival performance, and overall performance. Additionally, entrepreneurial performance can be measured by using financial indicators as well as considering the business growth in term of annual increases in sales and number of employees (Mould, 2013).

Recognizing the importance of entrepreneurship education in promoting entrepreneurship development and the economy, Malaysia has taken the initiative by implementing entrepreneurship programs and activities under some of the ministries. One of the organizations is Muda Authority Development Area (MADA). MADA stands for the Malaysian Agricultural Development Authority, which is a government agency under the Ministry of Agriculture and Food Industries in Malaysia. MADA's role in entrepreneurship is to support and promote entrepreneurial activities in the Muda Agricultural Development Authority (MADA) area, which covers a large part of the state of Kedah and Perlis in Malaysia. MADA provides various forms of assistance

to entrepreneurs in the area, including funding, training, technical support, and access to markets. Currently, MADA has 1,261 entrepreneurs include the business of snack processing, beverages, traditional cakes, handicrafts, herbs, cosmetics as well as other business projects such as sewing, livestock projects, crop projects and aquaculture. According to MADA, there is only 10% of the total entrepreneurs in Muda Area are categorized as successful in their business. MADA measures entrepreneurial success by looking at the entrepreneurs' financial performance and their business viability and sustainability.

Extending the prior study of entrepreneur's performance (Small, 2017; and Obaji & Olugu, 2014), this current study is focusing in examining the market network, family, and government policy as the contributing factors to the entrepreneur's performance and their relationships among MADA entrepreneurs. Thus, the following hypotheses were proposed:

H1: There is a significant and positive relationship between market network and entrepreneurs' performance.

H2: There is a significant and positive relationship between family factor and entrepreneurs' performance.

H3: There is a significant and positive relationship between government policy and entrepreneurs' performance.

2. Literature Review

2.1 Entrepreneurs Performance

Researchers were varying in defining the entrepreneur's performance and its indicator as the study of entrepreneur's success is multifaceted which may incorporate either individual, organizational, external antecedent, or the combination of them. Namwambah et al. (2021) found that entrepreneurial training, networking, technology adoption, and financial access positively correlated to entrepreneurs' performance. Henley et al. (2011) has investigated several variables (passion for work, tenacity, self-efficacy, interpersonal control, and new resource skill) to determine entrepreneurial success. In the early study, Schein (1978) stated that the entrepreneur's performance is measured by organizational performance which is subject to the environment where the organization exists.

According to Hilali & Abousaid (2023), performance is a complex concept that encompasses various dimensions. It is commonly understood as the fulfillment of a company's objectives and the efficient execution of activities. However, this broad definition is challenging for companies to operationalize. Nowadays, it is widely acknowledged that company performance should consider multiple dimensions, including economic, social, and environmental aspects, leading to a more comprehensive understanding of overall performance. Firmansyah et. al. (2023) study was more focused on examining the firm performance by arguing that the model should also considering the digital transformation, digital literacy, and

market orientation influences on firm's performance. The study defined entrepreneurial performance as it reflects the capability of a business to sustain its operations or decide to cease operations. Key indicators of entrepreneurial performance include management expertise, product/service offerings, customer and market relationships, quality standards, business methods and collaborations, financial resources, marketing strategies, and the external environment. Thus, this study is conducted to explore the effects of market network, family, and government policy towards the performance of MADA entrepreneurs.

2.2 Market Network Factor

Market networks play a crucial role for business success and economic growth for a nation nowadays. According to Schaefer (2016), market networks have stronger retention and engagement than marketplaces. According to Hani (2014), networking is one of the most important skills that one must learn to make his or her business grow and success. This is because networking will help to generate new business through referrals, opportunity to get advice from experts, and built-in source for marketing. Besides that, Small (2017) stated that networking is also the strongest and most powerful marketing tactic to accelerate and sustain success for any individual and organization.

According to the research study by Boso et al. (2013), network ties were found to play a crucial role in shaping the complex relationship between firm's entrepreneurial orientation and market orientation activities and business success for entrepreneurs. Social network ties and business network ties (suppliers, customers, distributors, and competitors) maximize the performance benefits of aligning high levels of entrepreneurial orientation and market orientation. Therefore, authors encourage entrepreneurs to leverage their external ties to earn greater rewards for their entrepreneurial and market-oriented activities to be more successful. Effective utilization of networking can enhance a firm's financial performance and expand its market share by identifying new business prospects, facilitating skills transfer, and garnering positive industry ratings. Therefore, it is crucial for MSMEs to enhance their networking efforts to boost performance. Understanding the impact of networking on entrepreneurs' performance is essential for achieving this objective Namwambah et al. (2021).

Research has shown that networking positively affects the performance of small businesses in various ways. It grants them access to valuable resources like information and funding while fostering partnerships and collaborations. A specific study conducted in the West Java province confirmed the positive association between networking and financial performance. This relationship was demonstrated through increased sales growth and enhanced profitability among small businesses (Nugroho, 2023).

2.3 Family Factor

Ironically, only few attentions have been put to see how the family as a specific social institution give the impact to the entrepreneurial outcomes, although most entrepreneurs have families that highly influence their business activities (Jennings et al., 2013). Some studies in the field of entrepreneurship have highlighted the pivotal role of the family in the entrepreneurial journey. This is due to the significant connections observed between entrepreneurial activities, outcomes, and the involvement of family members in the business. The perspective of family embeddedness focuses on the interpersonal interactions between entrepreneurs and their family members. It explains the significance of family and its associations in the entrepreneurial context (Neneh et. al., 2022). The family domain contributes to the provision of essential resources, such as physical, human, financial, and social resources, which are crucial for entrepreneurial startups and their success. However, there are varying findings regarding the impact of different types of family support on different business outcomes and in different contexts.

In more dated studies, for example research conducted by Adjei et. al. (2019) proved that family relationship constellation positively impacted the entrepreneur's performance in term of productivity. Earlier Putnam (1993) proposed that social networks provided by extended family- or community-based relationships are likely to amplify the effects of education, experience, and financial capital. This leads to the fact that participation in social networks benefits individuals involved in start-up activities. Previous study stated that, other factors such as age, education, and family status also influence individual's entrepreneurship development (Renzulli et al., 2000). However, Hossain et. al. (2009) states that family responsibility of individuals is a potential constraint to their business activities. Contrary to this, family support can be a pillar of their business success. For example, Bhunia and Siddika (2023) in their new study on women entrepreneurs revealed that various factors influence the success of women in entrepreneurship, both internal and external. Internal factors such as education, experience, and personal relationships were found to play a significant role. Additionally, external factors like access to loans, financial stability, and family support were identified as crucial determinants.

2.4 Government Policy Factor

Recently, it has been established that entrepreneurship is a very important component of job creation as well as economic development. To be an entrepreneur, the success of income generation for the major group depends on government involvement. According to Ariffin et. al. (2020), there are several ministries established for instance the Ministry of Entrepreneurial and Cooperative Development (MECD) in 1995, the Ministry of Women,

Family and Community Development (MWFCD) in 2001 and other supporting government agencies provide support to entrepreneurs including funding, physical infrastructure, and business advisory services. In fact, various incentives programs and activities have been developed by the government to enable the entrepreneurs gain enough capital to start and develop their business (Zainol & Daud, 2011). Therefore, the government has been actively involved and concerned about entrepreneurship development. This is to ensure that the entrepreneurs can develop their business successfully and not be left out from the process of national and economic development.

Entrepreneurship is an important engine of economic growth (Minniti, 2008). To develop successful entrepreneurs, the government policy needs to be strengthened to ensure that the entrepreneurs are receiving supportive programs from the government. However, according to GEM's finding on Malaysia's entrepreneurial environment, the result was negative relationship between performance and government policy factor. They found that the government policies disfavour new firms and the government bureaucracy, regulation and licensing requirements delay the new firms from expanding (Teoh & Chong, 2007). Recent study by Alkahtani et al. (2020) suggested a similar finding where the density of government support exhibits a substantial and favorable impact on sustainable competitive performance. However, the success factor of entrepreneur's performance not merely depends on the tremendous amount of government support and policy alone. The other important element which plays a crucial role in the implementation of government policy as entrepreneurs success catalyst is how well the related information is being conveyed and disseminated to the entrepreneurs at the bottom as the latest finding suggested not all entrepreneurs were well-informed regarding the supporting policy which affecting them (Musabayana et al., 2022).

3. Methodology

The participants in this study are entrepreneurs from MADA. To determine the appropriate sample size, Roscoe's rule of thumb, as cited in Sekaran and Bougie (2013), was adopted. This rule suggests that the sample size should be greater than 30 and less than 500. Additionally, for multivariate research, the sample size can be determined by multiplying the number of variables by ten or the number of items by five. As this study investigated four variables with a total of 14 items, a sample size of 70 was considered appropriate. However, 145 respondents participated in this study, exceeding the recommended sample size.

The Likert scale is used to measure the scale of the study, where respondents are asked to express their level of agreement or disagreement with a series of statements related to the variables. The scale consists of five response categories ranging from "strongly disagree" to

"strongly agree". In this study, a convenience sampling technique is employed, which involves collecting information from readily available members of the population (Sekaran & Bougie, 2013). To analyze the data, IBM SPSS was utilized as the statistical tool. The variables were assessed for reliability through Cronbach's Alpha tests. The Cronbach's alpha value for the Government Policy Factor variable was 0.703, indicating that its reliability is acceptable. However, the other two variables, namely market network and family factor, were found to be poor in terms of reliability, as their Cronbach's alpha values were only 0.591 and 0.592, respectively.

4. Finding and Analysis

4.1 Respondents' Demographic Profile

Table 1 shows the frequency and percentage of demographic profile for the total 145 respondents. Out of all the respondents, 64.1% were female and 35.9% were male. Most of the respondents were aged above 40 years, accounting for 37.9%, followed by those aged between 36-40 years, accounting for 21.4%. The frequency analysis of academic qualification showed that most respondents had SPM/STPM qualification, with 97 respondents accounting for 66.9%.

Table 1. Respondents' demographic profiles

Profile	Frequency	Percentage (%)
Gender		
Male	52	35.9
Female	93	64.1
Age		
16 – 20 years old	1	0.7
21 – 25 years old	8	5.5
26 – 30 years old	23	15.9
31 – 35 years old	27	18.6
36 – 40 years old	31	21.4
More than 40 years old	55	37.9
Academic Qualification		
SPM / STPM	97	66.9
Diploma	26	17.9
Bachelor	10	6.9
Masters	2	1.4
PhD	0	0.0
Others	10	6.9

The respondents were also asked whether they have prior working experience with government or private sector and if their parents have experience as entrepreneurs.

Table 2. Respondents' profile

	Frequency	Percentage (%)
Prior Working Experience		
No	70	48.3
Less than 1 year	16	11
2 – 5 years	32	22.1
6 – 10 years	27	18.6
Parent have experience as entrepreneur		
Yes	79	54.5
No	66	45.5

The number of respondents with no prior working experience is 70, which is the highest among the categories, followed by those with 2-5 years of experience in either government or private sectors. 27 respondents, accounting for 18.6 percent, reported having 6-10 years of working experience. In addition, out of the total respondents, 66 stated that their parents had experience as entrepreneurs, which is 45.5 percent, while 79 respondents, which is 54.5 percent, stated that their parents had no experience as entrepreneurs.

In this study, correlation analyses were performed to measure the strength of association between two metric variables. The Pearson Correlation index was used to determine whether there is a linear or straight-line relationship between the two variables. The values of the Pearson Correlation range from -1 to +1, with negative numbers indicating a negative correlation and positive numbers indicating a positive correlation. The interpretation of the correlation results is as follows: $r = 0.10$ to 0.29 indicates a small correlation; $r = 0.30$ to 0.49 indicates a medium correlation; $r = 0.50$ to 1.00 indicates high correlations (Hair et al., 1998).

Table 3 displays the correlation between the dependent variable, entrepreneurs' performance, and each independent variable. It reveals that there is a relationship between the variables. The market network factor and family factor have a medium correlation yet significant relationship with the dependent variable, as indicated by their r -values of .362 and .336, respectively. On the other hand, the government policy factor demonstrates a stronger relationship with the entrepreneur's performance, with an r -value of .533, indicating a high correlation. Additionally, all the relationships between the dependent and independent variables are positively related, as shown by the positive r -values.

Table 3. Relationship between independent variables with entrepreneurs' performance

Variables	Significant value (p)	Pearson Correlation (r_s)
Market Network	0.000	0.362
Family Factor	0.000	0.336
Government Policy	0.000	0.533

Note: Significant value with $p \leq 0.05$

Table 3 reveals that all p -values are below 0.01, indicating a significant relationship between the independent variables (market network factor, family factor, and government policy factor) and the dependent variable (entrepreneurial performance). As a result, the proposed hypothesis can be accepted.

As shown in Table 4, the model summary of the multiple regression analysis indicates that the R square value is 0.339, implying that entrepreneurial performance is affected by the 33.9% of the variation in three independent variables (market network, family factor, and government policy factor).

Table 4. Result of model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.594 ^a	.353	.339	.50121

a. Predictors: (Constant), MeanGF, MeanFF, MeanMN

Based on the multiple regression analysis coefficients shown in Table 5, it is evident that government policy factor has the highest impact on the performance of entrepreneurs as its beta value is the highest ($\beta = 0.437$, $t = 5.966$, $p < 0.05$). This is followed by the family factor, with a beta value of 0.200, $t = 2.812$, $p < 0.05$, indicating that it is the second independent variable that affects the performance of entrepreneurs. On the other hand, the market network factor has the lowest beta value among the three independent variables, with a small but significant relationship to the performance of entrepreneurs ($\beta = 0.145$, $t = 1.947$, $p < 0.05$). Overall, the multiple regression analysis coefficients demonstrate that government policy factor has the strongest impact on entrepreneurial performance, followed by the family factor and the market network factor.

Table 5: Coefficient table of the regression analysis

Model	Unstd Coefficients		Std Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (constant)	.956	.379		2.519	.013
MeanMN	.183	.094	.145	1.947	.053
MeanFF	.173	.062	.200	2.812	.006
MeanGF	.433	.073	.437	5.966	.000

a. Dependent Variable: MeanPER

5. Conclusion

There are various factors that influence the success of an entrepreneur. These factors can include personal traits and characteristics, such as perseverance, innovation, risk-taking, and adaptability. Additionally, external factors such as market conditions, competition, government policies, access to financing, and networking also play a crucial role in determining the success of

entrepreneurs. Both internal and external factors must be thoroughly investigated as they both affect the entrepreneur's performance in business.

The investigation of the relationship between market factor and entrepreneur's performance in this study was supported by Namwambah et al. (2021), Small (2017), and Boso et al. (2013) studies, which found a positive and significant relationship between these variables. The same output was observed for the family factor and the dependent variable, which is consistent with the previous studies by Jennings et al. (2013) and Adjei et al. (2019). Moreover, the findings are in line with the prior research by Alkahtani et al. (2020), and Musabayana et al. (2022), which investigated the significance of government policy in entrepreneurial success.

These studies provide evidence that market factors, family factors, and government policy are crucial determinants of entrepreneurial success. Market factor refers to the support provided by the market in terms of opportunities, resources, and networks, which can facilitate entrepreneurs to achieve their goals. Family factor is the social capital that entrepreneurs can leverage in the form of financial and emotional support, knowledge sharing, and business advice. Government policy, on the other hand, includes regulations, tax incentives, and other support programs that can impact entrepreneurial performance positively. Overall, these studies highlight the importance of considering multiple factors to understand and support entrepreneurial success.

The study on the factors influencing entrepreneurs' performance among MADA entrepreneurs is significant in several ways. Firstly, it provides insights into the factors that affect the performance of entrepreneurs in the context of MADA, which can help policymakers and business owners to develop effective strategies to support entrepreneurship and enhance its contribution to economic development. Secondly, the study contributes to the existing literature on entrepreneurship by providing empirical evidence on the relationship between market network, family factor, government policy factor, and entrepreneurs' performance. Thirdly, the study adds to the knowledge base of entrepreneurship research by exploring the factors that influence the performance of entrepreneurs in the agriculture sector, which has been relatively under-researched. Overall, the study has significant implications for policy and practice, as well as for future research on entrepreneurship in the context of developing countries.

This study only covers a limited number of factors that can impact the performance of MADA entrepreneurs, and it is important to note that there may be other factors that were not considered. The findings of this study can serve as a reference for future researchers who wish to continue studying the performance of MADA entrepreneurs or related areas. Researchers in the future are recommended to consider additional variables beyond those examined in this study, such as an entrepreneur's background, education, and financial situation. These variables could also play a role in determining an

entrepreneur's performance, and further research is needed to fully understand their impact.

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The Identification of Occupational Safety and Health Awareness Factors Among TNB Employees at Jalan Lahat Ipoh, Perak

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Full Paper

Article history

Received

26 July 2023

Received in revised form

26 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Awareness in occupation safety and health at workplace are most important factors. The safe side of any workplace happens when precise protocol is applied throughout every process which is carried out. An organizational management system should facilitate its organization and employees by providing defined information of occupational health and safety risks allied with the business of the organization. Factors which are associated with the awareness intensity are more likely hazardous working area, safety and health conditions, lack of emergency plans and etc. This overall research was carried out at Tenaga Nasional Berhad (TNB), Jalan Lahat Ipoh Perak. This research is mainly targeted for the workers of TNB Jalan Lahat Ipoh, Perak includes management and staff. This research is conducted by use of 94 sets of questionnaires which are equally distributed among all the employees. This questionnaire comprises about total of four (4) segments where part 1 consists of demographic information, part 2 consists of employee and occupational safety and health policies. Part 3 consists of organizations responsibilities, standards, and documentation and part 4 comprises of planning, implementation and performance level of OSH in an organization. This study indicates the relationship between employees towards the knowledge of safety awareness at workplace and management of safety measures.

Keywords: - Awareness, Occupation Safety and Health, workplace safety

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1. Introduction

Safety awareness has a common definition where it is defined as avoidance of any kind of accidents to human beings such as injury or harm. Having awareness of safety is so significant that it comes naturally within all human beings. It is because safety values and beliefs are always cultivated within everyone from a very young age. Despite it is a norm that is practiced globally (Stephen, 2018).

On the other hand, narrowing down the definition of safety awareness in specific work area an organization, Clarke and Cooper has identified safety awareness as one the core of assumptions and beliefs that an organization member hold on the concern on safety issues. The normal

behaviors of the superiors such as the managers and the others work forces in an organization towards practicing the safety collectively is particularly important to be observed. This could help the team to collectively stand on the common ground and ensure to follow the safety awareness practice together. To prevent fatal accidents and injuries that could take place in any work environment (Clarke & Cooper, 2000).

It is a core practice that should be practiced globally in every workplace from all types of sectors and industries. Regardless of every public and private sector, the need of awareness on safety measurements to ensure all possible hazards are taken seriously and precautions are identified and practiced in an organization by the staff.

Proper safety awareness will be achieved in an organization when there is a proper management system being practiced in the organization within the staff. They will need to ensure that, the staffs understand the importance of ensuring the safety and practicing its values and beliefs on the common ground when they are in the organization. Safety policies and safety rules and regulations must be taken seriously by the management firsthand before it is cultivated within the other work force in every organization.

Different organizations and sectors have different safety and health policies that are implemented by the management to be practiced. For example, manufacturing industries have higher and tedious physical safety rules and regulation implemented since there are possibility for major hazards to take place when staffs work along with huge machineries. But looking into the organization from the management industry has different safety and health policies since they do not work with machinery. But they could be exposed to hazards such as wiring short circuits, improper carpet installations, dust and heat prone areas and many more (Frankfurt, 2018).

To ensure all the organizations from different industries and sectors has been following the right safety and health policies, a public health agency named OSHA, Occupational Safety and Health Administrations have been providing extensive safety and health guidelines and safety policies for every place and different organization. They help to identify hazards and necessary precautions to be taken. The OSHA believes in the right to a safe workplace is a basic human right, and workers should not have to choose between their life or their job, OSHA 3302-01R 2020.

The Malaysia, Organizational Safety and Health Act (1994) provides a legitimate guidelines, rules and regulations and policies that need to be implemented and cultivated within all the organizations, workplaces, and staffs and to encourage a tedious and higher level of safety and health precautions.

The OSHA act also ensures that the importance of the awareness of safety and health reached to all organizations and industries effectively and widely. The act emphasizes safety and ensures that the guidelines and policies that they have implemented have been strictly followed by the organization and industry. The OSHA act also implemented the regulations into the law, to ensure that this regulation is taken seriously and being practiced strictly in all workplaces by all work forces. It works as a self-regulated scheme in the law, where the guidelines are amended accordingly to the organization and industries. The main mission of the OSHA Act is to ensure safe working environment in all workplaces and within all Malaysian employees.

Regardless of every workplace, it has its own risk, it is OSHA main mission to ensure every workplace that an employee works will face no risk in on injury or life. Not only by helping the employees and employers to identify the hazards in their workplace but also to ensure that the guidelines and rules and regulations that is implemented

accordingly is being followed by the employees effectively. This is where the needs of awareness programmers by OSHA being shared widely to employers and employees in Malaysia.

The awareness programme of Safety and Health in the workplace will help to minimize the risk of possible diseases, fatal accidents and injurious to take place in the work site both indoor and outdoor. It is the duty of the employers to ensure the employees in their organization are well protected on the worksite and they are exposed to the most minimal level of risk to their health and life.

The objective of this study is to investigate the level of awareness on the safety and health within the staff in the TNB Jalan Lahat, Ipoh Perak.

2. Methodology

This research study was conducted at one of the main branch states of Perak which is also known as a “Wisma TNB Ipoh”. This branch is in the central city of Perak and precisely at Jalan Lahat Ipoh. The sampling method which has been used for this research is “Probability Sampling” method. Probability sampling is defined as a sampling technique during which the researcher chooses samples from a bigger population employing a method supporting the idea of probability. Probability sampling uses statistical theory to randomly select a small group of individuals (sample) from an existing large population then predict that each one their responses will match the general population (Nayeem, 2017).

By implementing this method, researchers can split the set of questionnaires data which is known as extensive population into smaller groups to represent the analysis of entire population without any overlap. This questionnaire sampling method is also classified by few factors such as age, gender, education as well as employment position under TNB Ipoh branch.

Employees are categorized into 4 main divisions which are Management, Technical Worker, Non-technical worker, and private sector (cleaning, gardening & security). Thus, a questionnaire-based survey was implemented for them. A set of 94 questionnaires are equally distributed among all the employees working under Tenaga Nasional Berhad Ipoh Branch respectively. Moreover, the questions given were carried out to understand the level of awareness of staff and management's safety based on the knowledge of the OSHA act 1994.

3. Result and Discussion

From the data collection based on the questionnaires, a total of 94 participants were voluntarily joined and out of 94 questionnaires which been administered, all were filled in and returned. Based on the 94 questionnaires received, 12 questionnaires had incomplete information which directly affected the results analysis. So, the overall response rate to this survey represents 82.0%, which is

believed to be a perfect conclusion for this research. According to Nigel, 50% response rate is basically sufficient, 60% good and above 70% rated excellent (Nigel, 2019).

3.1 Participants Characteristic Analysis

The first key element of this demographic segment research is gender. The majority participants who participated in this research are 52 males which comprised of 63.41% and followed by 30 females with an average of 36.59%.

Age plays an important role in research to identifying variety perception by indicating the level of maturity. Ages are divided into three (3) main categories such as 25-35 years old, 36-46 years old and followed by 47-60 years old. Participants who are aged from 36 – 46 years old comprise higher percentage of results which is 37.8%. The second highest percentages of participants are aged from 25-35 years old, which involves 32.9%. While the minority of participants are aged 47-60 years old, and their percentage of analysis will be 29.3%.

Another demographic input of this research is working position or best to say their designation. Each is categorized into four (4) phases such as Management, Technical, Non-Technical and Private sector (Cleaner, gardener & security guards). The highest evaluations are taken from the technical department which comprises 30.5% of total respondents. The second highest department would be non-technical, which encompasses about 26.8% and followed by Management which comprises 24.4%. The least proportion of respondents is from the private sector where they occupied about 18.3%. Private sector respondents are comprised of security guards, gardeners, and cleaners.

Education plays an important role in this evaluation, and they're equally divided into three (3) main categories which are known as SPM-CERT, Diploma-Degree, and Master-Doctorate. When comparing with education factor, the highest respondents are from Diploma-Degree background which encompasses 42.7%. While Master-Doctorate respondents comprise 32.9% and the minority of population are from SPM-Cert education which is also comprises of 24.4%.

Working experience input is also included in this research. The purpose of implementing working experiences is to identify their overall experiences which envelopes into their employment journey. Besides that, researchers can easily evaluate the analysis by use of extensive view of professional association of employees towards organization based on given profession. Working experience was divided into four (4) such as: less than 5 years, 10 years, 15 years and more than 20 years. The highest working experiences involved in this research is 15 years which comprises of 31.7% of respondents. The second highest respondents of this research are who worked for more than 20 years which comprises about 26.8% of staffs. Thirdly, a fraction of 25.6 % of respondents have 5 years of working experience and

lastly, the minor respondents are comprising of 15.9% who are worked for 10 years joined this study.

3.2 Employee and Occupation Safety and Health Policy Analysis

The relationship between employees and occupation safety and health policy, it is necessary to understand that it is a way of organizing the cooperation measures between both parties.

86.59% of TNB Ipoh branch employees agree that their working environment and occupation are safer. Among them about 13.41% reported that their working environment is not safer. As a result of the awareness of OSH policy, most employees are understanding the key concept of implementing OSH policy at workplace. An average of 78.05% of people reported that their organization does implement OSH policy. While 21.95% of employees are not aware that their company has an OSH policy which really could have a bad impact in future. It is because, OSH policy helps to minimize the effects of hazards as well as benefit the company too.

73.17% reported that they received proper training facilities in understanding OSH implementation at workplace. 26.83% of employees stated that they didn't receive training facility on OSH which is unacceptable because it is necessary for an organization to provide them with proper training to avoid any hazards-based impacts.

93.90% of employees reported that the organization has distributed OSH policy to employees equally in conjunction with safety of workplace environment. Providing an appropriate source of information for employees in the workplace enables them to work logically to avoid or manage any state of danger. On other hand, an organization should provide adequate protection tools for their employees to protect them against any health or safety issue while they're on the job. 97.56% of employees reported that their organization has a sufficient set of protection tools to protect them all the way. It shows that employees truly understand the nature of organization.

3.3 Organization Responsibilities, Standards & Documentation Analysis

Employers have a responsibility to provide a safer workplace for their employees under OSH laws and regulations as management and organization are interrelated. Employers should ensure that their organizational structures help to realize objectives and improve its OSH performance even beyond legal requirements.

Organization plays important roles in setting up OSH policies for the betterment of their employees. Every organization should consist of its own OSH committee team to serve the organization's safety culture. OSH committee team are able increase the awareness of safety at the facility. Therefore, employees at TNB Ipoh branch agree that their company have OSH committee team to integrate the safety and health priorities into the working

corporate culture which comprises about 92.68%. They're able to help by providing adequate training for employees and management while about 7.32% of employees denies those statements.

Employees also reported that their organization's OSH committee endorsed a safer and healthy working culture environment for themselves which is comprises about 97.56% and only 2.44% employees denied the statement. 56.10% of employees reported that their higher officials received proper formal OSH training before the organization mutually endorsed the OSH act. While an average of 43.90% employees denied it as they didn't aware or understand the concept of OSH laws. For an organization to endorse with ISO certified, the employers or management should undergo many phases of evaluations to be granted. As TNB is known as Multinational Companies, they are now certified with MS ISO 9001: 2000 Certification.

79.27% of employees reported that they agree that management have organize their competencies of OSH are maintain well or best to say up to date. Management should always keen the competencies of their staff as it will directly increase a good productively at workplace.

48.78% of employees agree that they have undergone medical surveillance programs such as DOSH, OSHA etc. while another 51.22% of employees denies that they didn't go for medical test. This indicates that one-half of them didn't take medical surveillance program.

95.12% employees have reported that TNB is certified with proven competence system like ISO, OSHMS and about 4.88% employees have denied it. TNB has won national recognition by the Government of Malaysia through the standards of MS ISO 9001, MS ISO/IEC 17025, MS ISO/IEC 17020.

3.4 Planning, Implementation & Performance Analysis

This segment of the questionnaire is about how an organization does plan, implements, and performs strategies in accordance with OSH implementation. An average of 81.71% employees reported that TNB does perform Hazard Identification, Risk Assessment as well as risk control and another 18.29% has denied the statement. For risk assessment factor, TNB has launched TNB-Group wide Risk Assessment practice to identify the key issue of risks.

TNB emphasizes health risk assessment before assigning to specify job and majority employees answered "Yes" with an average of 63.41%. It is compulsory for an organization to send their employees for health risk assessment test to identify their potential for health information so that they're eligible to enter for the assigned work. Furthermore, employees of TNB also stated that their organization does have work procedure associated with the scope of the services and 89.03% employees agreed with the given statement.

An average of 60.98% of TNB employees reported that their organization does consist of the Emergency Response Plan (ERP). Specific contingency plans are in-situ and are regularly tested to ensure the continuity of critical functions and services within the event of an emergency.

Question 19 emphasizes noncompliance notice related to OSH by TNB and all of them answered "NO" which comprises 100%. While question 20 focuses on fatalities incident at TNB workplace. Most employees answered "Yes" which comprises of 100.00%. Employees indicates that there are not any death incidents happened due to any misconduct. Question 21 emphasis on Lost Time Injury (LTI) at TNB, Ipoh Branch. All employees answered "No" as there is no Lost-Time-Injury happened even though employees worked more than 12 hours for any specific assigned job.

4. Conclusion

The conclusion indicates that the level of implementation of Occupational Safety and Health as tool is high. This indicates that the safety policy on OSH which followed in organization serves as a good guide for implementation of OSH Management System and adequate allocation of resources. The exposure of OSH among organization employees is well structured and maintained.

A safe working environment and occupation will lead employees to pursue their task confidently without any fear or second thoughts; based on the conducted survey 86.59% of TNB Ipoh branch staff stated that the feel safer and confident to work while the 13.41% reported their working environment neither safe nor they confident to work there. To overcome this the management should thoroughly reanalyze their OSH policy again to avoid any unethical risks at the workplace. It is because, OSH policy helps to minimize the effects of hazards as well as benefit the company too (Baron, 2019).

To improve and implement OSH in between those not aware of it and as a legal and important requirement, TNB should expose the employees to OSH by providing them with proper training to avoid any hazard-based impacts.

Other than awareness, TNB also needs to ensure the safety of employees by giving them necessary kits such as, harness, first aid kit, fire spray, electric resistant glove, safety boots etc. These types of safety elements will ensure the safety of employees which will make them confident and feel safe while completing their task. Employees should be aware of what will happen if they neglect the proper PPE, don't report hazards, or fail to recognize how their own states of mind affect their safety. A strong PPE training is to ensure protective equipment is used every time to thrive a safety oriented, positive culture (Ramlan, 1977).

Acknowledgement

This study could not have been possible without the approval of the authority of TNB Jalan Lahat, Mr Aanathen Patchimuthu where data was collected and the collaboration who participated in this research.

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The Impact of HABA Technique on Students' Performance and Students' Learning Time (SLT) Using Online Approach

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Full Paper

Article history

Received

25 July 2023

Received in revised form

25 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

The HABA technique is a technique used specifically to address the adjustment for accrual basis accounting introduced by Sulaiman and Adam in 2019. But this technique has never been implemented for virtual teaching and learning purposes before. Then, the suitability of the technique to be used during the pandemic Covid-19 academic calendar is still in question. Therefore, this study was conducted to determine the relationship between the implementation of the HABA technique via online classes towards students' performance and Student Learning Time (SLT) on an accrual basis adjustment. This study adopts bivariate regression to assess the relationship of the variables and is supported with descriptive statistics which are mean, median, and standard deviation. The sample of the study was students from the first semester of the diploma in accountancy of Polytechnic Mukah for two consecutive academic sessions which are sessions 2020 and 2021. This study finds that the HABA technique via online classes can positively influence students' performance on the accrual adjustment. Besides, this technique is also able to inversely influence the SLT of the students to study on the accrual basis adjustment. Based on this study, students that have been taught the technique have portrayed better results as compared to other students. In fact, they are also able to shorten their study time to study this respective topic. This led to a positive impact on students' academic achievement for this course. In conclusion, this technique is suitable to be adapted to both physical and virtual teaching and learning approaches.

Keywords: - Accrual basis, adjustment, HABA

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1. Introduction

During the pandemic Covid-19, all teaching and learning has been shifted from a face-to-face approach to online teaching. These changes were not only for primary and secondary school but also to tertiary level including polytechnics. Polytechnics is one of the public higher education institutions in Malaysia that niche on technical and vocational education (TVET). Among the courses offered in Polytechnics was the Diploma in Accountancy which requires 3 years to complete the course.

Based on the admission entry data for semester 1 from the June 2020 intake of Polytechnics Mukah, Sarawak, it

shows that 85% of accounting students do not have any accounting background during their SPM level. Due to this, the course lecturer has decided to expand the use of the HABA technique in accrual accounting adjustment to be used during online classes. HABA technique has been created and introduced by Sulaiman and Adam in 2019 as a technique to help students in solving the accrual basis adjustment. According to Sulaiman & Adam (2020), this technique can contribute to students' performance, especially in basic accounting courses among first-semester students in preparing the financial statement with adjustments. But this technique has never been used for online classes yet. Therefore, this study tries to fill the

gap in the implementation of this technique via virtual class.

Then this research was conducted to determine the relationship between the effectiveness of the HABA technique and students' performance during online class implementation for accrual basis adjustment. Besides, it also means to determine the relationship between the effectiveness of the HABA technique in reducing the student learning time (SLT) for accrual basis adjustment topics. With these two objectives, it is hoped that the research can contribute to the new approach to learning and teaching basic accounting courses under new norms.

1.1 Problem Statement

DPA10013 Financial Accounting 1 is a core disciplined subjects for first-semester accounting students for a diploma in accountancy for Polytechnic Malaysia. One of the topics included in the syllabus is the preparation of financial statements with adjustments. This topic is a combination of two topics which are adjustment and financial statements. Financial statements with adjustment were the most difficult topic for the student to understand. (Sulaiman & Adam, 2020). This argument also aligned with Ahn & Jacobs (2019) where accrual accounting required good knowledge and technical skills to it because it is hard and difficult to perform.

Due to the spread of the Covid-19 pandemic, the education system has shifted the paradigm from traditional learning to the online learning approach. This has created a negative perception among the students on the effectiveness of online classes due to their readiness for it. This is aligned with a study by Butnaru et al. (2021) whereby there is a negative relationship between students' perception on the effectiveness of face-to-face classes compared to online classes. In addition, students also felt that it was hard for them to gain and process the input from teachers because the online class was not attractive and effective for them. This argument is consistent with a study by Annamalai (2021), where students have been passively receiving knowledge because online teaching delivery was boring since only the teacher is explaining.

Taking these three main issues together, the researchers felt that it would be a great challenge for the accounting lecturer to deliver the accrual basis adjustment via online classes and at the same time to make it attractive for the students to learn.

1.2 Research Objectives

This research is conducted with two main objectives which are:

1. To determine the relationship between the effectiveness of the HABA technique through online classes in improving students' performance on accrual basis adjustment.
2. To determine the relationship between the effectiveness of the HABA technique via online classes in reducing Student Learning Time (SLT) for accrual basis adjustment.

2. Methodology

Accounting can be split into two bases known as cash basis and accrual basis. According to Malau et al. (2022), cash basis happens to be when revenue and expenses was recognized when it is received or paid. On the other hand, the accrual basis takes place whenever revenue is recognised when it is earned and expenses when it is incurred. In normal business practices, business organizations use an accrual accounting basis rather than a cash basis for their financial business activities. The reason is supported by Haykal et al. (2020) where an accrual basis has a better approach to analyzing the company's actual performance.

In addition, Ball & Nikolaev (2021) pointed out that, principally, the financial statement prepared under a cash basis was not so informative as compared to the financial statement prepared under an accrual basis. It is because, referring to Khair et al. (2020), the cash basis is different from the accrual basis in terms of reporting its assets and liabilities and different in how the recognition of its revenue and expenses is done. Besides, the quality of information conveyed and its accountability on a cash basis is not good as compared to an accrual basis (Mbelwa, Adhikari, & Shahadat, 2019). It also aligned with Poljašević et al. (2019) where an accrual basis can provide a basis for a better measure of sustainable fiscal policy as compared to a cash basis.

Although an accrual basis is preferable it is difficult to understand and implement in practice. Referring to Lubis et al. (2021), even though the information from accrual accounting provides measurable for business performance but it is hard to prepare clear information. It is because the construction of the accrual basis is too complicated, and its complexity covers many aspects. In addition, Poljašević et al. (2019) also added that the implementation of the accrual basis in some European countries still faces many uncertainties. Based on Sellami & Gafsi (2019), adequate and proper training programs that focus on the development of professional skills and expertise of practitioners on the basic need to be done. It is because the accrual basis was too sophisticated even though it was high in quality.

The difficulties are not only faced by professional practitioners but also by tertiary-level students. Based on Sulaiman & Adam (2020) study, accrual basis adjustment was found to be the hardest topic to possess. This finding is consistent with Gigli et al. (2018), where the lack of students' ability to integrate and coordinate the fundamental ideas with accounting equations has worsened their understandability on the accrual basis.

This situation gets worse when the teaching and learning method has shifted to a remote approach. Based on Chandra (2020), students have academic stress due to the current pandemic scenario. In addition, referring to Kulal & Nayak (2020), 82.4% of the students feel that the online classes were not effective as compared to the traditional classroom method. It is because most students are unable to grasp the knowledge via online learning

systems.

As an educator, lecturers also play vital roles where they need to know and possess the subject matter, teaching skills and integrate it with values. (Hassan, Zailaini, & Darussalam, 2020). According to Suhairi & Ahmad (2017), the teacher's understanding on subject matter influenced the student in classroom performance. In addition, according to Indrani et al. (2018), teacher must ensure that the students are able to acquire the knowledge.

3. Methodology

This study used bivariate regression that specifically adapts logistics regression where it only used one independent variable to test the individual dependent variable. The model adopted is as follows:

$$y = \beta_1 X_1 + \alpha + \varepsilon \quad (1)$$

3.1 Research Population and Sampling

This study was conducted on first-semester accounting students from Polytechnic Mukah, Sarawak from two consecutive academic sessions which are session December 2020 and Session 1: 2021/2022, where later in this study will be called Session 2020 for December 2020 and Session 2021 for Session 1: 2021/2022. For session 2020, it consists of 64 students from two different classes, which are DAT1A and DAT1B. Whereas for session 2021 it consists of 67 students that have also been split into two classes which are DAT1A and DAT1B respectively. As for the research controlling variable, DAT1A from both sessions was selected to use the HABA technique, and the other group did not.

3.2 Research Hypothesis

The hypothesis of this study is as follows:

H₁: There is a positive relationship between the use of the HABA technique during online classes and students' performance on accrual basis adjustment.

H₂: There is a negative relationship between the use of the HABA technique during online classes and Student Learning Time (SLT) for accrual basis adjustment.

3.3 Research Design

To examine the effectiveness of the technique on students' performance for accrual basis adjustment through online classes, students' performance on Test 2 and *Penilaian Alternatif* (PAlt) were used to see the differences in both groups. Meanwhile, to examine the effectiveness of the technique during online classes on reducing Student Learning Time (SLT) for accrual basis adjustment, the questionnaire has been distributed to the students and the result was analyzed using a descriptive statistical method. This study also uses mean, median and standard deviation as a tool for comparison of the data. Referring to Sulaiman & Adam (2020), the following are

steps on how to derive the technique:

- i. Draft a table that consists of 2 columns and 3 rows.

- ii. Label the first row on the left column with the notation "CA" and "CL" for the first row on the right column.

CA	CL

- iii. Label the second row with the notation of "HA" and "BA" respectively.

CA	CL
HA	BA

- iv. For the final row, bring down "B" and "H" diagonally from the second row.

CA	CL
HA	BA
B	H

- v. Finally, add the letter "D" at the back of letter "B" and "H" respectively. Then, the HABA table will appear as in Table 1.

Table 1. Technique to derive HABA table

CA	CL
HA	BA
BD	HD

Legend:

CA: Current Asset

CL: Current Liability

HA: *Hasil Akru* (Accrued Revenue)

BA: *Belanja Akru* (Accrued Expenses)

BD: *Belanja Dahulu* (Prepaid Expenses)

HD: *Hasil Dahulu* (Prepaid Revenue)

- vi. After the calculation for the adjustment transaction has been done, students need to categorise whether it is *Hasil* "H" (revenue) or *Belanja* "B" (expenses). Students are also required to identify whether the transaction is *Akru* "A" (accrued) or *Dahulu* "D" (prepaid).
- vii. Then, the combination of the two letters need to be done whether it is HA, BA, BD or HD.
- viii. Finally, students need to refer to the account classification on the first row whether it falls under CA or CL.

4. Finding and Analysis

Table 2 and Table 3 below show the statistical result of the logistics regression analysis on students' performance for Test 2 and PAlt for 2020 and 2021 academic sessions.

Table 2. Statistical logistics regression analysis result for academic performance 2020 academic session

Assessment	Test 2		PAlt	
Class	DAT1A	DAT1B	DAT1A	DAT1B
<i>p</i> -value	0.00082*		0.02024**	
Coefficient	0.22572		0.19297	
Intercept	0.31156		0.39686	
Mean	54	31	59	40
Median	53	26	76	39
Std. Deviation	31.7	17.8	34	30.7

Table 3. Statistical logistics regression analysis result for academic performance 2021 academic session

Assessment	Test 2		PAlt	
Class	DAT1A	DAT1B	DAT1A	DAT1B
<i>p</i> -value	0.05087**		0.00336*	
Coefficient	0.13415		0.23999	
Intercept	0.3942		0.39947	
Mean	52.84	39.42	63.95	39.95
Median	60.60	33.00	76.40	32.00
Std. Deviation	31.68	22.21	33.06	31.30

Note: * Significance at the level of .01

** Significance at the level of .05

Based on Table 2, the *p*-value for Test 2 and PAlt for the 2020 academic session was significant at 1% and 5% respectively. It also has a positive coefficient which is 0.22572 and 0.19297 for both assessments that reflect the slope of the regression. Whereas, Table 3 shows the *p*-value for Test 2 was significant at 5% with a slope of 0.13415 and the *p*-value for PAlt that significant at 1% with a slope of 0.23999.

Then, it is proven that the implementation of the HABA technique has a positive relationship with students' performance on an accrual basis adjustment using an online teaching approach.

It has also been supported by the mean value of DAT1A which uses the technique that has a much higher value compared to DAT1B that do not use the HABA technique. Besides, the standard deviation that reflects the dispersion of the result also shows that DAT1A has a more consistent standard deviation as compared to DAT1B whereby for the 2020 academic session, DAT1A only increased by 2.3% whereas DAT1B increased by 12.9%.

On the other hand, the standard deviation for the 2021 academic session also reflects the same pattern where DAT1A increased only by 1.38% but DAT1B increased by 9.09%. Therefore, the H_0 hypothesis is rejected.

Next, Table 3 shows the result of the analysis of the relationship between the use of the HABA technique with SLT.

Table 3: Statistical logistics regression analysis result on Student Learning Time (SLT) for the 2020 and 2021 academic session

Session	SLT (2020)		SLT (2021)	
Class	DAT1A	DAT1B	DAT1A	DAT1B
<i>p</i> -value	0.00970*		0.00056**	
Coefficient	-2.78125		-3.15714	
Intercept	9.21875		10.500	
Mean	6.44	9.22	7.34	10.50
Median	5.00	7.00	7.00	9.50
Std. Deviation	2.91	5.13	3.06	4.03

The *p*-value for both academic sessions was significant at 1% respectively. Both session also has a negative slope which is -2.7815 and -3.15714. Then, it is proven that the implementation of the technique is able to reduce Student Learning Time (SLT) to study on the accrual basis adjustment.

In addition, it is also consistent with the other descriptive statistic result. For the mean value, DAT1A shows a lower value of hours studied compared to DAT1B for both academic sessions which is 6.44 and 7.34 hours compared to DAT1B which is 9.22 and 10.5 hours respectively.

Lastly for standard deviation, DAT1A which used the HABA technique shows more consistent results which only increase by 0.15% whereas DAT1B that do not use the technique decreased by 1.1%. Therefore, the H_0 hypothesis was also rejected.

5. Conclusion

Based on the result it is proven that the HABA technique is not only suitable to be used during physical teaching classes but also suitable for virtual classes. The data shows that there is a positive relationship between the use of the HABA technique and students' performance where the more students are introduced to the technique, the better their results for accrual basis adjustment. This concurs to the study by Januszewski & Sugajaska (2022) where education via online on Managerial Accounting has effectively and positively able to enhance students' performance.

Furthermore, the result also supports the hypothesis where HABA technique is able to reduce the Student Learning Time (SLT) for accrual basis adjustment where the more students are introduced to the technique, the lesser the time taken for the students to study accrual basis adjustment effectively. This result concurs with finding from Muthuprasad, Aiswarya, Aditya & Jha (2021) where virtual class through online approach open up the opportunity for students to learn based on their own pace more conveniently and effectively. Therefore, it is concluded that the HABA technique is one of the teaching delivery methods that is also effective to be used for online classes, especially for accrual basis adjustment.

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The Implementation of 3D Printing Prototype Making in Industrial Design Final Year Student Project

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Full Paper

Article history

Received

2 August 2023

Received in revised form

2 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Technological innovation has accelerated rapid manufacturing today. The adaptation of 3D printing has spread in many products manufacturing that proves the increasing of productivity and has fulfilled the requirements in industrial revolution 4.0 (IR4.0) towards digitalization. Industrial design students here in Polytechnic Ibrahim Sultan are encouraged to explore prototype making by using 3D printing to develop creativity through this product design process. During this time, product development in industrial design was practiced manually using standard techniques namely sketch, presentation drawing, technical drawing, rendering, prototype, and model making. This research was conducted to provide a review of the implementation of 3D printing in industrial design final year students' prototype making and to analyze the impact of the 3D printing implementation on CLO achievement. The research method of this study is qualitative research, where group discussion has been conducted in a focus group. Generic process of CAD has been used in the development process consists of eight stages which include CAD, STL convert, File transfer to machine, Machine setup, Build, Remove, Post Process and Application. The findings of this research indicate the advantages of 3D printing that elevates students' skills from traditional methods to technology-driven methods, improvement of CAD drawing techniques and enhancing skills for lifelong learning. Based on this result, Course Learning Outcome (CLO) for DVI50144 (Industrial Design 4) session 1 2022:2023 are increased compared to session 2 2021:2022 for CLO1 (Cognitive) 6.5%, CLO2 (Psychomotor) 3.0%, CLO3 (Psychomotor) 2.5% and CLO4 (Affective) 17.5%. The adaptation of 3D printing in Final Year project (FYP) allows students to explore the challenges of 3D printing in industrial design and enhance their creativity to become industrial designers in future and the effort of lecturers to improve the skill in 3D printing.

Keywords: - 3D printing, prototype making, industrial design, Final Year Project

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1. Introduction

The Industrial Revolution 4.0 (IR4.0) that hit the world today has witnessed the implementation of digitalization in the various levels of education in Malaysia. Along with the development of technology and innovation, Malaysia is seen refusing to fall behind in the flow of development that can improve the capabilities, skills, and expertise of its population. This phenomenon is also aligned with the executive summary of the Malaysian Education Development Plan 2015-2025 (Higher Education) or PPPM (PT) through a new system of higher education that focuses on success, beyond input, as well

as using technology and innovation to meet needs and improve student learning experience. The teaching and learning methods driven by IR 4.0 have also given a point of change to the educational landscape of TVET in Malaysia, especially in the Diploma of Industrial Design, Polytechnic Ibrahim Sultan. Changing approaches from traditional methods to methods of use of technology – 3D printing in the development process of prototype final project students have driven toward monitoring skills along with the National 4th Industrial Revolution (4IR) that promoting a culture of innovation and creativity in society that emerged from the evolution of technologies. Polytechnic is seen as the country's leading TVET field leader with a graduate market capability achievement rate

of 96.27% according to the 2022 KPI Performance Report issued by the Department of Political Education and Community Colleges (JPPKK) on 17 January 2023. To face the challenges in the development of IR 4.0, students in the field of industry design must master the skills that represent IR 4.0 that can improve their marketability in the future. Hence, the possesses of 3D printing processes is important in rekindling of the powerful pedagogy of hands-on learning and to deepen the educational approach to traditional subjects (Pai, Gourish, Moger, & Mahale, 2018). According to Chun (2021), 3D printing is important and necessary to be adapted in the curriculum to be able to create the expertise. Thus, will impact on the education of future product designers (Lindley, Adams, Beaufoy, & McGonigal, 2016). Despite this importance, this study was focused on final project prototype design development to demonstrate creativity in utilizing 3D printing and both knowledge of manufacture and theoretical understanding by this new technology. Accordingly, in this research the term 3D printing (3DP) is used instead of some cases or program used AM (Additive Manufacturing) technologies.

1.1 Research Objectives

1. To provide a review of the implementation of 3D printing in industrial design final year students' prototype making.
2. To analyze the impact of the 3D printing implementation on CLO achievement.

1.2 Research Questions

1. What is the review of the implementation of 3D printing in industrial design final year students' prototype making?
2. What is the impact of the 3D implementation on CLO achievement?

2. Literature Review

2.1 3D Printing in Design Education

3D printing is an additive fabrication process that can turn digital computer-generated geometry into physical objects using a variety of materials through a layer-by-layer building process (Micallef, 2015). Meanwhile, Li & Zhao (2016) stated 3D printing technology is the main form of "additive manufacturing". It works by transferring a product's design and shape into a computer model to create a finished object. Fig. 1 shows a 3D printer used in the Industrial Design Department, Polytechnic Ibrahim Sultan. The process works by starting with the base layer and then building up each additional layer until the full objects have been completed (Hausman & Horne, 2014). According to McCulloch (n.d.), 3D printing was invented by Charles Hull in 1983, where the first 3D model was a printed cup (Hull, 2015). 3D printing is an innovative technology and shall have a huge impact on the future of

society because of its emphasis on creating something quickly (Gibson, Rosen, Strucker, & Khorasani, 2021). Ford & Minshall (2019), stated the benefit of adapting 3D printing in universities to support student learning in the lab or classroom and as a medium for visual learning aids too. A variety of benefits are being identified by adapting this technology into teaching. Berry et al., (2010) found 3DP can facilitate learning, develop skills, and increase student engagement through creativity. Learning by making has a long-established history in design education as products must be taken beyond concepts through a repetitive process of various testing and development to produce functional, aesthetic, and commercially manufactured products (Loy, 2014). For a generation that has mainly been brought up immersed in the virtual world, 3D computer-based modelling is the current level of sophistication in product design education rather than spending time in physical workshops like previous generations. Lindley et al., (2014) mentioned that manufacturing through 3DP reduces the complexity of traditional manufacturing through a design process where students can explore creatively, which opens new possibilities by realizing the virtual and real worlds through a design project for Industrial Design (IDE) students.



Fig. 1. 3D-printer used in Industrial Design Department, Polytechnic Ibrahim Sultan

2.2 Implementation of 3D Printing in Industrial Design Final Year Project

Realizing this benefit, final year students of Industrial Design at Polytechnic Ibrahim Sultan have demonstrated their prototype making using 3D printing appropriately for the purpose of the curriculum syllabus. They are given an individual project to develop a product design and instructed to follow the Design Council's Double Diamond Design Process, as shown in Fig. 2, for a model-based orientation in the final project. This model was developed by the Design Council in 2005 and is called a 4D model because the name of each phase starts with a 'D': *discover*, *define*, *develop*, and *deliver* (Tschimmel, 2012). This model is graphically based on a simple diagram that describes the divergent and convergent stages of the design process.



Fig. 2. The Double Diamond Design Process developed by the design council (Gimenez & Johnson, 2020)

The Double Diamond Process became a reference in the project outline that encouraged students to come up with imaginative, user-centered solutions to social or product issues. Hence, it also achieves this by incorporating and valuing 3DP as a mechanism to replicate commercial processes (Lindley, Adams, Beaufoy, & McGonigal, 2014). As a final year project, it was an opportunity to encourage students by demonstrating the management of the final project development process from preliminary design to the construction of a product design prototype. Referring to the Course Learning Outcomes (CLO) of Industrial Design 4 (DVI50144), CLO1 (Cognitive) analyzes basic research techniques, organize, and analyze data to generate a design concept and proposal. CLO2 (Psychomotor) creates realistic ideas into sketching and mock-ups by applying the right design process methods. CLO3 (Psychomotor) construct a model, scale model, or prototype precisely referring to the technical drawing, mock-up, and 3D rendering. CLO4 (Affective) present a high-quality presentation highlighting the product design. CRR (Course Review Report) result summarized the increment of achievement in DVI50144 session 1 2022: 2023 compared to session 2 2021:2022. The number of CLO's increments are rising after students implemented 3D printing to produce the prototype making for the Final Year Project (FYP) compared than students in session 2 2021:2022, that used traditional and manual method. The increment of CLOs concluded that students are experienced and have developed the knowledge and skills to enhance their understanding of industrial design. They were given a final project brief: 'Construct a 3D design in the form of a model, and prototype based on your selected design using 3DP'. This includes the ability to produce designs such as 3D product prototypes driven by CAD packages. Comprehensive technical skills are required as a part of the design process, which become a need for life-long learning and demonstrate the ability to practice as product designers (Lindley, Adams, Beaufoy, & McGonigal, 2016).

3. Methodology

The generic process of CAD to part showing eight stages as referred in Fig. 3 which consists of (1) CAD (2) STL convert (3) File transfer to machine (4) Machine

setup (5) Build (6) Remove (7) Post- process (8) Application (Gibson, Rosen, Strucker, & Khorasani, 2021). It summarized, at early stages of the prototype making process, it may only require rough parts because of the speed they can be fabricated, but later stages of the process, parts may require careful cleaning and postprocessing such as sanding, surface preparation and painting. It develops on prior learning of the design process, a knowledge of manufacturing and the skill base of CAD (Solid works CAD Package) (Lindley, Adams, Beaufoy, & McGonigal, 2014). This project development process was dependent on students' creativity and skills through the implementation of new technologies, computers, and additive manufacturing (Lindley, Adams, Beaufoy, & McGonigal, 2014). The construction of 3D design form model or prototype had two distinct benefits: Firstly, it allowed students to indicate their creativity in making a form which previously impossible and secondly, the final product or prototype design represented the ability of enhancement skills and creativity that could be useful in promoting themselves as future product designer.



Fig. 3. Generic process of CAD to part, showing eight stages (Gibson, 2021)

The beginning development of prototype parts can be produced with model software that is able to determine the external geometry form. 3D printing can be ideal to use since the model /prototype is lightweight, fast to print and install (Hansen, Lundh, & Chen, 2014). This research is focusing on the usability and accessibility of SolidWorks that was implemented by Industrial Design students to develop the 3D prototype model parts. According to Adamczak & Graba (2020), the proper CAD program helps designer visualized the model of a new industrial form. However, the computer package used needs to be accessible, efficient and user friendly (Hansen, Lundh, & Chen, 2014). It reflects the implementation of 3D printing in prototype making give a positive impact to the academic achievement overall.

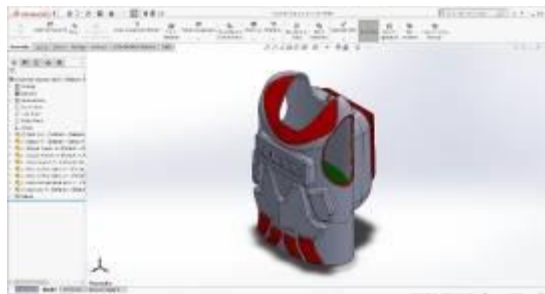
3.1 Second Stage – STL Convert

Gokhare & Raut (2017) claimed Charles Hull was a pioneer of the solid imaging process known as stereolithography and the STL (stereolithographic) file

format was now still widely used in 3D printing. STL refers to a format that is used to transfer information from CAD software to 3D printer (C Iancu, D Iancu, & Stăncioiu, 2010). Meanwhile, Gibson et al., (2021), describes STL format able to describes the external closed surfaces of the original CAD model and forms the basis for slices calculation.

3.2 Third Stage - File Transfer to Machine

The STL file describing the part must be transferred to the 3D printing machine (Gibson, Rosen, Strucker, & Khorasani, 2021). According to Gokhare & Raut (2017), before printing a 3D model from an STL file, it must be processed by a piece of software called a slicer, which converts the 3D model into a series of thin layers. Complete model construction can take from several hours to several days, depending on the method used, the model's size, and the complexity of the model. Fig. 7 shows the comparison of time allocation for completing the 3DP processed product part depending on its size and complexity developed by Ahmad Imran Hakim bin Shahril for the final year project in 2022. Part (a) took 13 hours and 56 minutes, while part (b) took 7 hours and 56 minutes.

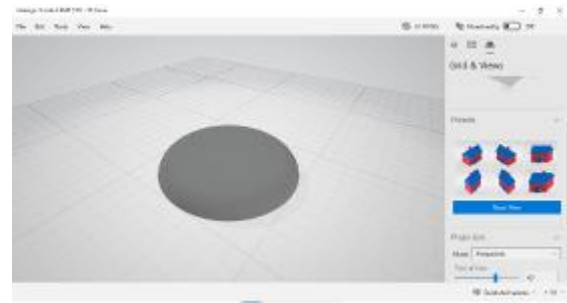


(a)

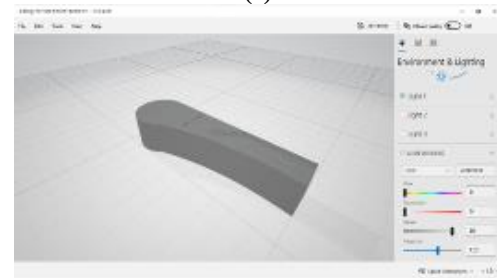


(b)

Fig. 4. Prototype parts using SolidWorks – developed and implemented by Ahmad Imran Hakim bin Shahril for Diploma Industrial Design Final Year Project, 2022



(a)

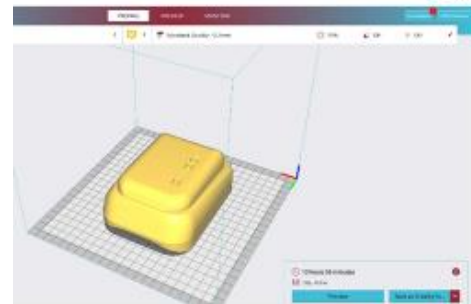


(b)

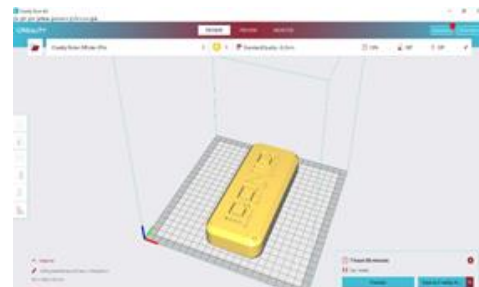
Fig. 5. Prototype parts convert to STL – developed and implemented by Ainursofea binti Razak for Diploma Industrial Design Final Year Project, 2022



Fig. 6. Various stages of build process (Hiemenz, 2011)



(a)



(b)

Fig. 6. (a) and (b) Time allocation depending on the form complexity-developed and implemented by Ahmad Imran Hakim bin Shahril for Industrial Design Final Year Project, 2022

3.3 Fourth Stage – Machine Setup

Machine setup, or prep machine, allows the system to automatically feed the material filament to the extrusion head. The base must be inserted first, followed by the file selection to begin building the model. The setting would relate to the build parameters, namely material constraints, energy source, layer thickness, time consumption, etc. (Gibson, Rosen, Strucker, & Khorasani, 2021).

3.4 Fifth Stage – Build

Building the part is mainly an automated process, and the machine can largely carry on without supervision (Gibson, Rosen, Strucker, & Khorasani, 2021). During this process, it requires only slight supervision of the machine to keep it free from any errors like running out of material, power, or software disturbances, etc. Usually, to build a model or prototype using 3DP, the filament is chosen based on the design profile. Ahmad Imran Hakim bin Shahril was concerned about using thermoplastic polyurethane (TPU) to explore a new form of Safety and Rescue (SAR) jacket. An innovative element of the proposed form is to enhance the ability of elasticity compared to a conventional process (Parada, Rosa, & Mayuet, 2021). Meanwhile, the mock-up proposed by Ainursofea binti Razak uses silicate-reinforced polylactic acid (PLA) to visualize the free-standing mock-up structure of a self-service kiosk. The various filament options will allow students to investigate their various capabilities and their impact on the printing temperature, particularly in the 3DP process.

3.5 Sixth Stage – Remove

The parts need to be taken out after the building process is finished (Gibson, Rosen, Strucker, & Khorasani, 2021). This can involve interacting with the machine, which might have safety interlocks to make sure, for instance, that the operating temperatures are low enough or that there are no actively moving parts.

3.6 Seventh Stage – Post-Process

Post-processing refers to removing disposable support material after the part is completely done. It can be done by either washing or stripping away the support material that held the part in place. Hiemenz (2011) also mentioned the removal depends on the type of material used for the support. For soluble support material, it is removed in a tank via an agitated water-based detergent solution. However, for breakaway support material it was removed manually by twisting, breaking, and scraping the support material from the part.

3.7 Eighth Stage – Application

Application step is the final step where the parts or product may be ready to be used. It may also require additional treatment before they are suitable for use. (Gibson, Rosen, Strucker, & Khorasani, 2021). cited priming and painting to provide a desired surface, texture,

and finish. Fig. 8 shows the painting process for surface treatment as implemented by Ahmad Imran Hakim bin Shahril before assembling with other parts and accessories to form his complete prototype.

4. Finding and Analysis

Seven students were chosen to participate in a group discussion to get their thoughts and opinions. To gain advantage from the use of 3D printing in industrial design education, the survey results are presented and analyzed in this part.

4.1 Transition from Traditional to Technology-Driven Method

The adaptation of 3D printing in the process of prototyping among students of the final year of the industrial design diploma is one of the latest approaches in the newly introduced after realizing the importance of the 3D Printing in elevating students' skills towards the Industrial Revolution 4.0. Traditionally producing prototypes that involve long processes and time-consuming in workshops have shown different results and outputs compared to prototyping using 3D printing. This comparison shows a significant outcome from the quality and total angle that is estimated to produce a prototype. Student A commented: "Traditional methods of making prototypes take a long process and require lots of time in a practical workshop. It requires manual skills and using conventional model making foam that is hard to turn into the desired form. Later, I found 3D printing to visualize the prototype-making process and shorten the process." The transition from traditional methods to technology-driven methods is important to elevate the skills of students at higher institutions and prove their capability to immerse themselves in technology. Meanwhile, student B noted the traditional making techniques are no longer reliable and undertake so much work: "I believe that stakeholders no longer find traditional method making techniques to be relevant or useful." According to responses, 3D printing is a useful technology-driven technique that enables students to create the intricate models they envision.



Fig. 8. Post-Process prototype – developed and implemented by Ahmad Imran Hakim bin Shahril for Diploma Industrial Design Final Year Project, 2022



Fig. 9. Painting for surface treatment – developed and implemented by Ahmad Imran Hakim bin Shahril for Diploma Industrial Design Final Year Project, 2022



Fig. 10. Painting for surface treatment – developed and implemented by Ahmad Imran Hakim bin Shahril for Diploma Industrial Design Final Year Project, 2022



Fig. 11. Prototype produced using traditional method-developed and implemented by Vaishnavi Selvam for Diploma Industrial Design Final Year Project, 2022



Fig. 12. Finished SAR (Safety and Rescue) jacket prototype – developed and implemented by Ahmad Imran Hakim bin Shahril for Diploma Industrial Design Final Year Project, 2022

4.2 Improvement of CAD Drawing Techniques

Industrial Design course train students in 3D drawing that is useful to print with a 3D printer. Student C said: “I become more proficient in CAD drawing skills such as SolidWorks, KeyShot and Creality.” However, Student D commented: “Proficient in 3D modelling software can fully express the idea, and ultimately the 3D printer will turn the idea into the model.” The replies indicate that learning computer control language and using modelling software proficiently offers an edge to actual production without technical restrictions.

4.3 Enhancing Skills for Lifelong Learning

From this research, the result indicates possessed in 3D printing skills can improve students' lifelong learning skills. According to Student E: "Practicing my 3D printing skills during learning times has helped me become more independent, proactive, and capable of making plans, as well as inspired to become more creative and forward-looking mindset," It is important to realize the planning ahead before implement something. Meanwhile, Student F said: “I was totally ready to welcome the future of “smart factory” with more innovative ideas as Industry 4.0 summarized to contain nine pillars that evokes to digitalize manufacturing.” This overview scenario also encourage Students G mentioned: “I realized 3D printing technology will become important in future that brings chances to make products independently without concerning finance issues.” According to responses, 3D printing has embodied personalized and intelligent features that make personalized design and manufacture possible. Users are attempted to create their own customized items by straightforward processes and lower expenses.

4.4 Increment of CLO Achievement

The approach to the production of the Final Year Project prototype (FYP) using the 3D printing method among students of the final year of the Diploma of Industrial Design, Polytechnic Ibrahim Sultan on session 1 2022:2023 has successfully demonstrated an improvement in the CLO achievement of the DVI50144 (Industrial Design 4) course compared to session 2 2021:2022. According to Course Review Report (CRR), CLO3 (Psychomotor) has shown a 2.5% increase which shows 3D printing is an effective method to help improve the skills of students in producing better and perfect prototypes. However, the 3.0% increase involving CLO2 (Psychomotor) demonstrates that the digital method helps the comprehensive design production process to be more technically realistic. Meanwhile, CLO1(Cognitive) also draws 6.5% increment and CLO4(Affective) shows the increment 17.5% compared to session 1 2021:2022. It reflects the implementation of 3D printing in prototype making give a positive impact to the academic achievement in overall learning outcomes.

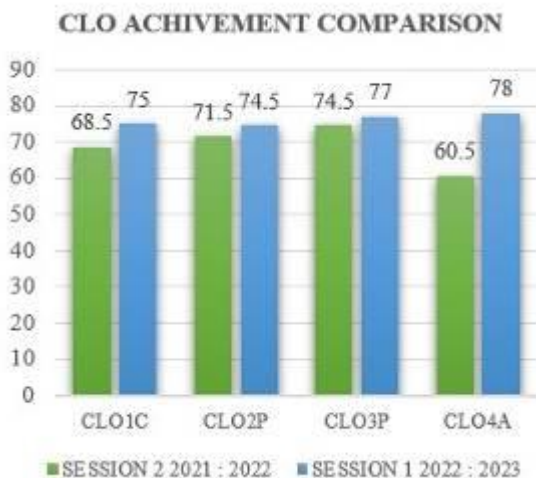


Fig. 13. Comparison percentage of CLO achievement for DVI50144(Industrial Design 4) session 2 2021:2022 and session 1 2022:2023

5. Conclusion

Overall, from the findings it was found that the use of 3D printing has helped students to understand, implement and apply technology-driven in the production process of the Final Year Project prototype (FYP) final year students of the Diploma of Industrial Design, Polytechnic Ibrahim Sultan. The adaptation of 3D printing is seen able to give exposure to the adaptation of manufacturing technology of IR 4.0 and towards globalization. The use of 3D printing has also proved the advantages of technology as a medium that helps improve student performance from an academic perspective, the transition of the learning medium from conventional to technology-driven methods as well as lifelong learning. Regardless, the use of 3D printing was also seen to demonstrate an improvement in

CLO for the DVI50144 (Industrial Design 4) course based on a comparison of the achievements of session 2 2021:2022 to session 1 2022:2023.

6. Recommendations

3D printing technology brings opportunities in industrial design. There is always a challenge from the advantages. The speed of the production depends on the complexity of the design. To finish with specific design, duration always becomes a challenge in dealing with deadlines. Development of prototypes using multi-color and multi-materials also challenge that must be concerned to create a variety of product. In addition, the next challenge is minimizing the use of the raw material as the support structure materials are unrecyclable. As advanced technology, staff in higher institutions such as in Polytechnic Ibrahim Sultan should be trained to improve their skills in smart manufacturing including 3D printing to become more high-skilled professional talents to shape the future generations towards IR 4.0.

Acknowledgement

The authors received no financial support for the research, authorship, and/or publication of this article.

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The Influence of OWL-Plantation System Application towards Employees Performance in Indonesia: A study case at PT Sebakis Inti Lestari

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Full Paper

Article history

Received

2 August 2023

Received in revised form

2 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

The study seeks to determine and analyze the effect of the OWL - Plantation System application towards employee's performance at PT. Sebakis Inti Lestari. It was conducted at PT. Sebakis Inti Lestari and the sample consisted of 40 office workers. Purposive sampling is a non-probability sampling technique of superior quality in which the researcher creates a limit based on the characteristics of the subjects to be sampled. The investigation employs SPSS version 25 for data analysis. According to the findings of this study, the OWL – plantation system significantly impacts employee performance.

Keywords: - OWL-Plantation System application, employee performance

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1. Introduction

The development of science and technology is occasionally advancing at an accelerated rate, making it a fascinating topic to observe. The evolution of this technology has an impact on all organizational activities. Thus, the need for data and information within the organization is essential for achieving its objectives. Operating a computerized system is one technology that can aid in data processing within an organization. The system referred to here is a company-required system or application that can aid in completing work and enhance employee performance.

To improve employee performance, the organization offers a specialized system or application. With these systems or applications, work can be completed more quickly, easily, and in various ways. Even the most complex tasks within the organization are facilitated by using these systems or applications. With this system, the company's expectations for individual and group performance can be met effectively.

The success of an organization can be determined by

the outcomes of the employees' efforts. Organizations require employee development because the prevalence of employee development activities involving activities performed by these employees demonstrates that the organization values its employees and expects them to grow.

If a company or organization implements a performance appraisal system, it will be possible to determine whether an employee is progressing at work. Performance is a condition that must be known and confirmed by specific parties to determine the level of achievement of results of an agency or company concerning the vision of an organization or company and to comprehend the positive and negative effects of an operational policy. Therefore, both the company or organization and the personnel themselves value performance. Employee efficacy is influenced by several factors related to both the workforce and the company or organization environment.

The system employed is one of the factors that can enhance employee performance when completing work. Employees can work effectively and efficiently with the system. The OWL-Plantation System is one of the

systems described in this study. It is utilized by plantation and oil palm companies. The OWL-Plantation System is a web-based Enterprise Resource Planning (ERP) application designed specifically to satisfy the needs of businesses in the plantation industry. Unique characteristics of plantation management distinguish the OWL-Plantation System.

The palm oil company PT. Sebakis Inti Lestari is in Sebakis, Nunukan Regency, North Kalimantan Province. It has the vision of becoming a highly competitive agribusiness firm that develops in collaboration with its Partners. The mission of PT. Sebakis Inti Lestari is to manage an oil palm-based plantation Agribusiness by relying on Human Capital, supporting high corporate values as the foundation of corporate culture, working based on best business practice standards, strong strategic partnerships, being environmentally sound, and adhering to business ethics fairly and sustainably. PT. Sebakis Inti Lestari is very concerned about the performance of its employees, which is why the company uses the OWL (Ontology Web Language) system, where input using the OWL system is very useful for all office staff, including HRD, finance, logistics, and plantation administration. The current problem faced by PT. Sebakis Inti Lestari is the unstable signal on the OWL system that may influence employee performance. Therefore, the author is interested in conducting a study to acknowledge the influence of the OWL-Plantation System application on employee performance.

2. Methodology

2.1 Employee Performance

The success of an organization's success depends on its employees' performance (job performance); consequently, every company will strive to enhance the performance of its employees in attaining predetermined organizational objectives. (Supatmi et al., 2013; Hasibuan & Silvya, 2019; Wardani et al., 2016) A growing and well-maintained organizational culture will be able to accelerate the organization toward greater development. On the other hand, performance will be affected by leaders' capacity to mobilize and empower employees when employees can provide excellent service.

2.2 Employee Performance Evaluation

According to Mathis and Jackson (2006), performance evaluation evaluates how well employees perform their tasks relative to a set of standards and then communicates this information to employees (Rani & Mayasari, 2015). Performance evaluation aims to communicate to employees what is expected of them and to increase mutual understanding. Performance assessment focuses on assessment as a procedure for measuring the extent to which the work of a person or group can contribute to the achievement of predetermined goals (Silaen et al., 2021). Every company or organization must be able to assess employee performance, and the results can be used to

inform management decisions regarding salary/wages increases, further mastery, increased employee welfare, and a variety of other important factors that can influence employees' work performance.

Employee performance evaluation is extremely useful for determining appropriate job training requirements, assigning appropriate responsibilities to employees so they can perform better in the future, and as a basis for determining promotion and compensation policies. Performance appraisal is a formal and structured method for measuring, evaluating, and influencing job-related characteristics.

2.3 Factors that Influence the Employee Performance

According to Simanjuntak (2005), three factors influence the performance of employees or workers. The first is individual factors, which include the ability and skills to execute the job. Several factors influence a person's competence, which can be categorized into two groups: aptitude and work skills and motivation and work ethic.

The second factor is support from the organization. To perform their duties, employees require the assistance of their employer. This assistance consists of organizing and providing work facilities and infrastructure, a convenient work environment, and favorable working conditions and conditions. Organizing is intended to provide everyone with clarity regarding the desired outcomes and the actions required to achieve them. Everyone must have and comprehend precise job descriptions and responsibilities.

The third factor, management support, company performance, and everyone's performance are also highly dependent on the managerial ability of management or leaders, both by developing employee competence and fostering the motivation of all employees to work optimally.

2.4 OWL-Plantation System Application

The OWL-Plantation System is a web-based Enterprise Resource Planning (ERP) application designed specifically to satisfy the needs of businesses in the plantation industry. Unique characteristics of plantation management distinguish the OWL-Plantation System.

In Indonesia, the OWL-Plantation System is an enterprise resource planning (ERP) system adapted to modern oil palm plantations. Suppose the customer wants to reduce implementation costs and use it immediately. In that case, the OWL-Plantation System is ready to be used without modification because it is specifically designed and by the business processes of modern Indonesian Palm Oil plantations. Due to the unique characteristics of each business, the OWL-Plantation System can adjust itself to the conditions it encounters if necessary (Nangkoel, 2016).

Plantation companies typically oversee numerous business divisions and expansive areas. Generally, business divisions are situated in remote areas. Thus, it can be determined that data access is a costly commodity. To address this issue, the OWL-Plantation System was

developed and employs web technology so that network data consumption is minimal and data expansion is modest. Because the managed area is so vast, regional policies will probably be modified frequently. Thus, the employed application system must also accommodate potential policy changes and variations between business units. To address these issues, the OWL-Plantation System is based on an open-source platform with a unique architecture, making it simple to customize and develop.

2.5 The Relationship between OWL-Plantation System and Employee Performance

OWL – Plantation System is a web-based Enterprise Resource Planning (ERP) application designed specifically to satisfy the needs of businesses in the plantation industry. Unique characteristics of plantation management distinguish the OWL-Plantation System. In contrast, performance results from activities or work performed by employees to achieve the organization's objectives.

A system plays a crucial role in improving employee performance by facilitating the completion of certain organizational duties. The OWL system is one of the systems used by oil palm plantation enterprises. This system greatly assists employees in carrying out their assigned duties.

3. Methodology

The quantitative study was conducted in the Logistics and Purchasing department of PT. Sebakis Inti Lestari, Nunukan Regency, North Kalimantan Province. In research, the sampling technique, specifically the purposive sampling technique, is a superior quality non-probability sampling technique. The researcher creates a grid or boundaries based on the characteristics of the subjects to be sampled for research. As many as forty office employees will be surveyed to become research respondents. Through the distribution of questionnaires and documentation, quantitative data collection methods are executed.

4. Finding and Analysis

4.1 Finding

a. Validity Test

A validity test is a measurement of validity used by researchers in obtaining data from respondents. Table 1 below shows the output of the validity test.

Table 1. The validity test output of variable X

No	Variable X Indicator	<i>r_{count}</i>	<i>r_{table}</i>	S.Sig	Sig. Value	Score
1	Target (X _{1.1})	0,702	0,3120	0,05	0,000	Valid
2	Ability (X _{1.2})	0,711	0,3120	0,05	0,000	Valid
3	Support (X _{1.3})	0,757	0,3120	0,05	0,000	Valid
4	Cooperation (X _{1.4})	0,827	0,3120	0,05	0,000	Valid
5	Well Data Transfer (X _{1.5})	0,808	0,3120	0,05	0,000	Valid
6	Workforce Training (X _{1.6})	0,719	0,3120	0,05	0,000	Valid
7	Enthusiasm (X _{1.7})	0,655	0,3120	0,05	0,000	Valid

Table 2. The validity test output of variable X

No	Variable X Indicator	<i>r_{count}</i>	<i>r_{table}</i>	S.Sig	Sig. Value	Score
1	Target (X _{1.1})	0,702	0,3120	0,05	0,000	Valid
2	Ability (X _{1.2})	0,711	0,3120	0,05	0,000	Valid
3	Support (X _{1.3})	0,757	0,3120	0,05	0,000	Valid
4	Cooperation (X _{1.4})	0,827	0,3120	0,05	0,000	Valid
5	Well Data Transfer (X _{1.5})	0,808	0,3120	0,05	0,000	Valid
6	Workforce Training (X _{1.6})	0,719	0,3120	0,05	0,000	Valid
7	Enthusiasm (X _{1.7})	0,655	0,3120	0,05	0,000	Valid

Table 1 and 2 shows that the correlation on each indicator towards the total score gives a significant result namely $< 0,05$ and indicates that $r_{count} > r_{table}$ until it can be concluded that the item is valid.

b. Reliability Test

The results from the statistical test of Cronbach Alpha indicate the reliability level of an item. It is stated reliable if the Cronbach Alpha value is > 0.60 (Umar, 2013). Table 3 shows the result.

Table 3. The output results of variable X reliability test

No	Variable X Indicator	S. Sig	Sig. Value	Score
1	Target (X _{1.1})	0,06	0,850	Reliable
2	Ability (X _{1.2})	0,06	0,849	Reliable
3	Support (X _{1.3})	0,06	0,843	Reliable
4	Cooperation (X _{1.4})	0,06	0,830	Reliable
5	Well Data Transfer (X _{1.5})	0,06	0,831	Reliable
6	Workforce Training (X _{1.6})	0,06	0,847	Reliable
7	Enthusiasm (X _{1.7})	0,06	0,855	Reliable

Table 4 indicates that the reliable score on each indicator gives a significant result namely $>0,06$, therefore it can be concluded that all the items are reliable.

Table 4. The output results of variable Y reliability test

No	Variable Y Indicator	S. Sig	Sig. Value	Score
1	Comprehension ($Y_{1.1}$)	0,06	0,823	Reliable
2	Innovation ($Y_{1.2}$)	0,06	0,816	Reliable
3	Working Rapidity ($Y_{1.3}$)	0,06	0,859	Reliable
4	Working Accuracy ($Y_{1.4}$)	0,06	0,810	Reliable
5	Cooperation ($Y_{1.5}$)	0,06	0,802	Reliable

c. Simple Linear Regression Test

In Table 5, it is known that the regression coefficient OWL – Plantation System (X) is 0.730, indicating that for every addition of 1 (one) percent, employee performance will increase by 0.730 so that it can be explained that the OWL – Plantation System (X) has a positive direction coefficient on employee performance (Y).

Table 5. The output result of simple linear regression test

Coefficients ^a					
Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	1,400	,451		3,106
	OWL-Plantation System	,688	,105	,730	6,581

a. Dependent Variable: Employee Performance

Source: SPSS Ver. 25

$Y = a + bX + e$

$Y = 1.400 + 0.730X + e$

d. Hypothesis Testing

Based on Table 6, it is explained that the X OWL – Plantation System variable affects employee performance because the value of 6,581 is more significant than 2.02439 and 0.000 is significantly less than 0.05.

Table 6. T-test (Partial)

Coefficients ^a					
Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	1,400	,451		3,106
	OWL-Plantation System	,688	,105	,730	6,581

a. Dependent Variable: Employee Performance

$T\text{-table} = t(a; n - k - 1)$

$= t(0,05; 40 - 1 - 1) = 0.025; 38 = 2,02439$

e. Coefficient of Determination(R-Square)

Based on Table 7, it is known that the R Square value is 0.520. It shows that the influence of variable X on variable Y is 52 percent and 48 percent is influenced by other factors not examined by researchers.

Table 7. The output of determination (R-Square)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,730 ^a	,533	,520	,41542

a. Predictors: (Constant), OWL-Plantation System

4.2 Analysis

Based on the findings of research conducted at PT. Sebakis Inti Lestari, this chapter details research findings involving two variables: the use of the OWL – Plantation System (X) and Employee Performance (Y).

According to the results presented above, at the time of testing, all the statements in the questionnaire were deemed valid if they exceeded the value of the r table, which was 0.3120. The reliability value of the OWL - Plantation System was 0.863, and the reliability value of employee performance was 0.853; conditions with reliability values exceeding 0.60 can be declared reliable.

PT. Sebakis Inti Lestari employee performance is significantly impacted by the variable Use of OWL – Plantation System (X). It demonstrates by a significant value of 0.000 0.05. The regression equation is $Y = 7,001 + 0.075X$, where 0.075 is the regression coefficient of the variable X on Y, indicating that if X increases by one unit, Y will increase by 0.075 units or 7.5%. H_0 is rejected, and H_a is admitted based on the partial test (t-test) results, which determined that the t-count is greater than the t-table.

According to the R-Square test results, the influence of the variable using the OWL-Plantation System on employee performance at PT. Sebakis Inti Lestari is 0.520, or 52 percent, while 48 percent are influenced by other factors not investigated by researchers.

It was also demonstrated by prior research by Khairaningrum Mulyanti (2020), namely the effect of accounting information systems on employee performance at PT. Iron Bird Logistics concluded that there is a significant relationship between work facilities and employee performance.

A simple regression analysis indicates a unidirectional (positive) relationship between the OWL – Plantation system and employee performance. As a result, PT. Sebakis Inti Lestari must maintain the positive relationship between the OWL – Plantation system and

employee performance.

5. Conclusion

Based on the results of the tests carried out on the analysis and discussion, it can be concluded that the results of a simple linear regression analysis using the OWL – Plantation System have a positive and significant effect on employee performance at PT. Sebakis Inti Lestari. From the results of the Partial test (t-test) above, it can be seen that after testing the variable (X), namely the use of the OWL - Plantation System, influences employee performance at PT. Sebakis Inti Lestari this can be seen from the t-count value of 6.581, which is greater than 2.02439 and significant where 0.000 is less than 0.05 according to the basis for decision making, namely if the t-count value > t-table then the independent variables individually affect the dependent variable, otherwise if the tcount value is < t-table, the independent variables individually do not affect the dependent variable and the significant value is <0.05. So that H_0 is rejected, and H_1 is accepted.

Acknowledgement

The authors would like to thanks Mr. Arkas Viddy, Ph.D. the director of Politeknik Negeri Nunukan, Dr. Besse Asniwaty, M.Si, the first vice director of Politeknik Negeri Nunukan and Dr. Raqifoh, M.M., the second vice director of Politeknik Negeri Nunukan for supporting this study until it is published in Borneo Engineering & Advanced Multidisciplinary International Journal.

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The Relationship Between Knowledge and Quality Towards the Perception of Islamic Banking Among Non-Muslim Students in Politeknik Mukah

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Full Paper

Article history

Received

25 July 2023

Received in revised form

25 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

This research purposely examines the relationships between quality and knowledge towards perceptions of Islamic banking facilities including products and services among the non-Muslim students in Politeknik Mukah (PMU). The questionnaire distributed has taken into the consideration two factors that are deemed to influence the acceptance of the students which are quality and knowledge around 96 respondents were involved in this research all of them are non-Muslim students of PMU. The data collected were analyzed using the technique of the Partial Least Square Structural Equation Model. The knowledge, quality and perception were constructed as a reflective measurement model. The survey findings further revealed that knowledge, quality is significantly associated with the perceptions of Islamic banking facilities including products and services among the non-Muslim students in PMU. This research has may assist the key player of the Islamic bank industry and work as a guide for them to ensure that the services and products of the Islamic banks can hold the market shares of the non-Muslim citizen who involve in the banking industry.

Keywords: - Knowledge, quality, perception, students, Islamic banking

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1. Introduction

Islamic banking industries is not a something new for the Malaysian. Islamic banking is a banking system based on the Shariah principles as mentioned by the holy Quran and the teaching of prophet Muhammad S.A.W. Every Muslim believe that every banking transaction involving them should comply with the teaching of Islam through the achieving of the Shariah principles. There are a lot of banking facilities offered by the Islamic bank in Malaysia such as *wadiah yad dhamanah* (deposits with guarantee), *mudharabah* (profit-sharing) and *ijarah* (leasing). Some of the Islamic banks in Malaysia has their conventional counterpart. Hence, most of the banking facilities offered is the same facilities with their own counterpart but in the version that comply with the Shariah principles. Even

though the operation of the Islamic banking industry is highly related with Islamic teaching, the banking facilities is not only restricted to the Muslim. There is no requirement mentioned by all seventeen Islamic banks in Malaysia that the facilities are restricted for non-Muslim. Study done by Saiti et al. (2022) and Setiawan et al. (2021) has proven that there is huge involvement of the non-Muslim in the Islamic banking industry. This is mainly due to the competitive facilities offered by the Islamic banks compared to other conventional banks. Even though study done by Wan Ahmad et al. (2019) shows the opposite reaction of the non-Muslim participants towards the Islamic banks, but it is applied to the non-Muslim living in the minority Muslim countries.

The main factor led to this lower number of non-Muslim consumers is the limited knowledge and resources about the Islamic banking facilities by the non-

Muslim. Malaysia is one of the countries that has a fastest growth in Islamic banking industry since the last decade. Bank Negara Malaysia (BNM) through its Annual Report 2021 has supported this fact by stating that the growth of the Islamic banking industry has move faster than their conventional counterpart. The increase in demand is not just in the commercial sector, but also in the household sector. BNM has established the Malaysia International Islamic Finance Centre (MIFC) to cater the huge demand and the increasing growth trend of the Islamic banking industry in Malaysia. MIFC works as a network to group all communities which directly involved in the Islamic banking industry to access the updates and latest resources about Islamic banking industry. Due to this bright opportunity of the Islamic banks, all Malaysian should have an adequate knowledge about the Islamic banks in Malaysia for them to compare the facilities of the Islamic banks with the conventional banks. With this knowledge, all Malaysia regardless of their religion has an opportunity to subscribe the best bank's facilities offered to them. As a tertiary level student, in a few years, the student of the PMU will start their career and be exposed to the banking facilities offered in the market. An adequate knowledge of the students is a must as they can compare all banking facilities offered and decide the best for them.

Although, Muslim customers are a minority in Sarawak, demand for Islamic Banking products and services is expected to increase by the non-Muslim community. A study conducted in Bintulu, Sarawak by Latip et al. (2022) discovered that nearly half of the respondents had Islamic banking accounts. Due to the relatively high percentage of account holders, the adoption of Islamic banking can be considered satisfactory in Bintulu, Sarawak. The study's findings have implications for the Islamic banking industry, the government, and individuals. The high level of awareness and perception of Islamic banking products in Bintulu, Sarawak, creates opportunities for banks to provide Islamic banking products. The non-Islamic market is huge and has great potential for the Islamic banking industry. If non-Muslim customers continue to ignore the existence of Islamic banking products and services, Islamic banking operations will face difficulties to compete with conventional banking systems. By attracting non-Muslim customers, Islamic banks can ensure long-term survival.

Hence, study on the perception by the students especially for the non-Muslim students at PMU should be done to investigate their perception to the Islamic banking facilities. This is important as the Islamic banks has always been highly related to the religion of Islam compared to the conventional banks. With a majority of non-Muslim in PMU, it is also important for the practitioner to determine the perception of the student. This is because the current perception of the non-Muslim students will impact the demand of the Islamic banking facilities in future. Other than that, there is a possibility that the student is currently using any banking facilities offered by the Islamic banks especially related to their

study fund. Hence, the current quality of Islamic banks services received by the students may also impact their perception towards the bank. To determine the perception of the non-Muslim students, researcher will analyse two variable which are knowledge and quality of the Islamic banking facilities. If the knowledge and quality significantly impact the perception of the non-Muslim students, hence all parties should enhance the aspects related with both variables tested.

2. Literature Review

2.1 Knowledge

A person's understanding and knowledge of Islamic banking will also affect the public's view of Islamic banking itself. Simply put, people's views on Islamic banking depend on what they know about the products and services. Increased understanding and knowledge of Islamic banking products and services would impact demand for these products and services. Knowledge is someone's interpretation of information based on their background and experience (Saraswati, 2016). Recently (Mohd Amin et al., 2022), Knowledge of Islamic banking products is one factor that may influence interest in using Islamic banking services. Referring to the planned behavior theory, a person's Knowledge can influence their behavior or actions in doing something. For example, knowledge and understanding of Islamic banking can pique the community's interest to use Islamic banking products such as savings accounts.

According to the findings of other studies, knowledge can enhance customers' intention to use Islamic banking products and services. (Chaouch, 2017). Furthermore, Mahdzan & Au (2017) and Mariadas and Murthy (2017), It was discovered that knowledge is one of the significant factors influencing the adoption of Islamic banking. Hristov and Kuhar (2015) discovered that the level of knowledge and information obtained by customers prior to deciding to use Islamic banking products influences their decisions. According to Echchabi & Echchabi (2013), Customers' use of Islamic banking products and services will be influenced by having a strong knowledge of Islamic banking products.

Meanwhile, Mehtab, Zaheer, & Ali (2015) argue that understanding Islamic banking is inextricably linked to Islamic financial practices.

According to Mahdzan et al., (2017), non-Muslim respondents are unable to conceive of the concept of Islamic banking in general, nevertheless, their understanding of the Islamic principles is in moderate level. Surprisingly, studies have revealed that even Islamic bank employees are not aware of some of the fundamentals of Islamic financial concepts.

2.2 Quality

The quality of service is another factor that influences Islamic banking customers' loyalty. Ireland (2018) discovered that conventional banking products and

services are more appealing to many customers. Because of Islamic banking is less capable than conventional banking by offering high-quality services, a dual banking system is used. With the dominance of conventional banking and more modern information technology, their service offerings are more appealing than Islamic banking.

In the business sector, quality is crucial since it may sustain customer pleasure and loyalty while lowering risks. To gain competitive advantage, Islamic banks must improve and maintain their superior service quality, fulfill customer satisfaction, and gain customer loyalty (Alnaser et al., 2018; Pasha and Razashah, 2018).

In the business sector, quality is crucial since it may sustain customer pleasure and loyalty while lowering risks. To gain a competitive advantage, Islamic banks must improve and sustain superior service quality, meet customer satisfaction, and gain customer loyalty (Alnaser et al., 2018; Pasha and Razashah, 2018).

In a related study, Zeshan (2016) discovered that people prefer IB because of its ease of use, confidentiality, stability, and quick implementation of procedures. Ali and Raza (2017) recently examined the relationship between bank service quality and customer satisfaction and discovered a significant positive relationship. In terms of European Muslims, Yusoff and Shamsuddin (2017) confirm that British Muslims are eager to adopt the Islamic banking system due to its reputation and quality. Service quality is essential for a company to survive and gain the trust of its customers. According to Ali and Raza (2015), service quality focuses on efforts to meet customers' needs and the accuracy of delivery to meet customer expectations.

2.3 Perception

Customer perception is widely regarded as the most important factor determining an effective IB system around the world. Because perception influences consumer behavior, it is important to understand whether IBs can address their fundamental distinction from the conventional banking system. IBs are replicating conventional banking products to attract customers to the primary factor of Shariah compliance; however, it is unclear whether customers consider Shariah compliance to be a credible point of differentiation.

According to a study conducted by Saad and Alshehri (2021), customer perceptions of performance depend on their experience. The overall response to services by users depends on their perception of the performance of products and services. Loo, M. (2010) examined the Malaysians' perceptions and attitudes toward Islamic banking products. His study included one hundred Muslim and non-Muslim participants. According to the study's findings, the Muslim community supports both Islamic and conventional banking products. Meanwhile, many non-Muslims believe that Islamic banking products are only available to Muslims. Again, the findings show that young non-Muslims are more likely to use Islamic

banking than the elderly. He went on to say that perceptions and acceptance of Islamic banking products vary depending on demographic factors such as age, gender, education, income level, occupation, and so on. According to previous research, the majority of Islamic banking customers are younger and have a higher education.

Nani (2019), human perception is an important aspect of psychology because it allows them to respond to the presence of various aspects and symptoms around them. Each person's perception is unique. Many things, including information, experience, and point of view, can affect these discrepancies. Users and preparers of financial statements may have different perspectives on Islamic banking.

Non-Muslims have reacted differently to the existence of Islamic banking in many different nations. In comparison to their awareness and knowledge of Islamic banking, non-Muslim students in the United Arab Emirates have a higher level of familiarity with conventional banking's features. Muslim students believe that Islamic financial institutions are favoured above conventional banking institutions, while non-Muslim students are less interested in Islamic banking (Setiawan et al., 2018).

To be successful in their endeavors, IB marketers must understand which characteristics of IB products will most likely entice customers. Understanding consumer perception, motivation, attitude, and behavior toward IB products and services is the most popular approach.

3. Methodology

In testing the relationship between the variables, a quantitative descriptive method has been selected based on the Partial Least Squares-Structural Equation Modeling (PLS-SEM) technique. Prior to determining the minimum sample size, a power analysis was performed using the conceptual framework. PLS-SEM was chosen because it is variance-based (VB-SEM) which does not require large sample sizes as it works well at minimum sample sizes of 30-100, (Joseph and Olugbara, 2018). A total of 100 sets of questionnaires have been sent out for this study. However, only 96 respondents were successfully collected during the Covid-19 endemic which is in the second quarter of 2022. As it still meets the minimum sample size criteria, researchers have proceeded with the study with the available responses.

SEM techniques are used to construct the path analysis that measures the relationship between various variables. SEM is an analytical technique used to confirm the validity of the model in research. There are two steps evaluated by PLS-SEM model which are evaluating the outer and inner model. Evaluating the outer model is also known as measurement evaluation while evaluating the inner model known as structure evaluation. Measurement evaluation is evaluated using the value of outer loading, average variance extracted (AVE), and composite reliability (CR), while the structure evaluation is

evaluated using the value of path coefficients and R-square (R²).

4. Finding and Analysis

This study's findings are based on feedback obtained from the result of a questionnaire that has been distributed online to 96 respondents who are non-Muslim students of PMU from various academic departments.

Table 1. Respondent's demography

Item		N	%
Ages	<18	2	2.08
	18-20	60	62.50
	21-25	29	30.20
	>25	5	5.22
Religion	Christian	73	76.00
	Hindus	1	1.04
	Buddhism	6	6.25
	Others	16	16.71
Gender	Male	40	41.67
	Female	56	58.33
Academic Department	JTMK	15	15.63
	JKA	20	20.83
	JKE	18	18.97
	JKM	20	20.83
	JP	23	23.74

They are referring to Table 1, most of the respondents aged between 18-20 years, which represents 62.50% of the respondent population. Most respondents from this age group were expected based on the facts that the student registration records of PMU show that most of the students registered are students who just completed *Sijil Pelajaran Malaysia (SPM)*. For the religion item, 76.00% of respondents are Christian, followed by other religions and Buddhism with 16.71% and 6.25% respectively. In terms of the distribution of respondents by gender, the number of respondents from female exceeds males by 16.66%. For academic department items, the sample led by the involvement of students for the Commerce Department of 23.74%.

It was then followed by the Mechanical Engineering Department and Civil Engineering Department with a percentage of 20.83%.

4.1 Assessment of Measurement Model

The construct reliability and convergent validity of the constructs in this investigation were assessed in Table 2. The construct knowledge (0.880), quality (0.903), and perception (0.882). Overall, the composite reliability (CR) values from three constructs in satisfactory level CR>0.7-0.9 show that these constructs have internal consistency. After deleting items with low loadings, these constructs also demonstrate good convergent validity. As a result, they reach an average variance extracted (AVE) value of 0.5, indicating that the items loaded to the corresponding constructs explain more than 50% of the constructs' 'variances' (Hair, et al., 2014).

Table 2. Internal consistency and convergent validity

Construct	Cronbach's Alpha	CR	AVE	Convergent Validity (Ave > 0.5)
Knowledge	0.880	0.917	0.735	Yes
Quality	0.903	0.992	0.775	Yes
Perception	0.882	0.883	0.653	Yes

The assessment of discriminant validity is shown in Table 3. Henseler's Heterotrait-Monotrait (HTMT) (2015) criterion has been used to evaluate discriminant analysis to date. This indicates that the constructs are separate from the criterion, which requires a stricter assessment than the previous criterion, implying that all constructs are distinct at the HTMT0.90 level (Henseler, et al., 2015).

Table 3. HTMT criterion

Construct	Knowledge	Quality	Perception
Knowledge			
Quality	0.797		
Perception	0.890	0.858	

Criteria: Discriminant validity is established at HTMT0.90

4.2 Assessment of Structural Model

Table 4 shows the results of the hypothesized relationships' path co-efficient assessment using a bootstrapping procedure. All two relationships are found to have a value > 1.645, thus significant at 0.05 level of significance. The relationships are significant (Knowledge → Perception $\beta = 0.569$ $p < 0.01$), and (Quality → Perception $\beta = 0.775$ $p < 0.01$).

Table 4. Path co-efficient assessment

	Beta	S.E.	t-value	p-value
Direct Effect				
Knowledge → Perception	0.569	0.087	6.516	0.000
Quality → Perception	0.775	0.093	3.551	0.000

The coefficient of determination (R²), effect size (f²), and predictive relevance (Q²) of exogenous variables on an endogenous variable are all evaluated in Table 5.

Table 5. Determination of co-efficient (R²), effect size (f²), and predictive relevance (Q²)

	f ²	R ²	VIF	Q ²
Direct Effect				
Knowledge	0.523	0.525	2.105	0.365
Quality	0.230		1.000	
Perception	0.175	0.705	2.135	0.436
Lateral Collinearity: VIF 3.3 or higher (Diamantopoulos & Sigouw 2006)				
R ² ≥ 0.26 consider Substantial (Cohen, 1989)				
F ² ≥ 0.26 consider Substantial (Cohen, 1989)				
Q ² > 0.00 consider large (Hair, 2017)				

As presented in Table 5, R2 value of knowledge (0.525) and Perception (0.175) is above 0.26 as suggested by Cohen (1989) a substantial model. Next, the effect size (f^2) is assessed. The values of 0.02, 0.15 and 0.35 represent small, medium, and significant effects consistently (Cohen, 1988). From the results knowledge (0.523) is large, Quality (0.230), and Perception (0.175) is medium sizes. In addition, the predictive relevance of the model was examined using blindfolding procedures. Overall, the three constructs $Q^2 > 0.00$ consider significant (Hair, 2017).

5. Conclusion and Recommendation

The aim of this study is to examine the the relationships between quality and knowledge towards perceptions of Islamic banking facilities including products and services among the non-Muslim students in Politeknik. The results show quality and knowledge has positively influence perceptions of Islamic banking facilities including products and services among the non-Muslim students in Politeknik. This study supported by finding (Amin, 2008), shown the majority of the Islamic banking customers including non-Muslims were satisfied with the overall service quality provided by the banks. Furthermore, higher educational institutions may play a significant role in providing exposure to students by offering programs or elective subjects related to Islamic banking. The result of this research is also open for any parties to study the factors that influenced the PMU students' views, perceptions, and awareness towards Islamic banking. Due to limitations of distributing to 96 respondents, the future will considerably be using the students and lectures in other institutions in Malaysia.

Acknowledgement

This research is fully supported by Polytechnic associates that range from the PMU administration department, fellow lecturers, and the students of PMU. I thanked them for all their commitment and cooperation.

The research results are hoped to help any parties, especially Islamic banking to ensure their products can break through the non-Muslim market and compete with conventional banking.

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Full Paper

Article history

Received

22 July 2023

Received in revised form

22 July 2023

Accepted

11 August 2023

Published online

30 September 2023

The Relationship Between Psychological Distress and Academic Adjustment Among the Undergraduates: A Conceptual Paper

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Abstract

College is a period of transition and preparation from adolescence to adulthood, and from studying to work. Failure of individuals to adapt to university not only affects their studies and life at the university level but also affects their work and life after adulthood. Depression and anxiety also have negative effects on student development. The relationship between psychological distress and academic adjustment is worth exploring. Numerous studies claim a correlation between these two variables in previous research. However, by increasing the level of student life satisfaction or reducing academic stress by observing and responding to the event, psychological distress does not always affect college students' academic adjustment. The inner potential mechanism between psychological distress and academic adjustment is needed to do further exploration.

Keywords: - *Academic adjustment, psychological distress, relationship*

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1. Introduction

College life is both an opportunity and a challenge for students. On the one hand, leaving the old environment, the diversity and openness of the college environment, and the unknown and uncertainty of college life also allow college students to explore different possibilities and find themselves. On the other hand, after entering the college campus, students must adjust in every way, including the changes in life, learning, environment, and other aspects, as well as the clear learning goals and self-development requirements of the college. Students' academic maladjustment to this stage not only easily leads to mental health problems such as anxiety and depression, but also impacts their career choices and even their personal development after graduation (Huang, Liu, & Luo, 2022). This finding is also supported by Thompson et al., (2019), while managing developmental tasks such as academic tasks, social interactions, and personal needs; it is not unexpected that many students

experience low psychological well-being. Due to the strong correlation between academic adjustment, performance, and dropout rates (Alipio, 2020), low academic performance and adjustment, and increasing dropout rates to college challenges are not brand-new phenomena in educational institutions around the world.

As reviewed by Kerr (2020), 75 percent of adults develop a mental disorder before the age of 25. Young adult students, who make up between 12 and 50 percent of the population in this category, are even more likely to experience mental health problems (Grasdalsmoen et al., 2020). Since they must deal with several demands, including living away from their families, a rigorous curriculum, and ineffective mentor-mentee and health education programs, students in higher education are thought of as going through a difficult stage in their lives. Thus, the considerable high probability of emotional disruption might cause psychological distress among them such as depression, anxiety, and stress particularly especially during the Covid-19 over restriction orders on

social interaction, isolation, and the switching of teaching and learning platforms from the physical classroom to virtual classroom (Planchuelo-Gómez et al., 2020). Psychological distress not only decreases the mental health of students directly (Petzold et al., 2020), but also lower academic performance as it will have an impact on how students learn (Thompson et al., 2019), and this procedure has an impact on how well students perform academically as well as on their way of life and commitment to their studies. Furthermore, poor psychological health will increase substance use and suicide ideation (Luca et al., 2016).

As disclosed by Achmad et al., (2018), self-adjustment at college was related to stress, pressure, and cultural background; consequently, these contexts affect students' academic performance, emotional response, and sociability. Therefore, it is imperative to explore the relationship between psychological distress and academic adjustment to improve students' college life experiences.

2. Definition Concept of Academic Adjustment

Gerdes & Mallinckrodt (1994) referred to academic adjustment as a process that demonstrates how students cope with their social, psychological, and academic challenges. However, academic adjustment has been defined by Van Rooij et al., (2018) as the degree of intellectual acceptance of the new environment as a significant indicator of how much a student has transitioned into university successfully. They categorize academic adjustment into four aspects: the motivation to study and have specific learning objectives, to contribute oneself to academic practice, to aspire to fulfil academic requirements and to be pleased with the academic climate. Anderson et al., (2016) nevertheless, endorse that academic lifestyle, academic achievement, and academic motivation are the three most challenges a student faces once they enter tertiary education.

Academic lifestyle is described as a person's compatibility with their temporary role as a student. The main goal of the academic lifestyle is to achieve intellectually satisfying results. Satisfaction with academic performance is referred to as academic achievement. The concept of academic motivation is the desire of students to continue and complete their educational journey. In this context, academic adjustment is defined as the ability to adjust to the new environment, which contains that academic lifestyle, academic achievement, and academic motivation.

3. Definition and Concept of Psychological Distress

Psychological distress is a general term for psychological functioning that is disrupted in the face of stressful life circumstances. This definition is consistent but precisely with Burnette et al., (2020), it is described as depression, anxiety, psychological stress, (lack of) well-being, and the absence of other distress-related notions (e.g., suicidality). While psychological distress is

frequently mentioned in healthcare literature, it is rarely described as a separate concept. Kessler et al., (2003) defined psychological distress as emotional suffering brought on by the interaction of anxiety and depressive symptoms, which the same definition of Turner, Aspin, and Gillman (2019). In this study, psychological distress was defined as a uniform mixture of symptoms of depression and anxiety.

The Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5) by the American Psychiatric Association (2013) defines depression as a disorder characterized by either a depressed mood or noticeably diminished pleasure in all activities, as well as at least four additional symptoms lasting at least two weeks, such as significant weight loss or gain, disturbed sleep, decreased concentration, fatigability, psychomotor agitation, or rumination. Meanwhile, Latifah et al., (2016) characterized depression as sadness, feelings of guilt, loss of interest, and low concentration. In other words, depression could appear as the feeling of low spirit or dejection, mental distress, deep disappointment, and failure in fulfilling specific goals in life, which may lead to a suicidal impression. Anxiety was explained by Bukhari & Afzal (2017) as tension and apprehension, which is a normal reaction to the impression of threat but is out of proportion to the seriousness of the situation and interferes with day-to-day functioning. It affects how someone functions emotionally, cognitively, physically, and behaviorally (Kiran et al., 2020).

4. Relationship between Psychological Distress and Academic Adjustment in Previous Research

Based on numerous studies, there is a correlation between psychological distress and academic adjustment. For example, a study among university freshmen in Pakistan by Bukhari & Ejaz (2020) showed that psychological distress (depression, anxiety, & stress) is strongly negatively correlated with overall adjustment. This situation is in line with the article reported by Ling & Tini (2022) in Malaysia, depression, generalized anxiety, social anxiety, and hostility significantly impacted the academic adjustment of students and academic adjustment issues are considerably exacerbated by psychological strain. Similarly, a study from Iran demonstrates that there is a negative relationship between academic achievement and anxiety and depression (Khesht-Masjedi et al., 2019). A review of literature from the past 30 years shows that over 40% of undergraduates cite mental and emotional problems as contributing to their academic performance challenges (Sharp & Theiler, 2018). In other words, higher anxiety and depression will adversely impact the success and academic achievement of students.

However, if students increase their level of life satisfaction or reduce academic stress by observing and responding to events, achievement and success in academic status depend on students' abilities, behaviors, or qualities. As endorsed by Van der Zanden et al., (2018), students reported higher psychological well-being in learning environments where their perspectives were

challenged, and higher-level thought was stimulated. For instance, people who must choose between their social life and their studies stressed that anxiety is typically achieved in the classroom. In a similar vein, among Turkish adults, and mental health workers in rural Australia, higher levels of positive psychological adjustment were associated with lower levels of depression, anxiety, stress, and burnout, as well as higher life satisfaction (Yildrm & Solmaz, 2022; Samios, 2018). This probably also explains the research found by Martin (2021), there was no evidence to suggest that psychological distress from natural disasters would hurt pupils' ability to succeed in a large southwestern university. Despite the surprising nature of this finding, a study by Di Petro (2018) indicated that distress from natural disasters does not always affect college student's ability to succeed academically, which is consistent with Martin (2021), although natural disasters are always stressful. These inconsistencies inspire the researcher to explore more what are the inner potential mechanisms between psychological distress and academic adjustment.

5. Conceptual Framework

University students frequently experience high rates of mental illnesses like depression, stress, and anxiety, which can be detrimental to their academic success and emotional health. Milic et al., (2020) emphasized this point, noting that mental health disorders are more prevalent in schools than in the general population, probably because of the high academic demands. Over their three or four years of education, students must overcome and adapt to a range of new problems to successfully move to university.

This conceptual framework as shown in Fig. 1 demonstrates the link between psychological discomfort and academic adjustment. Depression and anxiety are the psychological distress domains (Kessler et al., 2003). Whilst according to Anderson et al., (2016), academic adjustment primarily consists of three components: academic lifestyle, academic achievement, and academic motivation.



Fig. 1. Conceptual framework

6. Conclusion

In conclusion, to achieve a successful transition to university, students must overcome and adjust to a variety of changes including academic lifestyle, academic achievement, and academic motivation while in college. Psychological distress among undergraduates is significantly higher and alarming and generally harms

their academic performance. Therefore, the relationship between psychological distress and academic adjustment among undergraduates should be identified. This paper describes the definitions and correlation between academic adjustment and psychological distress among undergraduate students worldwide. It is not only of great significance to individuals' academic adjustment and future careers but also provides an essential theoretical and practical significance to universities for preventing and intervening in college students' academic adjustment and psychological distress.

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Full Paper

Article history

Received

24 July 2023

Received in revised form

24 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Usability and User Satisfaction Evaluation on JTMK Project Selection System by Single Blind Method using System Usability Scale and Net Promoter Score

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Abstract

The continuous growth of technology gives a positive impact to the society in many aspects such as data management and education. Final Year Project / Integrated Project is a compulsory subject for students to graduate. The supervisor is required to select potential supervisees and guide them based on the given period of time. Therefore, JTMK Project Selection System by implementing single blind method is designed and developed in previous research study with the aim to facilitate the selection of potential supervisees based on the proposal report. A comprehensive evaluation is required to evaluate the usability related to the usability (acceptable / not acceptable) of the system and to identify the user satisfaction using this system. This research study implements System Usability Scale (SUS) to evaluate the system usability and Net Promoter Score to identify the user (supervisor) satisfaction. The results of SUS indicate that the system is good and acceptable (SUS Score = 73.25). The result of NPS is 80% shows that, the supervisors are satisfied with the system functionality. Future work is to study the perceived usefulness and ease of use of the system among supervisors by implementing the Technology Acceptance Model.

Keywords: - System Usability Scale, Net Promoter Score, user satisfaction, web-based system, education institution

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1. Introduction

The advancement of technology makes the management of digital information become more effective and easier to access by the specific user anywhere and anytime with the Internet connection. The existing technology also makes education become more interactive and increases the students understanding about the specific subject. According to (Raja and Nagasubramani 2018), with technology, lecturers able to make the class session become more enjoyable, and student are also able to acquire knowledge about a specific subject or course more effectively.

According to the Ministry of Higher Education, an engineering student who enrolled in any higher educational institution such as a local university and polytechnic are required to take the Final Year Project

(FYP) / Integrated Project (IP) subject. This is to allow the engineering student to illustrate their ability to apply the information they've gained in their academic program (Halim et al. 2014). Therefore, engineering student needs to form a group which consists two to three members and prepare the project proposal. Then the specific supervisor is appointed according to the supervisor expertise (Khamaruddin et al. 2017). The supervisor is responsible to guide and assist their supervisees to ensure the project can be finished according to the time frame given (Bakar et al. 2015).

A previous study by (Rahman & Razak, 2022) has developed the Integrated Project Selection System and later has been rebranded into JTMK Project Selection System (JPSS) by implementing single blind method. According to the authors, this system is designed and developed with the aim to allow supervisors to select the potential supervisees based on the proposal report not

based on the students to prevent bias in selection of student project. This means the supervisor and student does not each other until the supervisor choose the student project.

JPSS has been uploaded to the specific web hosting and with specific domain and launched to the supervisors to use the system functionality anywhere and anytime with the Internet connection availability. Thus, a thorough assessment of the supervisors' ability to successfully deploy the JPSS web-based system is needed. One example of a method to evaluate a product is usability, which focuses more on how the user interacts with the application to perform the specific task (Al-khomsan et al. 2015). Usability acts as a main factor that influence the success of the web based system (Pradini, Kriswibowo, and Ramdani 2019). Then the more usable of the website means more users is accepted and used the website and vice versa (Al-Soud and Nakata 2010).

A technique that can be used to gauge system usability is the System Usability Scale (SUS). SUS is a frequently used standard questionnaire that is referred to as a "quick and dirty usability scale" for evaluating perceived usability (Lewis 2018).

To evaluate the user satisfaction with the JPSS, Net Promoter Score (NPS) can be implemented. NPS is the effective method for measuring the customer satisfaction and also for monitoring their loyalties (Sasmito & Nishom 2019).

In this research study, SUS and NPS are used to execute a thorough evaluation of the JPSS's successful implementation according to the previously stated description. This is being done to determine user satisfaction with the JPSS implementation and the system's usability.

2. Methodology

2.1 System Usability Scale (SUS)

SUS is invented by (Brooke 1996) and acts as an evaluation tool to evaluate the usability of the products. SUS consists 10 questions in the form of a questionnaire and using 5-point Likert Scale to scale each question. Each participant was requested to give a rate: "Strongly Disagree," "Disagree," "Neutral," "Agree," or "Strongly Agree" (Joshi et al. 2015). A previous study by (Bangor, Kortum, and Miller 2008) mentioned that SUS is very reliable with the Cronbach's alpha value is 0.911 (excellent). Other than that, (Wahyuningrum, Kartiko, and Wardhana 2020) has conducted a reliability test using Cronbach's Alpha for the SUS questionnaires. The SUS questionnaire can be used with confidence because Cronbach's Alpha value is 0.734. On the basis of the preceding study, it can be said that the SUS is validated and trustworthy (Cronbach's alpha value is greater than 0.60) to be used to assess the product's usability.

A previous study by (Setemen, Erawati Dewi, and Purnamawan 2019) has developed an Online Peer Assessment (PAON) system and implement SUS to

measure the system reliability. The SUS result indicates that POAN system is reliable and can be accepted by the user with a "Good" rating (SUS score = 80.00). In addition, a prior study by, (Ahmad and Hussaini 2021) analyzed the usability of a mobile application for higher education at Universiti Kuala Lumpur. The SUS result shows that the mobile application is reliable and acceptable.

2.2 Net Promoter Score (NPS)

NPS is created by (Reichheld 2004) with the aim to measure user satisfaction about the specific product. NPS also one of the simplest methods to categorized customers according to their answers (Sasmito & Nishom 2019). NPS labels the users based on three categories which is Detractors, Neutral and Promoters (Cruz, Moreno, and Silupu 2019). Promoters is the user who is satisfied with the product, Detractors is the user who dissatisfied with the product and Neutral is user who satisfied for the time being and may dissatisfy in the future.

Previous study by (Pradini et al. 2019) adopted NPS in order to measure the user satisfaction towards SIPR web-based system. The author claimed that, the SIPR get NPS result is 80 %, which means the user is very satisfied with the system. Other than that, a previous study by (Ismail, Elisa Nalawati, and Putra 2021) has performed the usability test for the Donation application of Toddler Equipment by implementing SUS and NPS. The result of NPS is 45% indicates that the user satisfied with the application.

3. Result and Discussion

Research methodology can be defined as how the research can be done scientifically by adopting various steps (Patel and Patel 2019). In this research study, a research methodology from previous study by (Ahmad and Hussaini 2021) is adopted accordance with this research study. The research methodology consists 3 steps as shown in Fig. 1.

a. Step 1

Questionnaire for SUS dan NPS is developed based on the latest previous study by (Brooke 1996; Pradini et al. 2019; Wijaya, Munandar, and Utaminingrum 2019). Then the questionnaire will be uploaded to the Google form before distributing to the targeted respondents.

b. Step 2

About 30 respondents (supervisors) were selected from the academic institution who has been use the SPBSS. It is consistent with the previous study by (Memon et al., 2020) mentioned that, the appropriate sample size is between 30 and 500 respondents. The targeted participants receive a link to the Google Form that contains the SUS and NPS questionnaires.

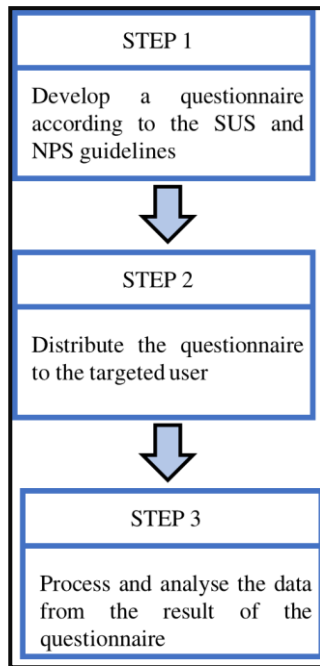


Fig. 1. Research methodology for SUS and NPS

c. Step 3

After the respondents have successfully answered and submitted the questionnaire, all the data will be analyzed according to the SUS and NPS guidelines. To calculate the usability of the system (SUS Score) three equation from the previous study by (Brooke 1996) is adapted as shown below.

$$Score_{Q1,Q3,Q5,Q7,Q9} = Scale\ Score - 1 \quad (1)$$

$$Score_{Q2,Q4,Q6,Q8,Q10} = 5 - Scale\ Score \quad (2)$$

$$SUS\ Scores = Sum\ of\ Scores \times 2.5 \quad (3)$$

For questions 1, 3, 5, 7, and 9, the score is determined using equation (1). While the Score value for even question 3, 4, 6, 8, and 10 is determined using equation (2). Last but not least, in order to determine the final SUS score value from the questionnaire, equation (3) is applied.

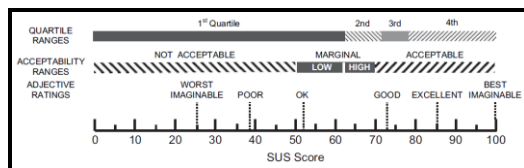


Fig. 2. SUS score categorization

According to (Brooke 1996) SUS score have a range between 0 to 100 and not in the percentage (%). SUS score can be categorized according to the Acceptability Ranges and Adjective Ratings as shown in Fig. 2 (Bangor et al. 2008). To calculate the NPS value this study will be adapted the formula from the previous study by (Pradini et al. 2019) as shown based on Fig. 3.

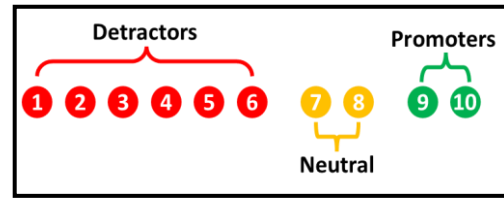


Fig. 3. NPS value

Based on Fig. 3, respondents who score 9 – 10 can be classified into Promoters, who gives value 7-8 can be classified into Neutral and who gives value 1-6 can be classified to Detractors. According to the (Pradini et al. 2019) total value of user satisfaction can be calculated based on equation (4) below.

$$NPS\ Scores = \% \text{ of Promoters} - \% \text{ of Detractors} \quad (4)$$

4. Data Acquisition for SUS and NPR

By giving the questionnaire to the intended respondents who were selected in a non-random manner, information is gathered (non-random sampling). The JPSS can only be accessed by the supervisor in this study, hence the respondents who worked as supervisors at the particular academic institution were chosen (Rahman & Razak, 2022). The questionnaire of SUS and NPS is distributed to the respondents via the specific Google Form URL. Detail of SUS and NPS questions can be seen in Table 1 and Table 2. This can further be enhanced by using an IoT web host application that allows the users to connect into the proposed system from remote area if there is internet connectivity. This shows the great potential of the IoT based platform to control the proposed system over the internet regardless of any range limitations.

Table 1. List of SUS questionnaire

No	SUS Question
1	I think that I would like to use this system frequently
2	I found the system unnecessarily complex
3	I thought the system was easy to use
4	I think that I would need the support of a technical person to be able to use this system
5	I found the various functions in this system were well integrated
6	I thought there was too much inconsistency in this system
7	I would imagine that most people would learn to use this system very quickly
8	I found the system very cumbersome to use
9	I felt very confident using the system
10	I needed to learn a lot of things before I could get going with this system

Table 2. Item net promoter score (NPS)

No	NPS Question
1	Are you satisfied with the JTMK Project Selection System by implementing single blind method? Give a score of 1-10 for this website!

5. Result and Discussion

After the data (questionnaire) are collected, all the data will be analyzed and calculated based on the equations (1), (2), (3), and (4).

Table 3. Respondents SUS Score

Respondent	Questions										SUS Score
	1	2	3	4	5	6	7	8	9	10	
R1	4	0	0	4	4	4	4	4	4	1	85
R2	4	3	4	4	4	4	3	4	4	1	75
R3	1	1	1	3	2	2	3	3	3	1	82.5
R4	3	1	3	3	3	3	3	3	3	3	72.5
R5	4	1	3	2	4	3	3	2	3	3	87.5
R6	3	1	2	1	2	1	3	2	2	3	75
R7	3	3	3	3	2	2	2	2	2	2	75
R8	3	1	3	3	3	3	3	3	3	3	72.5
R9	3	1	3	3	3	3	3	3	3	3	77.5
R10	2	1	3	2	3	3	3	4	4	3	82.5
R11	4	0	4	4	4	4	4	4	4	4	82.5
R12	4	0	4	3	3	3	4	4	4	4	82.5
R14	4	0	4	4	3	4	4	4	4	4	85
R15	4	0	4	0	4	4	4	0	4	0	75
R16	0	4	0	4	0	4	0	4	0	4	82.5
R17	0	4	0	4	0	4	0	4	0	4	72.5
R18	3	1	4	4	3	2	1	4	4	4	87.5
R19	4	0	4	4	2	4	3	4	4	4	75
R20	4	0	4	4	4	4	4	4	4	2	75
R21	4	0	4	4	4	4	3	4	2	1	72.5
R22	3	1	3	4	4	4	4	4	3	3	77.5
R23	3	1	3	3	4	3	4	4	3	1	82.5
R24	4	0	4	3	4	4	4	4	4	4	82.5
R25	4	0	4	0	4	4	4	4	3	3	82.5
R26	3	1	4	3	3	3	4	3	3	3	85
R27	3	1	3	3	3	3	3	3	4	3	75
R28	1	0	4	4	3	4	4	4	4	3	82.5
R29	4	3	3	3	3	4	3	3	3	4	72.5
R30	4	0	4	4	1	4	4	4	4	4	87.5
Total											2197.5
Average SUS Score											73.25

Table 3 displays the average SUS score across all 30 respondents, the total SUS score, and each respondent's individual SUS score.

Table 3 SUS score data reveals that 72.5 is the SUS score with the lowest value, while 87.5 is the highest value. Single-Blind Project Selection System SUS average is 73.25.

Based on the average SUS score in Fig. 2, we can categorize the system adjective rating is "Good" and acceptability ranges is "Acceptable" (Bangor et al. 2008). Therefore, it can be concluded that the respondents agree the system is reliable, acceptable, and good. Other than that, the average SUS also proves that the system is useful and reliable for the supervisors to select the potential supervisees based on the proposal report not based on the students (single blind method).

Table 4. Respondents NPS Score

	Number	Percentage
Promoters	27	90 %
Neutrals	0	0 %
Detractors	3	10 %
Total Responses	30	100%
Net Promoter Score		80 %

The Net Promoter Score (NPS) collected from the respondent's questionnaire is displayed in Table 4. The NPS Score is obtained from the percentage of Promoters minus the percentage of Detractors. The percentage of Promoters is 90%, while the percentage of Detractors only 10%. The total percentage of NPS for the JPSS is 80%. The NPS results indicated that the respondents (supervisors) are satisfied with the JPSS functionality to select the potential supervisees based on the proposal report not based on the students.

4. Conclusion and Future Work

This research study aims to identify the usability and the user satisfaction towards the JTMK Project Selection System (JPSS) by implementing single blind method. The research study begins with the developments of the questionnaire based on the SUS and NPR guidelines and then distributed to the selected 30 respondents (supervisors). After that, all the questionnaire result from the non-random respondents are analyzed to identify the SUS and NPR score.

The SUS and NPR score results show the positive feedback from the respondents. The average of SUS score results is 73.25 (Acceptable and Good) and the NPR score is 80 %. The SUS score indicates that respondents concur that the system is useful and suitable for use by supervisors. Other than that, the NPR percentage score indicates that, respondents are very satisfied with the JPSS functionality.

In future works, Technology Acceptance Model (TAM) is adopted to measure the supervisor perceives about ease of use of JTMK Project Selection System (JPSS) by implementing single blind method for project selection.

Acknowledgement

The authors would like to express greatest appreciation to Politeknik Mukah Sarawak (PMU) for the permission to carry out this research study work. Finally, the authors would like to thank the respondents for the feedback on the questionnaire and Department of Information and Communication Technology (JTMK) supporting this research study to evaluate the usability and user satisfaction for JTMK Project Selection System (JPSS) by implementing single blind method among the supervisors using System Usability Scale (SUS) and Net Promoter Score (NPS).

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Study of UI GreenMetric Compliance in Higher Learning Institutions

Full Paper

Article history

Received

29 July 2023

Received in revised form

29 July 2023

Accepted

11 August 2023

Published online

30 September 2023

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Abstract

Compliance of sustainable development is crucial. Institutions need to take actions for developing sustainability improvement. Institutions of higher learning have a great responsibility to encourage sustainability culture in society. The journey towards sustainability for universities and polytechnics is in different stages based on their institutions' priorities to become a green campus. UI GreenMetric World University Rankings is a trigger for Mukah Polytechnic to become a sustainability green campus. The first objective of this study is to identify criteria indicator for UI GreenMetric World University Rankings. The second objective is to analyse UI GreenMetric World University Rankings compliance in Mukah Polytechnic. In 2022, Mukah Polytechnic has made a first step by joining UI GreenMetric World University Rankings. Mukah Polytechnic manage to be in 595th place out of 1050 participant in world rank. Due to this achievement, several improvements made to boost Mukah Polytechnic world rank in 2023. Each criterion being analyse, to search for any lacking. Based on the study, it is found that energy and climate change was getting low marks. Number of renewable energy sources in campus and innovative programs in energy and climate change are the main contribution for low marks in these criteria. According to the analysis, there are several criteria contributing to high marks such as water and waste management. An improvement in documentation, more sustainability innovation and green activities will be executed in 2023. This is a preliminary afford to establish Mukah Polytechnic as a leading green campus worldwide.

Keywords: - Green campus, sustainability indicator

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1. Introduction

There are a lot of sustainability audits available nowadays. Among the popular green building audit is The Green Building Index (GBI), LEED (Leadership in Energy and Environmental Design), Energy Star, BREEAM (the Building Research Establishment Environmental Assessment Method), Green Globes, Living Building Challenge, National Green Building Standard, Green Guard, WELL Building Standard, and many others. The selection of green building assessment tools based on type of building and recognition need by a building management, institution, or government policy.

Mukah Polytechnic has selected The UI GreenMetric

World University Ranking as the assessment tool for green building compliances. Selection made due to the building status as a higher learning institution. The world rank recognition granted by the organizer is a major influence of Mukah Polytechnic taking part in the evaluation.

1.1 Problem Statement

This study conducted based on few emerge issues. According to Mushtaha et al. (2022), universities have direct and indirect negative effects on the natural and social environment due to the large areas covered and the pollutants released.

The trend of global warming has intensified, and global warming has caused significant damage to the natural ecological environment, on which humankind depends on survival (Zhou et al., 2022)

The increasingly waste apparent negative impact of human activities on the environment has heightened the urgency for the chemistry community to adopt greener and more sustainable practices (Sheldon et al., 2022)

Drinking water is beginning to be a rare resource in several regions and both uses of water and wastewater outlet are of main environmental and economic significance in several nations (Gheraout et al., 2019)

1.2 Objectives

This study consisting of two objectives, that are:

1. To identify criteria indicator for UI GreenMetric World University Rankings.
2. To analyse UI GreenMetric World University Rankings compliance in Mukah Polytechnic.

1.3 Research Scope

This study conducted in Mukah Polytechnic.

2. Literature Review

The University of Indonesia launched the non-profit UI GreenMetric World University Rankings in 2010. The ranking made based on evidence provide by institution following six criteria and several sub criteria. It is up to the institutions to provide relevant data, to get maximum marks for the ratings. Fig. 1 shows criteria taken into consideration for the evaluation.

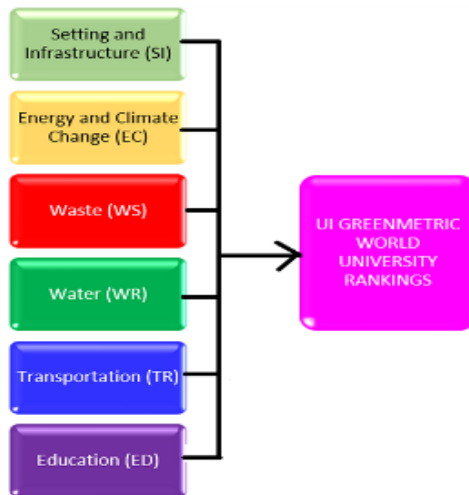


Fig. 1. Framework of this study

The value of infrastructure projects to society is challenging to measure (Zerjav et al., 2021). Setting and Infrastructure (SI) appraisal consisting of a lot of indicators to take care of. Some of this element is not

provided in the institutions such as vegetation area and budget allocated for sustainability.

According to Verichev et al. (2020), global climate change is changing meteorological parameters and climate zones for building in different parts of the world, as well as changing energy consumption by dwellings. Consequently, the possibility of applying the current building standard of the country in future climatic conditions has been questioned.

There has been an increase in waste management applications within the context of sustainability activities recently. The most important reason for that was the legal requirement for recycling and disposal of the waste generated by the producers. Developing nations still utilize the storage method, while developed countries recycle almost all produced waste to produce raw materials and energy (Koçak, & İkizoğlu, 2020).

Table 2 shows the weightage percentage for score provided in UI GreenMetric World University Rankings. Based on the distribution, it is found that the highest percentage distribution goes to Energy and Climate Change (EC).

Table 2. The weightage of categories in UI GreenMetric World University Rankings

No	Category	Percentage of Total Points (%)
1	Setting and Infrastructure (SI)	15
2	Energy and Climate Change (EC)	21
3	Waste (WS)	18
4	Water (WR)	10
5	Transportation (TR)	18
6	Education (ED)	18
TOTAL		100

3. Methodology

Qualitative approaches used as the methodology for this study. The observation and data collected to fulfil the evidence requirement by UI GreenMetric World University Rankings.

4. Analysis and Findings

The level of compliance for UI GreenMetric World University Rankings by Mukah Polytechnic is based on result gained from Fact File 2022. Mukah Polytechnic managed to place in 595 positions, out of 1050 institutions throughout the world, and in 25th rank in Malaysia.

4.1 Objective 1

The first objective achieves by compiling criteria indicators for UI GreenMetric World University Rankings. There are six criteria has been recognized, that is Setting and Infrastructure (SI), Energy and Climate Change (EC),

Waste (WS), Water (WR), Transportation (TR) and Education (ED).

4.2 Objective 2

Mukah polytechnic achievement based on UI GreenMetric World University Rankings self-audit document submission. Fig. 2 is the data analysed by UI GreenMetric organizer, establish from document submission made in 2022. Based on six criteria listed in UI GreenMetric World University Rankings, it is found that Mukah Polytechnic has an issue of energy and climate change, the percentage is low, that is 10%. Fig. 2 shows the percentage distribution among six criteria listed. The strength of Mukah Polytechnic in this self-audit document submission is water, where the compliance is 21%, compared to other criteria.

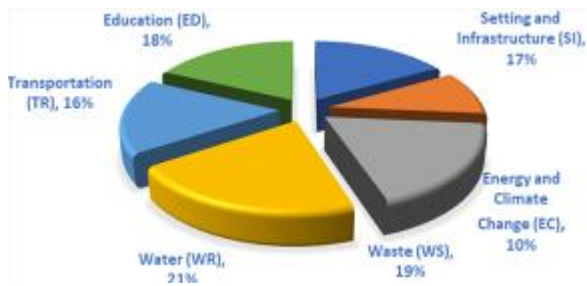


Fig. 2. Overall percentage of categories compliance of Mukah Polytechnic

Setting and Infrastructure, consisting of eleven sub criteria to be observe. Out of those sub criteria, Fig. 3, shows that SI.6 (university budget for sustainability effort) get the lowest score. This issue occurs due to a lack of awareness regarding the importance of providing budget for sustainability. SI.3 (Area on campus covered in planted vegetation), shows a low score. Even though Mukah Polytechnic located in rural area, the amount of planted vegetable is limited.

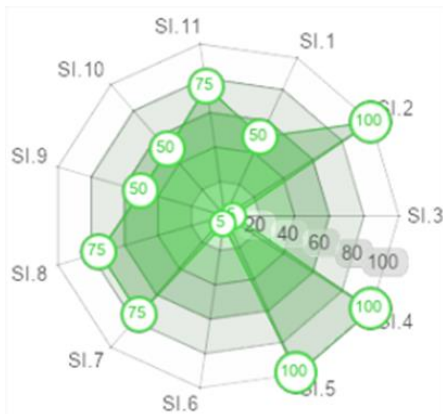


Fig 3. Setting and Infrastructure (SI) compliance of Mukah Polytechnic

Based on the evaluation for energy and climate change in Fig. 4, it shows that Mukah Polytechnic did not getting any marks in item EC 3 (Number of renewable energy sources in campus) and EC 9 (Number of innovative programs in energy and climate change). Basically, there are several innovations produced related to environmental sustainability, due to lack of evidence, the document cannot be submitted.

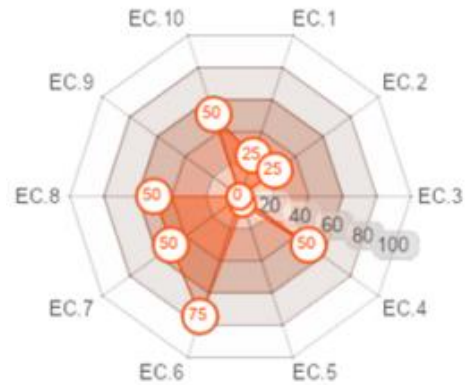


Fig 4. Energy and Climate Change (EC) compliance of Mukah Polytechnic

Energy saving program also being implement in Mukah Polytechnic, Table 3 shows the reduction of energy consumption in February and March 2023. This reduction is the impact of Earth Hour activity on 26 March 2022.

Table 3. Mukah Polytechnic electrical consumption

SARAWAK ENERGY BILL (RM)			ENERGY (kWh)	CO ₂ (Metric Ton)
FEBRUARY 2022 (28 DAYS)	49,609.94	1 BULAN	181305 kWh	152.29
	1,772.00	1 HARI	6475.18 kWh	5.44
	73.83	1 JAM	269.80 kWh	0.23
MARCH 2022 (31 DAYS)	37,787.49	1 BULAN	140242 kWh	117.8
	1,218.95	1 HARI	4523.94 kWh	3.8
	50.79	1 JAM	188.50 kWh	0.16

Referring to Fig. 5, it is revealing that WS.6 (sewerage disposal) has the lowest score. This low marks gain due to lack of documentation prepared. To look at the bright side, Mukah Polytechnic possess a groundwater well, able to provide clean water for residents. The water kept in a water tank, and well-treated.



Fig 5. Waste (WS) compliance of Mukah Polytechnic

The water (WR) compliance of Mukah Polytechnic shows in Fig. 6. WR.2 (water recycle program) and WR (water pollution control in campus area) appear to have lower marks compare to others. Mukah Polytechnic have undergo this element, but not widely implemented.



Fig 6. Water (WR) compliance of Mukah Polytechnic

Based on Fig. 7, TR.2 (shuttle service) has been rated as zero. The reason for not providing shuttle services is because size of institutions that is not so big. Covered pedestrian walkway provided almost everywhere in Mukah Polytechnic. Indirectly it is capable to reduce CO2 emission.

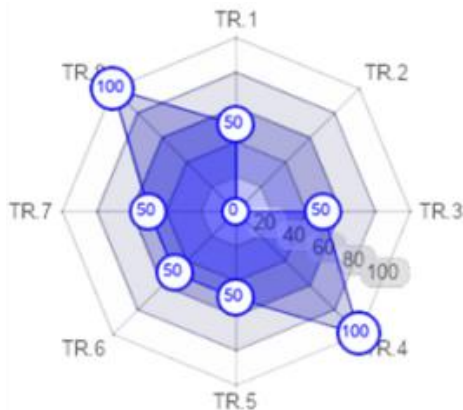


Fig 7. Transportation (TR) compliance of Mukah Polytechnic

Courses related to fundamentals of renewable energy are available in Mukah Polytechnic. These courses exposed students to the importance of green sustainability. Based on Fig. 8, ED.2 (the ratio of sustainability research funding towards total research funding) is very low. To enhance an individual career, Mukah Polytechnic encourages research to be carried out as part of excellence criterion. However, funding is up to an individual. This is why appropriate documentation cannot be submitted.

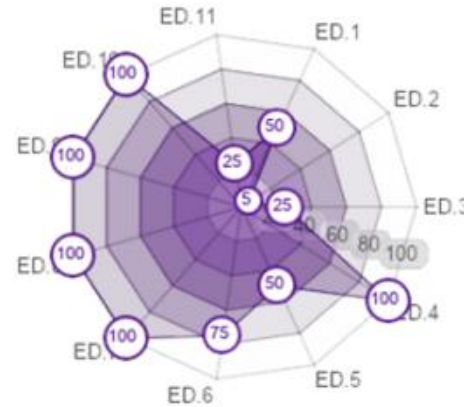


Fig 8. Education (ED) compliance of Mukah Polytechnic

5. Conclusion

The criteria listed in UI GreenMetric World University Rankings are comprehensive. It covers almost every element needed to maintain an institution to be in a sustainable environment.

Setting and Infrastructure (SI) is considered as a fix element. One of the methods to improve scoring in assessment is by increasing the planting of vegetables in Mukah Polytechnic area. Extra budget for sustainability should be implementing.

Energy and Climate Change (EC) compliance of Mukah Polytechnic is focusing on item that has not being implement yet. Initiative to provide a renewable energy source in campus and innovative programs in energy and climate change must be carried out.

An issue of Waste (WS) compliance of Mukah Polytechnic is not so urge. Development in sewerage disposal will assist Mukah Polytechnic to become a sustainability campus.

Water (WR) compliance of Mukah Polytechnic is in good conditions, in accordance with the needs of becoming a sustainable campus.

Lack of shuttle service in campus due to campus size and the existence of covered walkway throughout Mukah Polytechnic. Transportation (TR) compliance of Mukah Polytechnic still in adequate conditions.

Education (ED) compliance of Mukah Polytechnic is set back due the ratio of sustainability research funding towards total research funding. There are a lot of research being carried out but there not divided specifically either there related to sustainability or not.

To ensure the compliance of UI GreenMetric World University Rankings, sufficient document must be prepared. The document provided need to comply with the criteria listed. Staff and management must be educated in documenting all evidence related to green sustainability. The management support is a motivation to achieve a better rank in 2023 is by complying all criteria, especially the low rating gain in 2022.

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Sustainability in Polytechnic Institutions: A Roadmap to A Greener Future

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Full Paper

Article history

Received

26 July 2023

Received in revised form

26 July 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Sustainability is an essential concept that has gained momentum in recent years as a response to the growing concern about global environmental issues. A sustainable approach seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. Polytechnic institutions, as centers of education and innovation, have a crucial role to play in fostering sustainability by integrating its principles into academic curricula, research, campus management, and community outreach. This paper will discuss the significance of sustainability in polytechnic institutions and provide recommendations on how to achieve it effectively. This research paper uses quantitative methods on previous studies related to sustainability and was published on Scopus from 2000 to 2023. The results of the study found that sustainability in polytechnic institutions can be improved in terms of collaborative relationships between institutions and encourage all students, not just freshmen, to think sustainably. The results of this study are expected to help TVET institutions, stakeholders, and the government to develop a green curriculum especially in the implementation of green elements as well as increase the marketability and competitiveness of TVET graduates.

Keywords: - Sustainability, polytechnic, TVET

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1. Introduction

Polytechnic institutions are specialized, career-focused educational establishments that provide students with technical and vocational training in various fields such as engineering, technology, applied sciences, and business management according to Technical and Vocational Education and Training – Education for sustainable Development (TVET-ESD) (UNESCO, 2014). These institutions emphasize hands-on, practical learning experiences and often collaborate with industry partners to align their curricula with the needs of the job market. Polytechnic institutions serve as vital contributors to the development of skilled professionals, who play a significant role in driving economic growth, innovation, and social progress (Giesecke, 2013). As centers of

education and innovation, polytechnic institutions bear the responsibility of promoting sustainability in their academic and operational practices to ensure a better future for the planet and its inhabitants.

Polytechnic institutions, with their focus on applied learning and industry-driven curricula, have a unique opportunity to contribute to sustainability by preparing students for careers that address environmental, social, and economic challenges (Sterling, 2004). The relationship between polytechnics and sustainability lies in their ability to influence future professionals who will implement sustainable practices in various sectors, such as engineering, technology, and business management.

The issue at hand is the urgent need for integrating sustainability into polytechnic institutions. As centers of education and innovation, these institutions have a crucial

role to play in fostering a sustainable future by addressing environmental, social, and economic challenges. The issue concerns the development and implementation of sustainable practices across various aspects of polytechnic institutions, including academic curricula, research initiatives, campus management, and community outreach. By failing to prioritize and incorporate sustainability, polytechnic institutions may inadvertently contribute to environmental degradation, resource depletion, and social inequalities, which can have long-lasting negative consequences for future generations.

Alshuwaikhath & Abubakar (2008) and Fadeeva & Mochizuki (2010) state that there is an immediate need to integrate sustainability into polytechnic institutions. As educational and innovative hubs, these institutions play an essential role in fostering a sustainable future by addressing environmental, social, and economic challenges (Lozano et al., 2013; Tilbury, 2011). By incorporating sustainability principles and practises into their curricula, research, and campus operations, polytechnic institutions can assist in equipping the next generation of leaders with the skills and knowledge necessary to create a more sustainable world (UNESCO, 2017; Wiek, Withycombe, & Redman, 2011).

Integrating sustainability into polytechnic education involves incorporating sustainable principles and practices across all aspects of the institution, including academic curricula, research initiatives, campus operations, and community engagement (Mochizuki & Fadeeva, 2008). By doing so, polytechnic institutions can produce graduates with the knowledge, skills, and values necessary to develop innovative solutions to complex sustainability challenges, thus fostering a greener and more equitable future.

1.1 Objective

This research will discuss the significance of sustainability in polytechnic institutions and provide recommendations on how to achieve it effectively. This study will make it easier for other educational institutions to use the same strategy or improve it in the future. To achieve this goal, the objectives are developed based on the following points:

1. To survey the intellectual core and landscape of the general body of knowledge in sustainability in polytechnic.
2. To access the quality of the current body of knowledge sustainability in polytechnic.

1.2 Scope

The scope of this study is focused on the 23 years of publication and research in Scopus from 2000 to 2023.

2. Literature Review

Sustainability has become a critical issue in higher education institutions, including polytechnics. Polytechnic institutions are expected to play a significant

role in promoting sustainability and creating a greener future. However, studies have shown that sustainability is not adequately integrated into the curriculum of polytechnic institutions (Nazif, Mustapha, & Ocheme, 2020).

The implementation of sustainability practices in higher education institutions has been analyzed in several studies which analyzed the current state of implementation of sustainability development in Portuguese higher education institutions (Aleixo, Azeiteiro, & Leal, 2018). The study found that there is a need for a more comprehensive approach to sustainability in higher education institutions. Storey, Killian & O'Regan (2017) mapped the field of responsible management education in the context of the Sustainable Development Goals (SDGs). The study highlighted the importance of integrating sustainability into the curriculum of higher education institutions.

Several studies have focused on the role of polytechnic institutions in promoting sustainability. Lee-Yaw et al. (2016) analyzed the possible ways that educational institutions can implement green ICT to ensure that their environment is economically sustainable. The study used Accra Polytechnic in Ghana as a case study (Pardal, Romeira, & Durão, 2020) that studied the challenges and opportunities of creating an eco-green campus at the Polytechnic Institute of Beja. The study highlighted the important role of higher education institutions in promoting sustainability.

Polytechnic institutions have also been studied in terms of their economic impact. Alves et al. (2015) estimated the economic impact of a group of polytechnic institutes located in regions with diverse socioeconomic realities. The study found that polytechnic institutions have a significant impact on the local economy.

In conclusion, sustainability is a critical issue in polytechnic institutions. Studies have shown that sustainability is not adequately integrated into the curriculum of polytechnic institutions. However, there is a growing awareness of the importance of sustainability in higher education institutions, and several studies have focused on the role of polytechnic institutions in promoting sustainability. Polytechnic institutions have also been studied in terms of their economic impact.

3. Methodology

In this study, qualitative methods were used in this research. Using the keywords “sustainability” and “polytechnic”, 168 papers have been identified for the analysis using a science mapping tool. Science mapping was conducted in two stages. The first stage involved constructing networks through keywords and institutions co-occurrence analysis as explained in the next section and the second stage involved generating maps for mining useful information from network measures, and to display conceptual, intellectual, or social evolution of the research field, discovering patterns, trends, seasonality, and outliers (Chen, 2017).

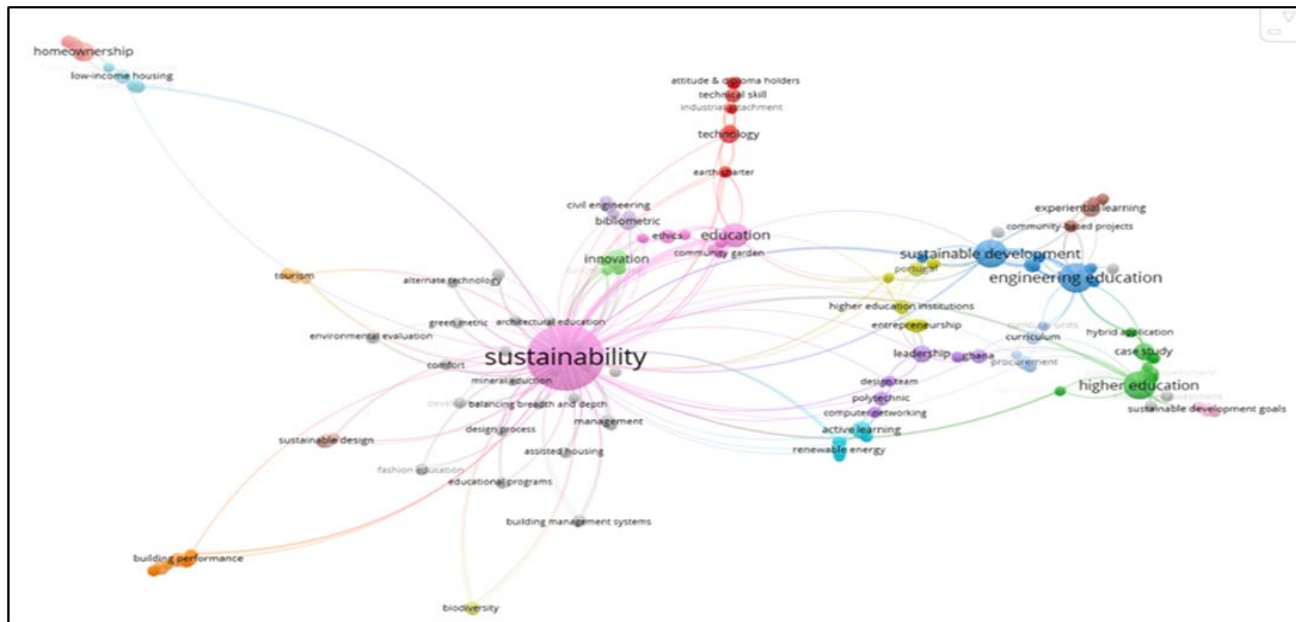


Fig. 1. Main research interests on sustainability in polytechnics (co-occurrence network keywords)

4. Result and Discussion

The study of sustainability in polytechnics were discussed in terms of: (a) keyword of occurrence and (b) country collaboration.

4.1 Objective

VOS viewer is used to establish a system of collaborative writing between numerous institutions. In a typical keyword co-occurrence network, the nodes represent the keywords themselves, and the edges represent the relationships between them (representing relations among sets of keywords). Connections between organizations are shown as lines between circles. The greater the concentration of institutions, the more often they occur simultaneously. Each cluster of keywords is represented by a different colour, and these colours correspond to research hubs. The closeness or cooperation between two nodes is represented by the thickness of the link's silhouette. These descriptions can later be applied to other networks by substituting keywords with countries and institutions. Table 1 and Fig. 2 shows the result of co-occurrence keywords.

Table 1. Top 50 keywords

Degree	Centralit	Label	Relative Influence
117	520	sustainable development	1
85	310	sustainability	2
73	280	engineering education	3
57	110	students	4
46	100	architectural design	5
45	60	education	6
40	90	Higher education	7
38	90	leadership	8
35	40	design	9
32	40	curricula	10

28	80	budget control	11
28	70	energy utilization	12
25	20	Beijing	13
25	20	investment	14
24	80	climate change	15
23	40	China	16
22	10	construction	17
22	60	buildings	18
22	10	building technology	19
21	20	energy conservation	20
21	20	building systems	21
20	10	construction industry	22
20	20	decision making	23
19	60	international cooperation	24
19	20	ecology	25
18	20	environmental engineering	26
18	10	architecture	27
17	20	energy efficiency	33
17	10	education computing	35
16	10	curriculum	37
15	10	teaching	38
15	10	energy saving	39
14	10	management	40
14	10	automation	42
14	10	3d model	43
14	20	civil engineering	44
14	60	building performance	45
14	10	4d model	46
14	20	urban planning	47
13	10	environmental management	48
13	10	emission control	49
13	10	carbon footprint	50

Using weighted degree values, the most influential keywords in the network were identified. Nodes were recoloured and resized according to their weighted degree values, with larger nodes and thicker linkages denoting greater weighted degree values (Van Eck & Waltman, 2011). Several key findings have been found from the analysis:

- i. Some research interests have received special attention, while others have remained under research. Given that this review paper initially focused on

these terms, sustainability development and sustainability are the most frequently occurring keywords. Engineering education, students, architectural design, education, higher education, and leadership have received considerable attention in sustainability in polytechnic research (Table 1). They are all interconnected terms related to the larger theme of sustainable energy and climate change mitigation. The results indicate that these have been the top themes in literature.

- ii. Sustainable development and sustainability mostly focus on engineering education and students. For instance, in Malaysia, green curriculum has been embedded in the engineering department of polytechnics Malaysia (Jabatan Pendidikan Politeknik, 2018) whereas for the non-engineering course, green elements are difficult to integrate into the existing program/syllabus structure. They must create syllabus based on the green compliance that suitable with Malaysian environment. Lozano et al. (2015) emphasize the importance of integrating sustainability into the academic curriculum of higher education institutions, including polytechnics. The authors highlight the need for interdisciplinary courses that cover sustainability principles and focus on practical applications across various fields. They also stress the importance of fostering problem-solving, critical thinking, and collaboration skills among students to enable them to develop innovative solutions to real-world challenges related to sustainability.
- iii. The result further suggests that limited attention has been directed toward knowledge in carbon footprint, emission control, management, environmental, urban planning and 4d model. This must draw the higher education administrator's attention, given that knowledge in carbon footprint, how to control emission, good management and applying new technology such 4D model can assist sustainability issue especially in knowing the impact of the programme. Briens et al. (2023) reported that as the importance of sustainability teaching and learning increases, a growing number of higher education institutions (HEIs) are evaluating the efficacy of their approach to sustainability education. However, most assessments fall short of determining how curriculum plans influence learning outcomes.

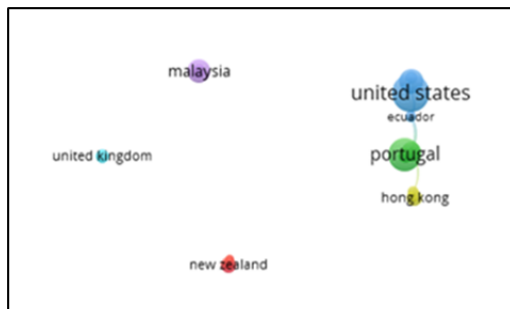


Fig. 2. Collaboration network of countries in the literature on sustainability in polytechnics

4.2 Collaboration Between Countries

It is helpful for research partnership and policymaking to learn about the network of institutions with a high investment and interest in research on retrofitting. Fig. 2 shows that out of the 50 countries studied, only 18 of them publish three or more documents. Concerning the strength of relations, the strongest relations were among these countries the United States, Equatorial Guinea, and Hong Kong have intergovernmental cooperation among these 18 nations. However, the link silhouette suggests that the networking is weak. Even though Malaysia, the United Kingdom, and New Zealand have produced more than three documents on the subject, there has been no international cooperation on sustainability in polytechnics for these nations.

5. Limitation and Suggestion

There is a lack of expertise in sustainability, particularly in third-world countries, is to highlight the disparities in resources, education, and infrastructure that contribute to this knowledge gap. These countries often face numerous social, economic, and political challenges that hinder the development of expertise in sustainability.

Moreover, the prioritization of immediate needs, such as addressing poverty, hunger, and basic infrastructure, may lead governments and institutions in third-world countries to allocate fewer resources to the development of sustainable expertise. Furthermore, the lack of collaboration and knowledge-sharing between developed and developing nations may also contribute to the gap in sustainability expertise.

To address this issue, it is essential to foster international partnerships and knowledge-sharing initiatives, as well as invest in capacity-building programs that can help develop local expertise in sustainability. By providing resources, training, and support to third-world countries, the global community can work together to close the sustainability expertise gap and promote sustainable development in all regions of the world.

Polytechnic institutions should foster research projects related to sustainability, encouraging collaboration among students, faculty, and industry partners. Research initiatives can range from exploring new materials and processes for energy-efficient construction to investigating the potential of renewable energy sources or developing innovative waste management solutions. By fostering a culture of sustainability-focused research, polytechnic institutions can contribute to the development of ground-breaking technologies and strategies that address environmental and societal challenges.

6. Conclusion

In conclusion, the integration of sustainability in polytechnic institutions is of paramount importance in shaping a greener and more equitable future. As centres of technical and vocational education, polytechnics have the

potential to drive positive change by equipping students with the knowledge, skills, and values necessary to address complex environmental, social, and economic challenges. To achieve this, polytechnic institutions must commit to incorporating sustainability principles across all aspects of their operations, including academic curricula, research initiatives, campus management, and community engagement. By establishing dedicated sustainability committees, developing comprehensive policies and action plans, and fostering a culture of sustainability, polytechnic institutions can serve as exemplary models for other educational institutions and contribute significantly to global sustainability efforts. As we collectively strive for a more sustainable world, it is vital for polytechnic institutions to embrace their pivotal role in nurturing the next generation of sustainability-conscious professionals and innovators, ultimately driving the transition towards a greener future.

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Virtual Industrial Visits Using Virtual Reality Glasses in Chemical Engineering

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Full Paper

Article history

Received

9 August 2023

Received in revised form

9 August 2023

Accepted

11 August 2023

Published online

30 September 2023

Abstract

Field trips are an essential component of engineering education, providing students with hands-on experience and exposure to real-world applications of engineering concepts. However, traditional field trips can be costly, time-consuming, and logistically challenging to organize and execute. Moreover, the COVID-19 pandemic has made it difficult for students to experience industrial visits. Virtual Reality Glasses have emerged as a solution to this problem. Virtual industrial visits using virtual reality (VR) glasses are an emerging tool for enhancing chemical engineering education. These visits allow students to experience the inner workings of industrial plants and processes, providing a more engaging and interactive learning experience. This paper discusses the usage of VR glasses in virtual industrial visits for chemical engineering students. The findings demonstrated that virtual industrial visits have the potential to significantly enhance chemical engineering education, providing students with a more engaging, interactive, and cost-effective way to experience real-world chemical engineering concepts and applications. The benefits of this approach are examined, including increased engagement, reduced costs, and logistical challenges associated with traditional field trips. The challenges and limitations of VR glasses in virtual industrial visits are discussed, including concerns about safety and the need for effective design and implementation of the VR environment. Ultimately, virtual industrial visits using VR glasses have the potential to significantly enhance chemical engineering education, providing students with a more immersive and realistic learning experience.

Keywords: - Virtual reality, virtual industrial visit, chemical engineering

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1. Introduction

Chemical engineering is a field that is constantly evolving, with new technologies and processes being developed and implemented all the time. As a result, it is essential for chemical engineering students to have hands-on experience and exposure to real-world chemical engineering applications. Field trips have long been a staple of chemical engineering education, providing students with the opportunity to see these applications in

action and gain a deeper understanding of the field. However, traditional field trips can be costly, time-consuming, and logistically challenging to organize and execute. As a result, many chemical engineering programs are exploring alternative approaches to field trips, including the use of virtual reality (VR) technology to create and experience virtual industrial visits, without the associated costs and logistical challenges (Liagkou et al., 2019; Marks & Thomas, 2022; Swathi, 2022).

Virtual reality technology has been increasingly used

in various fields to enhance learning and training experiences (Hudson et al., 2019). In engineering education, virtual reality has shown promise as an effective tool for enhancing student learning and engagement, particularly in complex and hazardous environments such as chemical plants (Ma et al., 2011; Suarez & Alvarez, 2006). Several studies have explored the use of virtual reality in chemical engineering education. For example, (Gao et al., 2023) developed a virtual reality simulation of a distillation column to enhance students' understanding of distillation process design. The study found that the virtual reality simulation was effective in improving students' conceptual understanding and problem-solving abilities. Virtual industrial visits using VR glasses offer a way for chemical engineering students to experience industrial sites, such as chemical plants and refineries, without having to leave the classroom (Salah et al., 2019). Using VR glasses, students can explore a 3D environment that is designed to simulate the real-world experience of an industrial visit, complete with realistic sights, sounds, and interactive features (Hu-Au & Lee, 2017).

The benefits of virtual industrial visits using VR glasses are numerous. First and foremost, they are cost-effective. Traditional field trips often require significant funding to cover travel, lodging, and other expenses. With virtual industrial visits, the costs are significantly lower, as students can experience the simulation from their own classrooms or computer labs (Makransky & Mayer, 2022). Virtual industrial visits using VR glasses are also logistically simpler to organize (Ausburn & Ausburn, 2004). Traditional field trips require extensive planning and coordination, including arranging transportation, scheduling visits with industrial partners, and ensuring the safety and security of all participants (Zhao et al., 2020). With virtual industrial visits, these logistical challenges are significantly reduced, as the visits can be scheduled and executed entirely within a virtual environment. Another benefit of virtual industrial visits using VR glasses is their flexibility in time. Because virtual industrial visits can be executed entirely within a virtual environment, it can be accessed from anywhere, at any time. This makes them particularly valuable for online chemical engineering programs, as well as for students who may have limited mobility or other challenges that make traditional field trips difficult (Blümel & Haase, 2009).

However, virtual industrial visits using VR glasses are not without their challenges and limitations (González-Peña et al., 2021). One of the biggest challenges is ensuring that the simulations accurately reflect the real-world experience of an industrial visit. This requires careful attention to detail in the design and implementation of the virtual environment, as well as ongoing testing and refinement to ensure that the experience is as realistic and immersive as possible (Paszkievicz et al., 2021). Another challenge is ensuring that virtual industrial visits using VR glasses provide a comparable learning experience to traditional field trips.

This requires careful consideration of the learning objectives and outcomes of the visit, as well as the implementation of the virtual environment to ensure that it is aligned with these objectives.

In this manuscript, the potential of virtual industrial visits using VR glasses as a replacement or supplement to traditional field trips for chemical engineering students are discussed. The benefits of VR glasses for chemical engineering education, as well as the challenges and limitations that must be addressed to ensure the effectiveness of virtual industrial visits, were also analysed in this study. The best practices for designing and implementing virtual industrial visits using VR glasses were discussed, including considerations for learning objectives, user experience, and evaluation.

2. Methodology

The methodology for conducting virtual industrial visits using virtual reality glasses in chemical engineering involves several key steps, including selecting appropriate content, and delivering the virtual experience. The first step in the methodology is to select appropriate content for the VR industrial visit. This involved selecting a few specific chemical engineering sites or plants, such as petrochemicals or offshore. The content should be relevant to the learning objectives of the department and should provide students with a comprehensive understanding of the real-world applications of chemical engineering.

The target group was undergraduate chemical engineering students at a private university in Sarawak, Malaysia. The participants consisted of 20 students who were invited to participate in the questionnaire at the end of the VR industry workshop. These students were invited and asked for their willingness to participate in the VR industry visit workshop. In the 1-hour VR industry visit workshop, the participants were participated in the industry visit using VR glasses (VRG PRO+ from China). Each session was assigned to 5 participants for each 15 minutes VR experience with 5 helpers on the spot to assist. After the briefing, the participants were asked to wear VRG PRO+ virtual reality glasses to view the 360-degree Youtube VR video for 15 minutes by sitting on a chair. 15 minutes were selected to play 3 different petrochemical plant 360-degree Youtube VR videos. The time was limited to avoid vertigo or discomfort rise from the VR glasses experience. The participants were required to sit on a chair to complete their session. For hygiene practices, the VR glasses were cleaned using an alcohol pad before each usage. After participation in the workshop, the participants were asked to answer the questionnaire for the online Google form. It took approximately 20-30 mins to complete the workshop and questionnaire.

The questionnaire is using Google form as the tool and the participants can access it at any time if they can access the internet. The participants were requested to answer questions about the effectiveness of the industry visit

experience using virtual reality glasses and does this approach makes their industry visit experience better or worse. The first question in the questionnaire was seeking for the participants' consent to answer the questionnaire and the participants can select not to participate in the questionnaire. The questionnaire was asked to be completed once per participant after the VR industry visit workshop based on their willingness. 20 responses were collected. The questionnaire was used to collect feedback from participants on the effectiveness of the virtual experience and the instructional materials. The assessment should be used to improve the effectiveness of future virtual industrial visits.

2.1 Ethics Considerations

Ethical approval for this study was obtained from Ethics Office, Curtin University Malaysia and met the requirements described in the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007). The approval number is HRE2023-0065.

3. Result and Discussion

The results of the study indicated that the VR industry visit was effective in enhancing the learning outcomes of the participants. The study also found that the participants were most likely to try VR for industry visit before COVID-19 is reported 30% of the 20 respondents, during COVID-19 is reported 65% of the 20 respondents, and after COVID-19 is reported 50% of the 20 respondents as shown in Fig. 1. There is a slight reduction in the percentage post COVID-19, but the percentage to be most likely to participate in VR industry visit is reported to be higher than before COVID-19. During the pandemic, VR technology has become more important due to travel restrictions and social distancing measures, making it a safer and more convenient alternative to physical visits (Manca et al., 2013). So, it's highly likely that many people have tried or are willing to try virtual reality for industry visits during COVID-19. After the pandemic, while people may return to physical visits, virtual reality may still be a useful tool for many industries, especially for those that require travel, cost, or time constraints. Therefore, it's also likely that virtual reality technology will continue to be used for industry visits even after COVID-19.

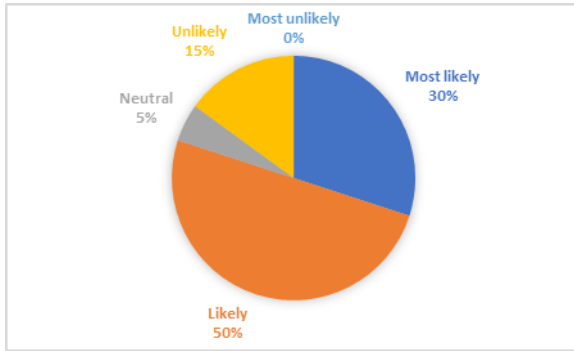
From Fig. 2, 50% of 20 respondents agreed that VR industry visit ease their understanding towards the contents delivered during the visit. 60% of 20 respondents think that VR has increased their interest in the industry visit. Only 25% of 20 respondents have rated "virtual environment able to provide the same experience of industry visit as reality" to be agreed. VR industry visits can enhance understanding of the contents delivered during the visit, as they provide a more immersive and interactive experience than traditional methods, such as videos or brochures (Klačková et al., 2021). With VR

technology, users can explore and interact with virtual environments, which can help them better comprehend complex processes or systems. VR technology allows users to experience things that might not be possible in real life, such as exploring hazardous environments or witnessing the workings of complex machinery. This can make the visit more memorable and enjoyable, which can lead to increased interest in the industry. However, while virtual reality can provide an immersive experience, it might not be able to replicate the exact same experience as a physical visit. There might be some aspects of the physical environment that cannot be replicated in the virtual world, such as smells or tactile sensations. Nevertheless, VR can still provide a valuable and realistic experience that can help users understand and appreciate the industry.

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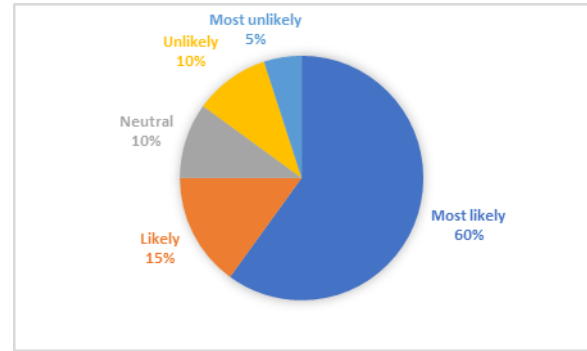
There are 4 major preferences to explore VR industry visit, gain first impression of the site (20%), time efficiency (18%), cheaper option and easy to plan (each score 17%) as shown in Fig. 3(a). and 3(b) shown the common elements that deter the respondents from selecting VR industry visit are impersonal/not tangibility (such as can't smell, ambience) (41%), followed by the lack of social interactions (33%), and technical difficulties (26%). Fig. 3(c) shows most of the respondents are looking for broadening knowledge (19%) and preliminary insights (19%) on place to visit through VR industry visit. 16% of the respondents think that VR industry visit can save money and a more relaxed approach to allow the participants to engage in the VR industry visit, which can provide additional flexibility, in terms of time.

How likely will you try virtual reality (VR) for industry visit before COVID-19?



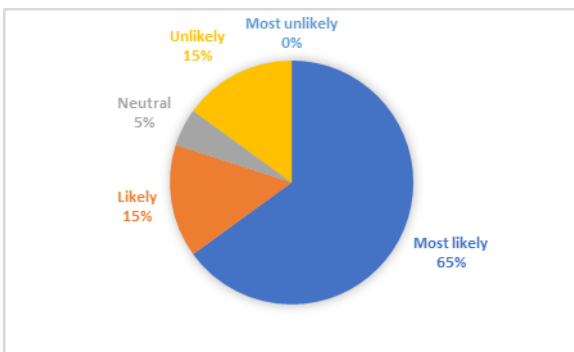
(a)

Is virtual reality (VR) industry visit easier your understanding towards the contents delivered during the visit?



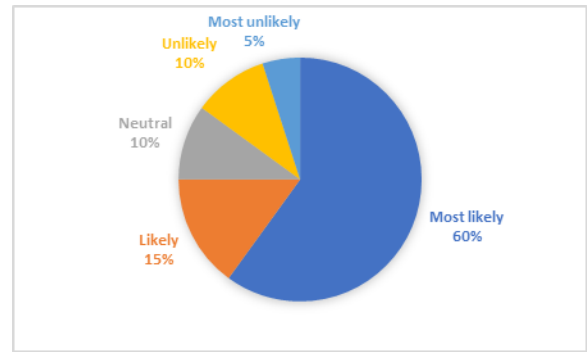
(a)

How likely will you try virtual reality (VR) for industry visit during COVID-19?



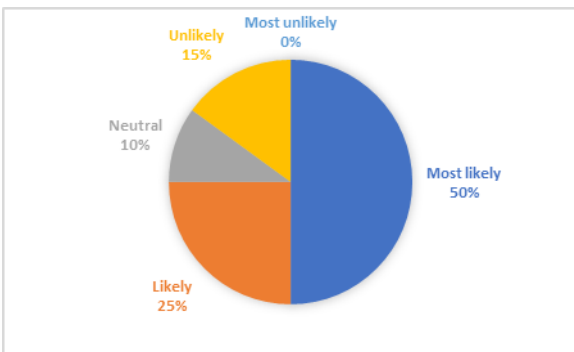
(b)

Will virtual reality (VR) increase your interest in the industry visit?



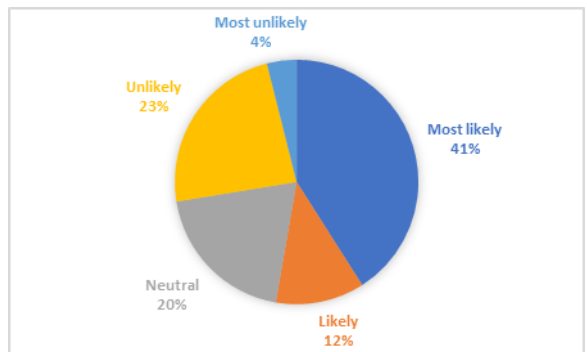
(b)

How likely will you try virtual reality (VR) for industry visit post COVID-19?



(c)

Is virtual environment able to provide the same experience of industry visit as reality?



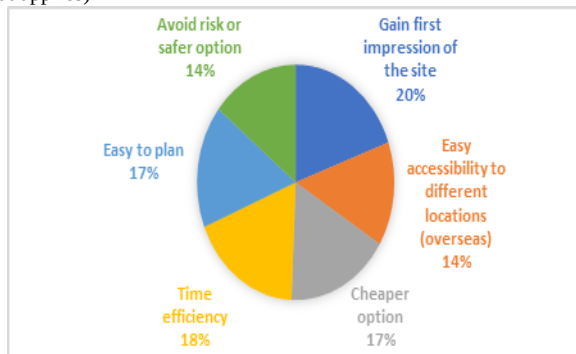
(c)

Fig. 1. Comparison on VR for industry visit: (a) before COVID-19, (b) during COVID-19, and (c) post COVID-19

Fig. 2. VR for industry visit: (a) easier to understand the contents, (b) interest, and (c) same experience with site visit

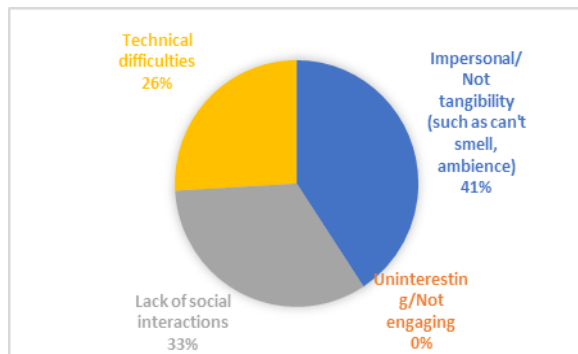
82.6% have agreed that they prefer both VR and face-to-face industry visit as shown in Fig. 4. VR industry visits and face-to-face industry visits both have their advantages and disadvantages. VR industry visits offer a more immersive and interactive experience compared to traditional face-to-face visits. With VR technology, participants can explore virtual environments, interact with virtual objects, and experience simulations that may not be possible in a physical location. VR industry visits can also be more accessible and cost-effective, as they eliminate the need for travel and accommodation expenses. Additionally, VR industry visits can be conducted at any time, regardless of the physical location of the participants. However, face-to-face industry visits also have their benefits. For example, face-to-face visits provide the opportunity to meet industry professionals in person, make personal connections, and build relationships. Additionally, face-to-face visits allow for more spontaneous interactions and conversations, which can lead to valuable insights and opportunities. Finally, face-to-face visits offer a more authentic experience, as participants can see the actual physical facilities and infrastructure of the industry (Zhao et al., 2020). The investigated group has observed an increase in cognitive level for the Reaction Engineering and Process Plant Engineering courses.

What do you like about virtual reality (VR) industry visit? (Select all that applies)



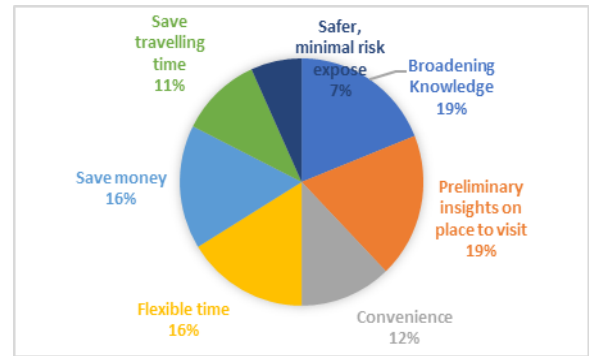
(a)

Which factor(s) deter you from selecting virtual reality (VR) industry visit? (Select all that applies)



(b)

What are you seeking for through virtual reality (VR) industry visit? (Select all that applies)



(c)

Fig. 1. VR for industry visit: (a) benefit(s), (b) deter factor(s), and (c) reason(s)

What are your preference in industry visit?

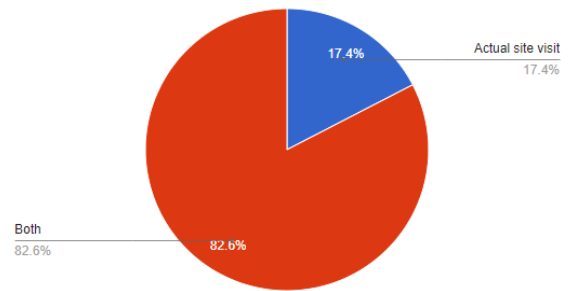


Fig. 4. Participants' preference in industry visit or site visit

4. Challenges and Limitations

While virtual industrial visits using VR glasses offer numerous benefits, there are also several challenges and limitations that must be considered (Damiani et al., 2018). One significant limitation is the technology itself. VR glasses are still a relatively new and emerging technology, and they may not be readily accessible to all students. One significant challenge is the limitations of the VR environment itself. While VR technology has come a long way in recent years, it still has some limitations in terms of visual quality and accuracy (Angelov et al., 2020). The virtual environment may not be able to accurately replicate certain aspects of the real-world industrial setting, such as temperature or pressure changes. This can impact the accuracy of the virtual experience and limit the degree to which students can engage with the virtual industrial visit. Furthermore, virtual industrial visits may not provide the same level of social interaction and networking opportunities as traditional field trips. Field trips provide students with the opportunity to meet and interact with professionals in the field, which can be valuable for networking and career development. Virtual industrial visits may not be able to replicate these opportunities. Another challenge is the potential for

motion sickness or disorientation. Some individuals may experience discomfort or even nausea when using VR glasses, which can limit the effectiveness of the virtual industrial visit. Additionally, the immersive nature of VR can also make it difficult for students to take notes or record observations, which can be important for later reflection and analysis. There is the potential for the virtual industrial visit to be seen as a replacement for traditional field trips, rather than a supplement. While virtual industrial visits offer several benefits, they cannot fully replace the hands-on experience and in-person interactions that come with a traditional field trip. It is important to strike a balance between the two approaches, and to use virtual industrial visits as a complement to traditional field trips rather than a replacement. Overall, while there are challenges and limitations to virtual industrial visits using VR glasses in chemical engineering education, the benefits of this approach are significant (Blümel & Haase, 2009). By leveraging the latest technology, educators can provide students with an engaging and interactive way to learn about the chemical manufacturing process, helping to prepare them for successful careers in this dynamic field (Fracaro et al., 2021).

5. Conclusion

In conclusion, virtual industrial visits using virtual reality glasses have the potential to revolutionize chemical engineering education. They offer a cost-effective, logistically simpler, and flexible way for students to experience real-world chemical engineering applications. The case study presented in this manuscript demonstrated that virtual industrial visits can provide students with an immersive, interactive experience that enhances their understanding of the chemical manufacturing process. However, there are still challenges to overcome, such as the need for high-quality VR equipment and the development of realistic and effective VR environments. Future research in this area should focus on addressing these challenges and further exploring the potential of virtual industrial visits in chemical engineering education. Overall, virtual industrial visits have a promising future in chemical engineering education and should be explored further. As VR technology continues to advance, virtual industrial visits will enable students to gain a deeper understanding of real-world applications of chemical engineering concepts and processes.

Acknowledgement

The authors would like to thank Curtin University Malaysia for their generous financial support under Curtin Malaysia Teaching Innovation Project (CMTIP), contract number: OLT/CMTIP/2022-004. The authors also thank Universiti Teknologi Brunei for realizing the current work.

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**UNIT PENYELIDIKAN
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