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POLITEKNIK MUKAH, SARAWAK

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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 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 Haji Mohamad Sabli

Chief Editor, **BEAM International Journal**

BORNEO ENGINEERING & ADVANCED MULTIDISCIPLINARY INTERNATIONAL JOURNAL (BEAM)

The Effectiveness of PLC Programming and Simulator Using Factory I/O

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Full Paper

Abstract

This paper presents the effectiveness of teaching and learning process of Programmable Logic Controllers (PLC) Programming and Simulator subject. The Mechanical Engineering Diploma course at Polytechnic has begun to introduce this subject using a software known as Factory I/O to students. In a recent year, PLC programming has been extensively used in various industries especially in the automation and manufacturing industry. Therefore, this subject is crucial for students to learn before they graduate and enter the working world. However, during the Movement Control Order, the students were having difficulties in implementing the practical task for the assessment of this subject. Due to that matter, this study was conducted in order to assist students in performing their practical work. In this research, case studies have been used a method of research and questionnaires were distributed in collecting the data. There are three main activities involved: switch Windows applications, PLC programming and testing. The results obtained from this work has proved that PLC programming and simulation using Factory I/O are able to help students in gaining better understanding of the subject and doing their practical assessments. With the study conducted, it is hoped that it can be a starting point for all Malaysian polytechnics to use Factory I/O for PLC programming module and further bringing a better quality of this course.

Keywords: - Factory I/O, PLC programming, simulator

1. Introduction

The PLC Programming & Simulator teaching aid module using Factory I/O has been introduced to students enrolled in the Programmable Logic Controller course of the Mechanical Engineering Diploma course beginning in the December 2020 session. It is a method of online practical implementation during the Movement Control Order where the students were not allowed to attend the study center. It also aims to provide exposure and as an added value of knowledge in the field of PLC programming. Indirectly, it increases the marketability of students when they graduate from the Polytechnic. This module has been used by all lecturers involved with the

PLC programming course. Fig. 1 shows PLC Programming & Simulator equipment using Factory I/O.

The module is divided into 2 parts that need to be completed by each student who is divided into specific student groups. Each group of students needs to understand the use of PLC and know the basic concepts of PLC and then produce a programming using Cx-Programmer software (Version 9.7) model OMRON PLC CP1E in order to test the level of understanding of the students.

Fig. 1. PLC programming & simulator using Factory I/O

Fig. 2 shows the interface display on a smartphone when this application is running.

Fig. 2. Display of the interface on a smartphone

This PLC Programming & Simulator teaching aid module is an ongoing effort made to ensure that the practical evaluation for the Programmer Logic Controller course for students can be implemented according to the plan that has been set and can have a positive impact on learning. Fig. 3 demonstrates the conveyor control simulation after the program is set and moved through the control.
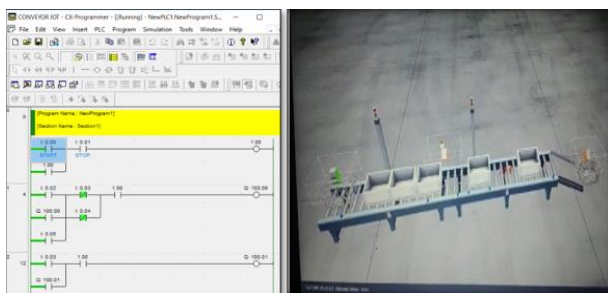
Fig. 3. Program and simulation of conveyor control

The problem faced by the students when following the practical course for the Programmable Logic Controller is the difficulty in understanding work procedures and performing practical tasks during the implementation

period of the Movement Control Order (MCO). This is because during that period, the learning process is required to be conducted online as students are not allowed to attend the study center. Where it requires students to be able to build programs using the Cx-Programmer software (Version 9.7) model OMRON PLC CP1E in practical exercises related to the course.

Due to the mentioned problem, this study is conducted in order to:

i.   Identify the effectiveness of the teaching and learning process of practical assessment from the aspect of using *PLC programming* in Factory I/O.

ii. Identify the effectiveness of the teaching and learning process of practical evaluation from the aspect of using *PLC simulator* graphically simulated.

iii. Identify the effectiveness of the teaching and learning process of practical assessment from the aspect of learning effects

2. Methodology

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 transitioning 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 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.

PLC simulation is also an important aspect in learning. The Factory I/O software has been backed by major international players, thus makes it a viable option to consider. The development of computerized simulation technology has changed the learning method to obtain various information as well as their interpretations (Spayde et al., 2019). By using simulation, students gain access to information from various sources quickly and easily (Tun et al., 2021; Ziden & Rahman, 2014). Under normal circumstances, the preparation of suitable building materials must also be considered, taking into account the cognitive level of students for all levels; high, medium and low students alike (Ziden & Rahman, 2012). The use of computers as a medium of interaction between students and instructors in the teaching and learning process for practical sessions makes it easier and more interesting. Visual aids such as simulations are the best tools for teaching and learning (Chernikova et al., 2020; Rasul, Bukhsh & Batool, 2011). Simulations produced with images that resemble the real situations allow students to obtain real results even if they do not involve the real equipment or machines. This allows students to evaluate the results that will be collected as a result of the experiment carried out. Virtual simulations can provide a better learning experience for students about how theories or concepts are applied in real situations (McGarr, 2020; Alessi, MS & Trollip, 2001).

The architecture of the proposed system is shown in Fig. 4 where there are three main activities involved: switch Windows applications, PLC programming and testing.
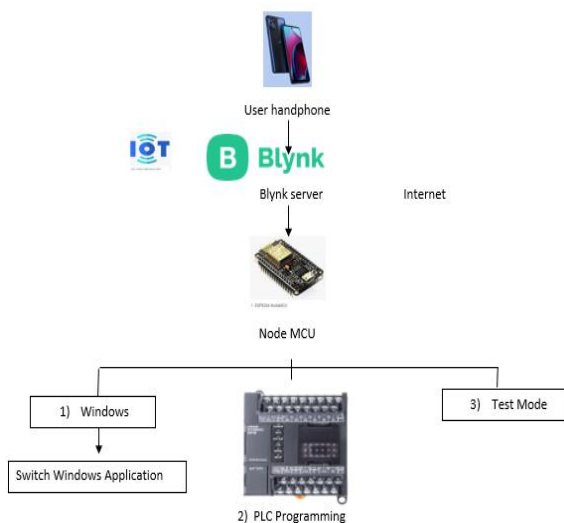
Fig. 4. System Architecture
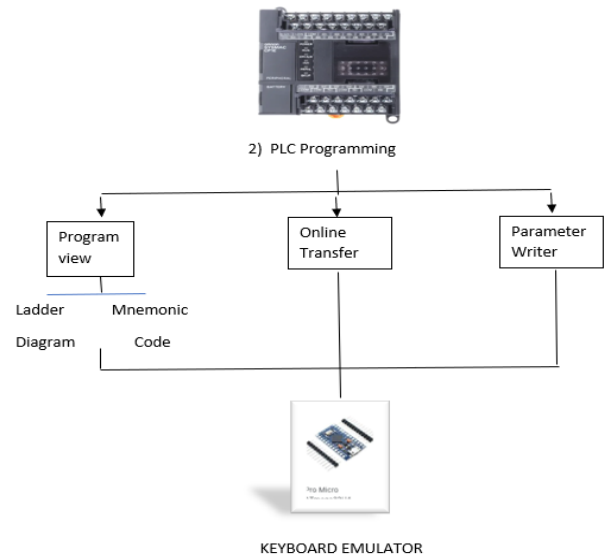
Fig. 4. (*continued*)
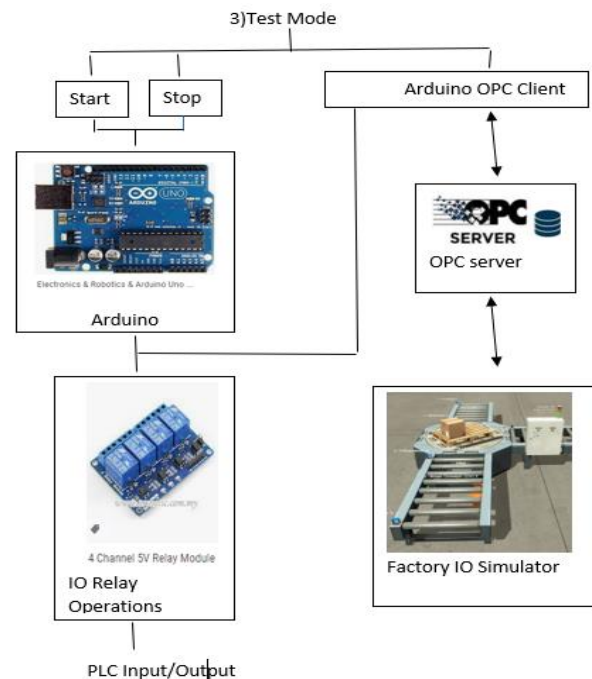
Fig. 4. (*continued*)

This is a quantitative study in the form of a case study to identify the effectiveness of teaching aids "PLC programming & simulator using Factory I/O" in the Department of Mechanical Engineering, POLIMAS. The sample of this study consists of 30 out of 51 students from the Department of Mechanical Engineering, POLIMAS (Feb/2022 session). The instrument for this study is using a questionnaire through google form. According to Konting (1990), questionnaires are more practical and effective because their use can increase the accuracy and truthfulness of responses given by the sample. Tuckman (1993) pointed that questionnaire method is easier to get

cooperation from respondents. For this study, questionnaires containing 2 parts of questions are distributed immediately after the end of the Teaching and Learning session for practical classes conducted online using teaching aids PLC programming & simulator using Factory I/O. The first part of the questionnaire requires students to fill in information related to the course and the second part contains 3 evaluation elements. These assessment elements are part A, to assess the students' perception of the use of software applications on smart phones; part B, to assess the students' perception of the use of simulation at the IO factory and part C, to assess the impact of learning on students. A 1-5 Likert scale is used to measure the students' responses to each question presented. The questions in parts A and B are measured according to the following scale: 1 = Strongly disagree (STS); 2 = Disagree (TS); 3 = Uncertain (TP); 4 = Agree (S); and 5 = Strongly agree (SS).

The data obtained is processed using SPSS software (Statistical Package for Social Science version 22.0). This study uses descriptive statistics by using the mean score value for the purpose of data interpretation. The researcher has determined that the criteria for analysis and interpretation of the mean score are divided into three levels as suggested by the Universiti Teknologi Malaysia Student Self-Development Committee (Azmi et. al, 2018). The interpretation of the mean score value used are low, medium and high (Landell, 1997).

Table 1. Interpretation of the score for the study (Landell, 1997)

Mean Score	Interpretation	Level of Inclination
1.0 to 2.39	Do not agree	Low
2.40 to 3.79	Disagree	Simple
3.80 to 5.00	Agree	Tall

3. Result and Discussion

This study is to identify the effectiveness of the teaching aid module "PLC Programming & Simulator using Factory I/O" for the Programming Logic Controller course. Based on the result shown in Table 2, the item that get the highest mean score of 4.55 is for *the interface format is attractive* and *the command icon layout is attractive/appropriate*. The second highest item with a mean score of 4.50 is for the item *takes a short time to learn*. The lowest item, *the circuit diagram is easy to read and understand*, has a mean score of 4.35. Overall, the average mean score obtained is 4.48 and it is well within high category. This proves that PLC programming using Factory I/O on the phone is within the high category and favorable by the students.

Table 2. Mean score analysis for PLC programming by Factory I/O using the phone

Item No.	Item	Min Score	Level
1	The interface format is attractive	4.55	Height
2	*font* size used is easy to read and clear	4.45	Height
3	The command icon layout is attractive/suitable	4.55	Height
4	The circuit diagram is easy to read and understand	4.35	Height
5	The software application is easy to operate	4.48	Height
6	Takes a short time to learn	4.50	Height
	Overall	4.48	Height

Based on Table 3, the item with the highest mean score of 4.70 is for the *simulated components resemble real components*. The second highest item with a mean score of 4.55 is shared by item No 7 and 12 respectively. The lowest item, *the components meet the requirements of all the practical performed*, get a mean score of 4.15. Overall, the average mean score obtained is 4.46 and is also within the high inclination category. This means that the responses obtained show that the PLC simulator graphically is in a very good level category. This proves that the students are very satisfied with the PLC simulator used during the practical assessment.

Table 3. Analysis of the mean score for the PLC simulator graphically

Item No.	Item	Min Score	Level
7	The simulation component is clear and interesting to students	4.55	Height
8	Simulated components resemble real components	4.70	Height
9	The simulation is easy to understand and operate	4.50	Height
10	Takes a short time to understand/operate	4.50	Height
11	Help students understand practical procedures more easily	4.33	Height
12	Help students to carry out practical	4.55	Height
13	The simulation works well and is satisfactory	4.36	Height
14	The components meet the requirements of all practicals performed.	4.15	Height
	Overall	4.46	Height

Based on Table 4, the item with the highest mean score of 4.90 is for *this practical teaching aid module capable of increasing student achievement in learning*. The second highest item with a mean score of 4.83 is for the *practical teaching aids module helps students to understand the practical implementation*. Finally, the item *this practical module item encourages students to cooperate with each other*, scores the lowest mean score of 4.70. Overall, the average mean score obtained is 4.79,

also within the high-level category. This means that the responses obtained show that overall, the students are very satisfied with the effect of learning on the students after the class is conducted.

Table 4. Mean score analysis for learning effects

Item No.	Item	Min Score	Level
15	This teaching aid module is very useful	4.73	Height
16	The practical module of this teaching aid encourages students to cooperate with each other	4.70	Height
17	This practical teaching aid module helps students to understand the practical implementation	4.83	Height
18	This practical teaching aid module is able to improve student achievement in learning	4.90	Height
	Overall	4.79	Height

4. Conclusion

The findings of the study show that in general, all respondents feel that the effectiveness of using the teaching aid module PLC Programming & Simulator using Factory I/O is outstanding in an effort to help them learn. This can be proven from the data obtained that clearly shows the students are favorable with the PLC Programming item using Factory I/O simulation software on the phone that has recorded a high average mean score reading of 4.48, which is in a high-level category. The same is for the case with the PLC simulator item in a graphical simulation that has recorded a high mean score average reading of 4.46 and for the learning effects that has recorded a high mean score reading as well with a score of 4.79. Based on the findings obtained, it is hoped that this study can be used as a starting point for the production of a practical PLC module that can be used in all Malaysian polytechnics and bring the quality of this course to a greater height.

Acknowledgement

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Awareness of The Internet and Social Media Platform for Business Among Micro Entrepreneur of Amanah Ikhtiar Malaysia Mukah Branch, Sarawak

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Abstract

The study was designed to investigate the level of awareness of the internet & social media platform for business among micro entrepreneur of Amanah Ikhtiar Malaysia Mukah branch. The study that has been conducted involves micro-entrepreneurs of Amanah Ikhtiar Malaysia Mukah branch who run small businesses around Mukah, Igan, Dalat, Oya and Balingian in year 2021 during Covid 19-pandemic. A total of 339 respondents from 2691 micro-entrepreneur population were identified through a distributed questionnaire. All these micro-entrepreneurs are participants or Sahabat Ikhtiar Amanah Ikhtiar Malaysia (AIM) Mukah branch. The participants is referring to borrowers who obtain microcredit or financing from Amanah Ikhtiar Malaysia. The data obtained were analyzed in terms of percentage, frequency, descriptive analysis and correlation between variables. The results of the study found that the awareness of entrepreneurs on the use of online applications is at a moderate level. The study also found that information and communication technology facilities as well as individual attitudes have a high significant relationship on the awareness of entrepreneurs on the use of internet and social media. The findings of this study can help micro-entrepreneurs who mostly have a moderate income level can be improved by mastering the needs of information technology in business. The effectiveness of this study also indirectly helps stakeholders as support in increasing the income of micro entrepreneurs better in terms of exploring business-marketing techniques in a more creative and innovative way especially during this Covid-19 pandemic which has affected income especially to micro entrepreneurs.

Keywords: - Micro-entrepreneur, online business, Amanah Ikhtiar Malaysia

1. Introduction

Online businesses are gaining popularity in Malaysia these days, owing to the country's development and economic progress. Entrepreneurs can save business time, promote, or advertise products and reduce operating costs as well as expand strategic alliances faster and more efficiently through online business. In 2019, 29 million people were accessing the internet in Malaysia compared to figure for the past five years which was 21 million This figure is expected to rise to 33.5 million by 2025 (Prime Minister's Department, 2022). Compared with sellers, buyers are the most internet users in Malaysia. A total of RM5 billion in the size of the online business market in Malaysia in 2014 compared to 2010 which was RM 1.8 billion. The rising number of internet users and online shoppers is representing the tremendous market potential of online businesses. However, the Laporan Tinjauan Ekonomi (2019) states that online presence for most small and medium entrepreneur is still lacking despite having an internet connection. This situation causes small and

medium entrepreneurs to have limited access to customers as well as less effective marketing and services. This includes the micro entrepreneurs or also known as participants in Amanah Ikhtiar Malaysia. This is due to the difficulty of accessing the internet in rural areas especially in Sarawak. According to the Chief Minister of Sarawak through an article in Sarawak Voice dated 22 November 2020, the Sarawak state government is committed to tackling Sarawak's rural problems including the internet because it is undeniable that there is still a large part of rural Sarawak that still do not have internet network.

Amanah Ikhtiar Malaysia is a micro credit institution where all participants or borrowers from AIM are 100% women. The repayment record of Amanah Ikhtiar Malaysia participants recorded almost 100% in 2019 and years before (Amanah Ikhtiar Malaysia, 2019). However, in time of pandemic Covid-19, Managing Director of Amanah Ikhtiar Malaysia, Mohamed Shamir (2020), Amanah Ikhtiar Malaysia (AIM) has approved a deferral of repayment to 373,815 AIM participants and has allowed the withdrawal of compulsory savings in AIM. amounting to RM 112.5 million as of 7 June 2020 and the amount is expected to continue to increase in time of pandemic Covid-19. Meanwhile in AIM Mukah Sarawak, Dato Sri Fatimah in Unit Komunikasi Awam Sarawak (UKAS) has recently received a letter from AIM's Participant from his constituency (Dalat) which has 1,043 members to apply for the postponement due to no income that makes them difficult to repay. This is a sign that AIM participants are depressed with the Movement Control Order (MCO) implemented by the government causing them to not be able to conduct business as usual which is conventional business or conducting business transaction face to face with customers. They lose income and are forced to withdraw compulsory savings (*simpanan wajib*) where normally compulsory savings are only withdrawn when they withdraw from being an AIM participant. This study is conducted to identify the level of awareness of micro-entrepreneur on the use of internet and social media platform as well as to study the extent of information and communication technology facilities influence the micro-entrepreneur.

2. Literature Review

The use of the Internet has had a significant impact on people's lives in recent years. According to Leung (2010), technology serves as a portal via which people can engage in order to get information, and the findings indicate that information literacy and the Internet network have a substantial association with the overall quality of life in a given community. The goal of expanding women's participation in entrepreneurship has been to bring about social change, and efforts have been made to encourage female entrepreneurs to use online apps to administer their enterprises. Female labor force participation is estimated to be 50% of the population in most nations, according to with 50% of the female population serving as

a potential labor force (Smith-Hunter and Leone, 2010). In Malaysia, 15.7 million Malaysians are women out of 32.5 million in 2019. Most women in Malaysia have become heads of households and also earn a living (Prime Minister's Department, 2022). Hence, women will continue to be a significant resource in terms of developing future generations while also making a significant contribution to the economic development of the country.

In Malaysia, rural populations, particularly women, are sometimes linked with hardship or an ascetic standard of living. This is owing to the fact that they have a low level of education, a lack of skills in the workplace, and because of genetic factors (Prime Minister's Department, 2022). Taking note of this, the government has implemented a number of measures aimed at alleviating the living conditions of rural populations. The use of information and communication technology (ICT) in rural communities is considered to be the most effective platform (Prime Minister's Department, 2022). This is due to the fact that information and communications technology (ICT) can have a significant economic influence on rural people if they take full advantage of the appropriate use of technology to expand their businesses.

3. Methodology

The study that has been conducted involves micro-entrepreneurs of Amanah Ikhtiar Malaysia Mukah branch who run small businesses around Mukah, Igan, Dalat, Oya and Balingian. The study conducted in year 2021, within Covid-19 pandemic. A total of 339 respondents from 2691 micro-entrepreneur population were identified through a distributed questionnaire. According to Krejcie and Morgan (1970), 335 respondents will be needed for the population size 2600. The respondent for this study is 339, which means it is sufficient for this study. The response rate for this study also achieved more than 80% whereby Fincham (2008) said that response rate of a survey must at least achieved 80% as the standard evaluation for a study. All these micro-entrepreneurs are participants or Sahabat Ikhtiar Amanah Ikhtiar Malaysia (AIM) Mukah branch. The participant is referring to borrowers who obtain microcredit or financing from Amanah Ikhtiar Malaysia. The data obtained were analyzed in terms of percentage, frequency, descriptive analysis, and correlation between variables. The Spearman Rho correlation analysis results used to determine the relationship between independent variables of awareness, ICT facilities and attitudes.

4. Result and Discussion

The result of the study showed a positive reaction and in line with the objectives that have been stated and the findings of previous researchers related to the level of awareness of micro-entrepreneurs on the use of online business applications for micro entrepreneur under

Amanah Ikhtiar Malaysia, Mukah. The findings of the study show that the level of awareness of the use of online business applications among entrepreneurs is moderate. It is also found that the item which is "I often log in on social media such as Facebook, Instagram, Website and Blog for at least once a day" is the highest mean on the construct individual attitude towards business online application which is 4.5251. However, the analysis on the Information and Communication Technology Facilities construct is moderate. This finding showed that with limited ICT facilities, the respondents still able to log in in any social media platform but as for entertainment purposes. It is because as in the same construct, the item which state "I have given detailed information about the products" and "I often give or answer questions from customers about products sell online is the lowest in the same construct with moderate level. Omar and Sallehuddin (2011) supported the finding, where they tend to use the internet for entertainment and communication purposes with family and friends.

Table 1. Results of correlation analysis

	Item	Significant	Correlation Coefficient
Awareness	ICT Facilities	0.000	0.816
	Attitudes	0.000	0.812
ICT Facilities	Attitudes	0.000	0.784

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

As shown in Table 1, the p-value for this coefficient is 0.000 (P < 0.05), indicating that the association between micro entrepreneur awareness and use of the internet and social media platforms is statistically significant at the 1% level. Between awareness and the use of the internet and social media platforms, the Spearman correlation coefficient is 0.816. This demonstrates that these two variables have a positive linear connection. Additionally, the spearman correlation coefficient exceeds 0.7. Thus, according to Hinkle et al. (2003), the relationship between respondents' awareness and the use of internet and social media platform is significance. From this result, it was found that the level of awareness of the use of online business applications has a high positive correlation with information and communication technology facilities and individual attitudes. The findings of the study show that the convenience of information and communication technology also influences the level of awareness of the use of online business applications. The summary of Hypothesis Testing are shown in Table 2 whereby coefficient has a p-value of 0.000 (P 0.05) and is significant at the 1% level. This demonstrates that the variables have a positive linear connection. As a result, H1,H2 and H3 are supported.

Table 2. Summary of hypothesis testing

Items	Hypothesis Statements	Results
H1	There is a significant relationship between level of awareness of AIM participants to the use of internet and social media platform.	Supported
H2	There is a positive relationship between the extent of information and communication technology facilities with influence of AIM entrepreneurs.	Supported
H3	There is a positive relationship between the extent of individual attitudes and the use of internet and social media platform.	Supported

A comparison was also made between the areas as shown in Table 3, where there are still operating areas of Amanah Ikhtiar Malaysia Mukah Branch still do not have a good internet line, namely the respondents who are in the Oya and Dalat areas. In this regard, ICT facilities are very important and can influence the attitude of micro entrepreneurs with the use of online business applications as the main tool to expand business.

Table 3. Comparison between area and level of individual awareness and ICT facilities toward business online application

	Mukah	Oya	Dalat	Igan	Balingian
Awareness	4.7190	3.0190	4.1964	4.9580	3.5663
ICT Facilities	4.1756	2.3293	3.0233	4.2162	3.2312

ICT Facilities are very important for micro - entrepreneurs who are in rural areas to encourage them to venture into online business. In a news published by TVS on September 7, 2021, the Sarawak government will ensure that 90 percent of areas in Sarawak enjoy high-speed internet facilities by 2022. The decision to upgrade the internet system will provide many benefits, especially for small businesses as an opportunity to grow their business especially those who settled around Mukah and Dalat (Ismail, 2021).

Not only that, facilities in terms of laptops, modems and telephone lines should also be emphasized to help entrepreneurs in rural areas. The results of the study also found that individual attitudes influence the level of awareness of the use of online business applications. Entrepreneurs who have a positive attitude towards online business will remain with such an attitude even if there are constraints or changes in the field of business ventured. This finding was supported by Omar and Rahim (2015) which revealed that motivation, interest, an entrepreneurial network, and innovation are among the elements that contribute to the success of entrepreneurs. Entrepreneurs need to have a positive attitude in venturing into online business and confidence to succeed. From the analysis of the study, it was also found that individual attitudes have a high positive correlation

relationship influencing the level of awareness of the use of online business applications.

4. Conclusion

The study was designed to investigate the level of awareness of the internet and social media platform for business among micro entrepreneurs of Amanah Ikhtiar Malaysia Mukah branch. The study been successful in determining the level of awareness of micro-entrepreneurs regarding the internet and social media, but it has also been successful in identifying the operating zone of AIM Mukah branch that requires attention in order to assist micro-entrepreneurs located in the rural area where internet lines are scarce and awareness is low. The relevance of the internet and online business application is also aligned with micro-entrepreneurs in rural regions, which can help improve household income, which is the primary goal of Amanah Ikhtiar Malaysia, which was established to reduce national poverty.

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Gender Influence on Information Literacy Skills in Completing Group Discussion Assessment Among Semester One Students at Selected Polytechnics in Malaysia

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Abstract

This study aims to determine the level of information literacy possessed by semester one students to complete a group discussion assessment and identify gender-based differences in the information literacy skills possessed by semester one students who complete a group discussion assessment at two selected polytechnics in Malaysia (N = 51). However, the study on information literacy skills among Malaysian polytechnic semester one student to complete Group Discussion has not been widely researching in Malaysia hence the gap this study hopes to fill. In this study, students completed 38 items on a survey from Marshall's Information Competency Assessment Instrument (ICAI). The inferential analysis (mean and standard deviation) was utilised to answer the research questions, while the independent t-test was employed to examine the research hypothesis. In completing the group discussion evaluation, students possessed various information skills, according to the study's findings. In addition, there were significant differences between the information literacy skills of men and women. As a nation's knowledge-based economy is a powerful asset, the findings suggest that educators in the twenty-first century should emphasise improving students' information literacy abilities.

Keywords: - Information literacy skills, Information Competency Assessment Instrument (ICAI), polytechnic, group discussion assessment, t-test

1. Introduction

The Knowledge-Based Economy Master Plan indicates that the most critical asset for the K-based economy is human capital. In a K-based economy, educated and skilled human resources, or human capital, are the most valuable asset, and knowledge is the most critical factor of production. The knowledge-based economy may be defined as an economy in which knowledge, creativity, and innovation play an ever-increasing and vital role in generating and sustaining growth (Husin, Ibrahim & Baharom, 2013). With the growth and enhancement of knowledge-based information, the economy, and society, the value of education and knowledge rises. Education is increasingly becoming a prerequisite for a person's competitiveness on the labour market. (Nehari-Talet et al., 2021).

In Malaysia, the polytechnic was introduced in 1969 and has been a part of the higher education system. One of the essential aims of Malaysian polytechnic is to meet the growing demand for skilled human capital in Malaysia. Polytechnic education provides skilled semi-professionals in engineering, commerce, arts and designs, and hospitality to meet the need of the public and private sectors. Malaysian polytechnic has been operating for 50 years, and it was introduced in Malaysia with funding from the World Bank and in collaboration with the Colombo Plan. Currently, there are 37 polytechnics across

the country divided into three groups - premier, conversational, and metro. With the help and promotion of the importance of Technical and Vocational Education Training (TVET) institutions by the Ministry of Higher Education, more and more parents are sending their children to further their tertiary education (diploma, advanced diploma, and degree) in polytechnics. It is estimated that by 2020, an additional 1.3 million TVET workers will be joining the job market under the nation's Economic Transformation Programme by the Education Ministry's Malaysia Education Blueprint (MEB) 2015-2025 (MoHE, 2015). It endeavours to align with the constant and rapid change of technology, the increase in global human resources and climate transformation. This aligns with the Education Ministry's objectives to make the TVET institute relevant. The courses offered to the students are a "work-based learning" concept. This will provide students with good working experience as at least 85% of polytechnic graduates are expected to be employed within six months after completing their studies in polytechnics. Interestingly, like other university graduates, polytechnic graduates must apply English language skills effectively and successfully in their future workplaces.

For non-native English users, English is vital because it is widely spoken worldwide. Knowing English allows graduates to enjoy their lives and work no matter where they are. For students whose mother tongue is not English, mastering English is even more critical for their academic life and future careers. Students should improve their English language skills to master their knowledge of the English language better. Thus, the English language plays an essential role in producing quality employees. Beneficial and valuable training battlegrounds should anchor the teaching and training at TVET institutes before releasing the graduates to the real working world. Most importantly, the language curriculum must be enhanced in line with employability.

Awareness of literacy information skills has increased over the past years, but how it is presented and measured is markedly different. The American Library Association defined information literacy as recognising when information is needed and locating, evaluating, and using the necessary information effectively. The Association of College & Research Libraries (ACRL) defines information literacy as the skills required to find, retrieve, analyse, and use information. The ACRL has created a set of standards that detail the talent needed to be information literate. (Husin et al., 2013). According to Ode (2021), the abilities of male and female undergraduates to investigate or traverse the world of information proficiently are extraordinarily extraordinary. In contrast, it is unclear what criteria determine their skill in navigating the accessible information universe. Therefore, it is imperative to identify the critical factors that influence the information literacy skills of undergraduate students.

1.1 Problem Statement

Graduates of TVET are assured of applying good communication skills to deliver messages and information (Corneal, 2015) effectively. Practical communication skills undeniably ensure a better working environment for the engineering team and community. In Malaysia's polytechnics, the English courses are in three separate semesters: Communicative English 1, 2 and 3. Polytechnic students must learn and apply many language functions and purposes, especially in the workplace.

There are also some learning opportunities as polytechnic learners partake in their English lessons. Despite all the importance, advantages and opportunities, many polytechnic students cannot improve their English language proficiency in oral communication skills. (Hasni, Johor & Ismail, 2019) Researchers, teachers, and policymakers outside of Malaysia profoundly focus on information literacy skills. Lack of literacy skills is an obstacle to efficiently utilising information resources, mainly digital resources, in developing countries. Most students know the e-library resources but do not use them because they lack the skills. (Science, 2018) Theory and practice in second language learning have moved from treating the enterprise as one of mimicry and memorisation to a complex; multidimensional process influenced more by the interaction of the individual and the contexts of acquisition than by notions of standardised, overt forms of cognition. It has moved away from viewing language as a static set of automated processes toward one that accounts for the multiple, complex aspects of language as a central feature of human identity. Language teaching practice has consequently moved away from emphasising the learning of discrete linguistic items to activity that orchestrates full experiences of and involvement in language as it manifests itself in reality; that is, as a means of making and understanding meaning (Meskill & Mossop, 2000).

Semester one students must take the Communicative English 1 course, which focuses on developing their speaking skills to communicate effectively and confidently in group discussions and social interactions. One of the learning outcomes of this course is that students will be able to apply appropriate language and communication skills in discussions and conversations at the end of this course. To test students' understanding of this, they must sit for the Group Discussion (20%) assessment in week 6. Students are evaluated in terms of language, interactive skills and content. In this paper, the researcher focuses on students' abilities if they can show an excellent understanding of the topic, give three relevant, well-supported points, organise ideas very well throughout the discussion, and respond to tasks appropriately throughout the group discussion.

Nevertheless, the influence of the use of internet resources for learning among undergraduates gender is seen as a possible factor influencing the use of electronic information resources, library resources and ICT (Steinerova and Susol, 2007). Also, undergraduates who

lack Information Literacy Skills experience delay and frustration when completing coursework that requires research (Oakleaf & Owen, 2010). However, the study on information literacy skills among Malaysian polytechnic semester one student to complete Group Discussion has not been widely researching in Malaysia hence the gap this study hopes to fill.

2. Research Question

In this regard, this research intends to discover the information literacy skills possessed by semester one students to complete group discussion assessments to provide more details for TVET education, particularly some directly involved in curriculum design and planning. This study focuses on the following question:
1. What are information literacy skills possessed by semester one students to complete group discussion assessment?
2. Is there any difference in semester one students' information literacy skills in completing group discussion assessments based on gender?

2.1 Research Hypothesis

HO$_1$: There is no significant difference between male and female polytechnic students' information literacy skills in completing group discussion assessments.

3. Literature Review

The term information literacy has been mainly used in the context of library practice. During the last decade, it has attracted increased attention within learning and in library and information science and has been used to describe practices in schools and undergraduate education. Given librarians' long-term engagement with information literacy issues, it is worth noting that the term 'information literacy was not coined initially in the world of librarianship. The first instance of the use of the term is by Paul Zurkowski in a 1974 report on future needs for various competencies in work life in business and industry in the US (Bawden 2001, 230; Bruce, 1997, 5; Kapitzke 2003b, 55). Information literacy has also been described as a way of learning (Bruce 2008).

In Malaysia, the polytechnic library is vital in creating and developing self-reliant students with information-searching skills. A primary survey by the National Library of Malaysia indicates that the polytechnic library actively organised and conducted an information literacy programme. The polytechnic library continues to market its information literacy classes to staff and students to achieve information literate students. Students are exposed to and always have access to a robust information literacy programme conducted by the polytechnic library.

The purpose of the information literacy programme is to assist patrons in using all its resources, services and facilities to the fullest. The information literacy programme consists of this module: introduction to printed and non-printed materials, accessing the Library's Online Public Access Catalogue (OPAC) and library's electronic resources, evaluating information from printed and non-printed materials, information packaging and legal and ethical information used. The implementation of the information literacy programme, conducted by the polytechnic library, includes workshops and hands-on sessions. It is conducted annually, with a frequency of two (2) to ten (10) classes per year. The targeted audience is students, lecturers, and staff. (Husin et al., 2013). They require information literacy to process information. Information literacy is interpreted as the ability of an individual to recognise, locate, evaluate, and use efficiently the information he needs (Shinew & Walter, 2003). The information literate person recognises the need for information, determines the importance, accesses information efficiently, knows how to evaluate the valid information and its source, knows how to "nestle" founded information in his knowledge base, and understands the economic and legal, social and cultural questions of using this information. Towards these items, we can see that information literacy is the future, the key to success, and a foundation for getting an education (Mandušić & Blašković, 2013).

In another study by Abdullah et al. (2006) stated that information literacy levels among students in public and private universities in Malaysia showed that 50.1% of the students are at the intermediate level, 38.4% are beginners, and 11.5% can be classified as at the advanced competency level. The development of information skills and competencies in students is still lacking, especially at higher education levels.

According to Ali at al. (2010), information literacy competency showed that UPM engineering students need to improve to identify the most efficient search strategy, evaluate internet information and websites, and use information ethically. Without information literacy, it may result in a lack of awareness among students of the importance of developing good information skills. The level of information literacy in Malaysian society is not satisfactory. Yazid (2012), in his study, indicated that information literacy skills among National Library users were low, especially in terms of essential elements of information searching, evaluation, and awareness of legal and ethical use of information. These studies indicate that information literacy skills are essential to developing good information skills. This information literacy skill is the core of locating, evaluating, and using information effectively and ethically. In a study by Ode (2021), the results revealed that gender has no bearing on the information literacy skills of undergraduates in the Library and Information Science Department at the University of Maiduguri, Nigeria. On the other hand, very few studies identify polytechnic students' information literacy skills in completing English tasks in the classroom. Only a few studies, however, have investigated the impact of ICT and mobile learning in improving academic performance. The polytechnic ESL

learners believed learning through mobile could facilitate their ESL learning. They commented that mobile devices ease them in looking for a translation of words and learning new vocabulary. (Hashim, Yunus & Embi, 2018) Undoubtedly, lecturers need a gestation period to be comfortable with 21st-century teaching skills and tools. Information and digital literacy are also vital in line with the objectives of the establishment of polytechnics in Malaysia (Ahmad & Mohamed, 2017).

Another concern related to the constraint of learning through mobile was that it could be difficult for them to find relevant websites for English language learning and choose suitable learning materials. One of the comments was, "I need to learn to search for information.". Others have also commented that there is too much information on the internet. Thus, they should know how to choose the suitable materials and what suits them to learn ESL. (Hashim et al., 2018) This suggests that further investigation must be carried out to determine the information literacy skills of polytechnic students in completing classroom assessments. For this study, the researcher chooses semester one students for their group discussion assessment.

3.1 Conceptual Framework

Based on Fig. 1, the input hypothesis suggests that language acquisition occurs when learners receive messages they can understand, a concept also known as comprehensible input, which refers to classroom learning. However, Krashen (1992) suggests that this comprehensible input should be one step beyond the learner's current language ability, represented as I + 1. Besides that, from a Vygotskian perspective, the teacher's role is to mediate a child's learning activity as they share knowledge through social interaction. Social interaction with a skilful tutor allows the learner to observe and practice their skills. The child seeks to understand the actions or instructions provided by the tutor and then internalises the information, using it to guide or regulate their performance. Scaffolding is provided by the educator or a more competent peer (more knowledgeable other) to support the student as he or she is led through ZPD. Eventually, CALP focuses more on the learners' ability to demonstrate proficiency in the group discussion assessment. CALP refers to the learners' abilities to read, write, and discuss the information available effectively to excel in the group discussion assessment.
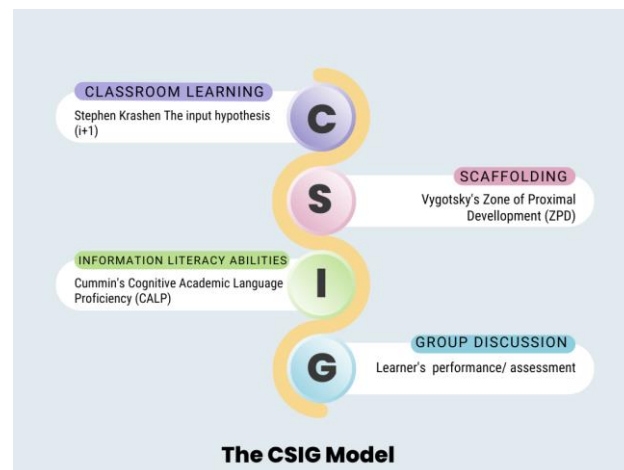
Fig. 1. Conceptual framework of the CSIG model based on Cummin's CALP (Krashen, 1992 and Vygotsky. 2012)

4. Methodology

This is a survey study. This non-experimental design study's data is collected using the online data-collection Google form.

4.1 Research Subjects

The author used closed-ended survey questions to collect data on students' perspectives regarding their information literacy abilities in completing their group discussion assessment. The questionnaire began with the segment on demographics from which the information above was extracted. Subsequently, students were invited to complete 38 items from Information Competency Assessment Instrument (ICAI) developed by Marshall. The Information Competency Assessment Instrument (ICAI) was designed to measure information competency (Marshall, 2006). It is the most prevalent, valid, and trustworthy instrument utilised in other studies (Allari et al., 2022). They were based on standard 5-point Likert scales with the anchors 'strongly disagree' = 1, 'disagree' = 2, 'neither agree nor disagree' = 3, 'agree' = 4, 'strongly agree' = 5. For item 2, 4, 5, 7, 11, 14, 15, 17, 19, 21, 22, 25, 28, 29, 31, 33, 34, 38, 40 are developed with reliability inverse. However, items 14 and 29 are omitted from the questionnaire, and it is due to their irrelevance to the study. Next, the instruments were tested for their reliability through the internal consistency method, the coefficient of Cronbach's alpha value of 0.824 was found, and the reliability range was indicated well. The mean score for ICAI was 3.416 (SD = 0.821).

4.2 Research Procedures

The questionnaire was utterly anonymous: there was no collection of names of participants or their teachers. Specific consent was sought from the participant at the beginning of the study. The questionnaire was shared in 8 Whatsapp groups' from the lecturers to the students in two polytechnics which are Polieknik Sultan Idris Shah and Politeknik Port Dickson. The research subjects individually answered 38 questions from the research instruments in a classroom setting under the supervision of lecturers teaching the classes concerned. The time allocated for the questionnaire was 20 minutes. The data from the Google form was extracted from the Google sheet.

4.3 Data Analysis

As this study is inferential, statistics for Information Competency Assessment Instrument (ICAI) were tabulated in frequency, percentage, mean, standard deviation and T-test to find the significance.

4.4 Findings and Results

The inferential analysis (mean and standard deviation) was used to answer the research questions, while an independent t-test was used to answer the research hypothesis. Data collected were computed and analysed using a Google spreadsheet at a 0.05 level of significance. This part presents the results of the analysis on the gender influence of information literacy abilities in completing group discussion assessments among semester one students in selected polytechnics in Malaysia.

Research Question 1: What are the information literacy skills possessed by semester one students to complete group discussion assessments?

This study is inferential; statistics for Information Competency Assessment Instrument (ICAI) were tabulated in frequency, percentage, mean, standard deviation and T-test to find the significance.

Table 1 shows that polytechnic students feel confident determining what topic to search for when given an assignment with a mean score of 3.804 (SD = 0.775). However, they also feel lost because the topic they want to research is unclear. (Mean = 3.490, SD = 0.834) This was followed by taking a complex topic and breaking it down into more useful, simpler items with a mean score of 3.333. However, the grand mean score task definition was found to be 3.4. It can be inferred that polytechnic students identify the topic criteria using 2.5 as the average benchmark in this study, allowing them to carry out their group discussions easily.

Table 1. Mean and standard deviation of respondents based on identifying the topic

		Mean	Std. Dev
1	When given an assignment for a research paper or a speech, I feel confident determining what topic I need to search for.	3.804	0.775
2	Sometimes I feel lost because the topic I want to research is not very clear to me.	3.490	0.834
3	I can take a complex topic and break it into more practical, straightforward items.	3.333	0.766
4	"Confused" is probably the best term to describe me when starting a project.	3.294	0.923
	GRAND MEAN & STD. DEV.	**3.480**	**0.824**

Table 2 shows that polytechnic students know the difference between "primary" and "secondary" sources with a mean score of 3.824 (SD = 0.888). However, they also sometimes feel unsure of how much information I need for the assignment. (Mean = 3.314, SD = 0.990) This was followed by polytechnic students who were certain they could use the information they found, with a mean score of 3.745 (SD = 0.627). The mean score for item number 7, students get confused because of the many different formats (print, electronic, etc.) when searching for information, was only 2.745. This suggested that most students were aware of determining the right materials for the group discussion topic. Overall, the grand mean score for determining the requirements was 3.407. Therefore, it can be inferred that polytechnic students possess determining the requirements criteria that allow them to read the right content for their group discussion assessment by using 2.5 as the average benchmark.

Table 2. Mean and standard deviation of respondents based on determining the requirements

		Mean	Std. Dev
5	I am sometimes unsure of how much information I need for the assignment.	3.314	0.990
6	I know the difference between "primary" and "secondary" sources.	3.824	0.888
7	When searching for information, I get confused because of the many different formats (print, electronic, etc.).	2.745	1.055
8	I am sure that I can use the information I find.	3.745	0.627
	GRAND MEAN & STD. DEV.	**3.407**	**0.890**

Table 3 shows that polytechnic students claimed it is easy to interpret the results of a search. with a mean score of 3.824 (SD = 0.888). This was followed by polytechnic students agreeing that they could confidently get their hands on the material (by printing, e-mailing, interlibrary loan, etc.) they needed. (Mean = 3.706, SD = 0.879). In

addition, polytechnic students knew how to broaden or narrow a search using Boolean operators (AND, NOT and OR) and truncation. (Mean = 3.235, SD = 0.815) However, polytechnic students struggled to use an index (e.g. catalogue, database, etc.) with a mean score of 3.059. In conclusion, the grand mean score for using information technologies was 3.436. it can be inferred that polytechnic students use the right information technologies to help find the content effectively for the group discussion assessment using 2.5 as the average benchmark.

Table 3. Mean and standard deviation of respondents based on using information technologies

		Mean	Std. Dev
9	I know how to broaden or narrow a search using Boolean operators (AND, NOT and OR) and truncation.	3.235	0.815
10	It is easy to interpret the results of a search.	3.745	0.771
11	I am unsure how to use an index (e.g. catalogue, database, etc.).	3.059	1.008
12	I can confidently get my hands on the material (by printing, e-mailing, interlibrary loan, etc.) I need.	3.706	0.879
	GRAND MEAN & STD. DEV.	**3.436**	**0.868**

Table 4 shows the mean and standard deviation of respondents based on locating & retrieve information. It was believed that polytechnic students understood the organisation of materials in libraries, with a mean score of 3.549 (SD = 0.730). This was followed by polytechnic students who were confident that they knew the difference between an abstract and an article, with a mean score of 3.373 (SD = 0.720). Conversely, the mean score for item number 15, students perceived that web search engines are unreliable with a mean score of 3.412. Overall, the grand mean score for determining the requirements was 3.313, and it can be inferred that polytechnic students were able to locate & retrieve information for their group discussion assessment using 2.5 as the average benchmark.

Table 4. Mean and standard deviation of respondents based on locate & retrieve information

		Mean	Std. Dev
13	I understand the organisation of materials in libraries.	3.549	0.730
15	Web search engines are unreliable.	3.412	0.942
16	I know the difference between an abstract and an article.	3.373	0720
	GRAND MEAN & STD. DEV.	**3.314**	**0.873**

Table 5 showed that polytechnic students could use many different types of media (print, video, photography, etc.) confidently as information for my topic, with a mean score of 3.882 (SD = 0.791). Polytechnic students who followed this were confident they could spot an inaccuracy, errors, etc., in the information from mass media, with a mean score of 3.451 (SD = 0.673). The grand mean score for reading and extracting information from mass media was 3.500. it can then be inferred that polytechnic students can read and extract information from mass media criteria that allow them to get the right content for their group discussion assessment using 2.5 as the average benchmark.

Table 5. Mean and standard deviation of respondents based on information from mass media

		Mean	Std. Dev
17	Sometimes I cannot figure out for whom the information is intended.	3.373	0.720
18	I can confidently use many different media types (print, video, photography, etc.) as information for my topic.	3.882	0.791
19	At times, the producer of the information is not transparent.	3.294	0.923
20	I can confidently spot an inaccuracy, errors, etc., in the information from mass media.	3.451	0.673
	GRAND MEAN & STD. DEV.	**3.500**	**0.777**

Table 6 showed that the grand mean score for evaluating information was 3.337. it can be inferred that polytechnic students were able to evaluate the information for their group discussion assessment using 2.5 as the average benchmark.

Table 6. Mean and standard deviation of respondents based on evaluating information

		Mean	Std. Dev
21	The information I find is so confusing that I do not know if I can use it.	3.235	1.031
22	I am not confident that the information I get is accurate.	3.235	0.815
23	The information I use is complete and reliable.	3.471	0.731
24	I am sure that the information I have answers my question or addresses my topic.	3.569	0.755
	GRAND MEAN & STD. DEV.	**3.377**	**0.833**

Table 7 showed that the grand mean score for organising and synthesising was 3.490; it can be inferred that polytechnic students could organise and synthesise information for their group discussion assessment using 2.5 as the average benchmark.

Table 7. Mean and standard deviation of respondents based on organize & synthesise

		Mean	Std. Dev
25	A lot of the information I find is irrelevant or unnecessary.	3.137	0.825
26	After collecting my information, it is easy to sort by similar content.	3.765	0.790
27	Sometimes my question changes depending on what information I find.	3.667	0.792
28	If my topical outline does not make sense, I get discouraged.	3.392	0.750
	GRAND MEAN & STD. DEV.	**3.490**	**0.789**

Table 8 showed that polytechnic students know to use the presentation of information skills successfully. The grand mean score for the presentation of information was found to be 3.451; it can then be inferred that polytechnic students are confident in presenting their information correctly for their group discussion assessment, using 2.5 as the average benchmark.

Table 8. Mean and standard deviation of respondents based on presentation of information

		Mean	Std. Dev
30	A lot of the information I find is irrelevant or unnecessary.	3.137	0.825
31	After collecting my information, it is easy to sort by similar content.	3.765	0.790
32	Sometimes my question changes depending on what information I find.	3.667	0.792
	GRAND MEAN & STD. DEV.	**3.490**	**0.789**

Table 9 showed the grand mean score for ethics & legality of information was found to be 3.490. it can then be inferred that polytechnic students possess ethics & legality of information criteria that allow them to read the right content for their group discussion assessment using 2.5 as the average benchmark.

Table 9. Mean and standard deviation of respondents based on ethics & legality of information

		Mean	Std. Dev
33	I am not sure how to record or cite all my sources.	3.137	0.825
34	I have questions about the privacy of the information I receive.	3.765	0.790
35	I can tell when information is biased.	3.667	0.792
36	I know that when the material is confidential, it should not be used.	3.392	0.750
	GRAND MEAN & STD. DEV.	**3.137**	**0.825**

Table 10 showed that polytechnic students felt the feedback was demoralising, with a mean score of 3.765 (SD = 0.790). They also felt that after the presentation of the information, the students were not sure how it was received. (Mean = 3.392, SD = 0.750) Polytechnic students who followed this scored a low mean score (Mean = 3.137, SD = 0.825) for item 37. While preparing a project, I am certain how others will receive it. This suggested that most students were afraid to learn or know about the feedback or evaluation; this also meant students were not ready to make a mistake or be penalised. However, students mentioned they were able to learn what processes would help find information in the future, with a mean score of 3.667.

Table 10. Mean and standard deviation of respondents based on evaluating & learning from experience

		Mean	Std. Dev
37	While preparing a project, I am confident about how others will receive it.	3.137	0.825
38	Feedback is demoralising to me.	3.765	0.790
39	I can learn what processes would help me find information in the future.	3.667	0.792
40	After the information was presented, I am unsure how it was received.	3.392	0.750
	GRAND MEAN & STD. DEV.	**3.490**	**0.789**

This PLC Programming & Simulator teaching aid module is an ongoing effort made to ensure that the practical evaluation for the Programmer Logic Controller course for students can be implemented according to the plan that has been set and can have a positive impact on learning. Fig. 3 demonstrates the conveyor control simulation after the program is set and moved through the control.

4.5 Hypothesis testing

Based on research question 2, a corresponding hypothesis was formulated, and the results of the tested hypothesis are shown in Table 11. The hypothesis was tested at a 0.05 level of significance. HO_1: There is no significant difference between male and female polytechnic students' information literacy skills in completing group discussion assessments. The data were analysed using t-test statistics to determine whether there was a significant difference between male and female polytechnic students' information literacy skills in completing group discussion assessments; the result is presented in Table 11.

Table 11. Difference between male and female polytechnic students' information literacy abilities in completing group discussion assessments

	N	X	SD	D	T	Sig. (2-tailed)	Remarks
Female	28	130.07	11.49	23.68	18.37	0.021	
Male	23	138.08	11.75				
TOTAL	51						

Table 11 showed a significant difference between male and female polytechnic students' information literacy abilities in completing group discussion assessments. This is reflected in the result: t (18.37) = 0.021, p < 0.05. That is, the result of a t-value of 0.021 significant value was less than 0.05 alpha values. Thus, the null hypothesis is rejected. This implies a significant difference between male and female polytechnic students' information literacy skills in completing group discussion assessments favouring males, with a mean score of 138.08.

5. Conclusion

This research examined gender influence on information literacy abilities possessed by semester one students to complete group discussion assessments in two selected polytechnics in Malaysia. The data gathered and analysed in this study indicated that students possessed various information abilities to complete group discussion assessments. Also, there was a significant difference between male and female information literacy skills possessed by semester one students to complete group discussion assessment in favour of males and could be considered to be similar to submission (Science, 2018) that females experience more difficulty finding information, felt less competent and comfortable using the resources. The study result contradicts with the information literacy skills of undergraduates in the Library and Information Science Department at the University of Maiduguri, which according to the results, gender has no bearing on the information literacy skills.

The findings suggest that polytechnic students are competent in reading and extracting information for their group discussion assessment. This also proves that students are aware of alternative resources to explore more. The only drawback of this study is that students are not ready to receive feedback on their research or the topics discussed in the assessment. There should be further investigation into such a phenomenon where students have clearly shown a good understanding of the task but are reluctant to receive or accept feedback. The research subjects for this study are millennials who crave quick and ongoing feedback. Millennials could be called the Instant Gratification generation. Therefore, this study could provide insight to the stakeholders, industry boards, and curriculum designers of the Malaysian Polytechnics Department to produce more K-based economy human capital in the nation.

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Students' Statisfaction Towards the Foods and Beverages Services of Canteen and Cafe at Mukah Polytechnic

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Full Paper

Abstract

This study was carried out to examine the level of student's satisfaction towards the food and beverages services provided by the canteen and cafe within the Mukah Polytechnic area. This study is important because the students' level of dependence is very high on canteen and cafe. This is because, canteen and cafe are the main places that will be visited by students to get daily food. The assessment of the level of student's satisfaction is tested by variables such as cleanliness, price, time and quality of service offered by canteen and cafe. This study was conducted by distributing questionnaires to 322 respondents who were students from each academic department at Mukah Polytechnic, Sarawak. From the research conducted, the level of students' satisfaction with the food service in canteen and cafe is high. However, for the price variable, it gets the lowest mean with a medium level of satisfaction. The study we conducted will be the hope of the students to provide a scientific response to the management and the Student Representative Council (MPP) of Mukah Polytechnic regarding the services level of canteen and cafe that the students are receiving.

Keywords: - Satisfaction, food and beverages services, cleanliness, price, time, quality of services

1. Introduction

This study was carried out to examine the level of student's satisfaction with the food and beverages services provided by canteen and cafe at Mukah Polytechnic. Other than that, it is also to be a platform for students to convey their feedback to the canteen and cafe of Mukah Polytechnic to improve the services. The significance of this study stems from the fact that students heavily rely on canteens and cafes, which serve as their primary sources of daily sustenance. Thus, it is essential to ensure that these establishments fulfill their duties and responsibilities towards their customers, particularly students, by conducting this study. The variables scrutinized in this research are cleanliness, pricing, timeliness, and the quality of services provided by canteens and cafes. We take this opportunity to relay the feedback of Mukah Polytechnic's students concerning the

predicaments they encounter daily, utilizing appropriate alternatives to mitigate them. This is to ensure that other students do not face the same difficulties in the future. In light of this, canteens and cafes must enhance their services in all aspects of the variables tested for future reference. Any unresolved issues may adversely affect students' acceptance of the canteens and cafes if left unaddressed.

At Mukah Polytechnic, the location of the canteen and cafe are located in two different areas, where the cafe is located close to the PMU residential college, which is between the male and female residential colleges.

While the canteen is located quite far from the residential college but closer to the academic and administration departments. There are five stalls operating in the cafe every day starting from 6.30am – 11.00pm. The stalls sell various types of food including heavy food as well as drinks. The food provided is served as a buffet

and by ordering ala carte. While in the canteen, there are three stalls that operate from 7.30 am until 4.30 pm. The system used at the canteen is also the same with cafe which using buffet and ala-carte ordering system.

This study examines the satisfaction level of Mukah Polytechnic students on four variables: the cleanliness level of the canteen and cafe environment, the prices of food and drinks, the waiting time for food preparation, and how service quality affects student satisfaction. The research seeks to investigate if students are satisfied with the level of cleanliness, prices of food and drinks, and waiting time for food preparation. Additionally, the study aims to determine the relationship between service quality and student satisfaction.

2. Literature Review

Canteen and cafe are a very important place in a Higher Education Institution. Every institution must have canteen and cafe that provide continuous food service to students. This is because canteen and cafe are the main destinations for the students to dine, especially for the one who stayed in the hostel.

Apart from the canteen and cafe at Mukah Polytechnic, there are also stalls, poly shops and koperasi that also sell food to students. However, in this study, researcher has chosed canteen and cafe because the daily meals provided are more nutritious. Adenan et al. (2018) highlighted that the consuming of nutritious foods is a need for students. This is because the foods consume by students will also impacted the academic achievement of the students. Hence, the unhealthy food environement should be be minimize as lower as we can.

a. Cleanliness

In the hospitality industry, the food cleanliness is become the main issues highlighted by the consumers, globally (Kim et al., 2019). However, the compliance of the food's services provider on the health protocols guidelines is still moderate (Maemunah, 2021). One of the main factors that affect the safety of the foods is the cleanliness of the food's environment. The cleanliness of the foods refers to a condition that does not lead to, or cause any contamination of food with other unpleasant substances such as food waste, soil, dirt or grease. Cleanliness is closely related to the safety and health of customers. Food safety is a food that is clean, uncontaminated and free from harmful bacteria that can cause food poisoning or also known as food-borne diseases. Chen et al. (2020) highlighted that several diseases like obesity, depression, cancer and irritable bowel syndrome are the examples of food-borne diseases. Referring to the interpretation of the Federation of Malaysian Consumers Association (FOMCA) in 2017, consumers are entitled to be protected from goods, production processes and services that may endanger health or life.

Consumers have the right to get the best service in

terms of cleanliness quality to avoid any disease and negative impact. Cleanliness is an important element in food handling. In the context of the food service provided by the cafe and canteen, the cleanliness assessed is based on the cleanliness of the equipment used to handle the food, the cleanliness of the surrounding area of the food premises, and the cleanliness measures practiced by the cafe and canteen workers. Equipment used for the food handling should be in good condition, easy to clean and disinfected. This can guarantee the safety of customers who use the equipment to eat (Al Faris et al., 2015). Knowledge on the importance of cleanliness practices by employees should be made a priority for the preparation and handling of food in every food premises in order to ensure food cleanliness is guaranteed and free of contamination.

Cafe and canteen workers are not allowed to cough, scratch their bodies, lick their fingers, spit and smoke while in the process of preparing and serving food. Any unhygiene behavior done by the food handler can put the foods on the risk of contaminated which will negative impact the consumers (Shahbaz et al., 2020).

b. Price

Pricing is an important element in the sale of products, including food at Mukah Polytechnic canteen and cafe. Students have to spend a certain amount of money to buy food every day. Klessen et al. (2005) highlighted that pricing is the most important aspects that will be considered by the students before they buy any foods and beverages. Adenan et al. (2018) added that the price of the nutritious foods is normally higher than the unhealthy foods which may lead to the higher consumption of unhealty foods by the students. Normally, students are financially sourced from parents, scholarships and income from the online businesses in order to survive while studying full-time. The limited income required the importance of financial planning to ensure that students can plan their budget and prevent them from spending more than the monthly budget that has been set. Hence the food labelling in the canteen and cafe is crucial for this budgeting purposes. This aspect of financial management needs to be given real attention because of the increasingly trend of life challenges nowadays especially in terms of monetary aspects (Abdul Rahman et al., 2016). It is supported by the study done by Md Zeni et al. (2021) that the financial management will also help the students to monitor their cash flow properly. Moreover, the increasing of the goods's price especially foods in the market will surely burden the students to manage their expenses in higher education institutions.

Other than tution fees, stationery and academic reference materials, food is another huge expense that should be incurred by students in the studies. Therefore, an affordable price is crucial in order to ensure the foods and beverages services in the institution is affordable by the students.

c. Time

In food and beverages industry, one of the main considerations for the customer in choosing the restaurant is by observing the timing needed for the foods preparation. The importance of timing for foods preparation has been highlighted by Se-Hak et al. (2020) and proven by the increasing demand of the fast food restaurant from year to year.

Restaurant with lesser food's preparation time lead to the higher number of customers. For students, time management is highly important as it has a positive significant impact on the students' academic achievement (Britton el al., 1991). Other than the academic achievement, Adams et al. (2019) mentioned that the time management has also associated with the anxiety level of the students. Most of the students find it is hard to find a study-life balance. Especially at Polytehcnic level, students have a class schedule from 7.30am to 4.30pm every day. Most of the students will spend approximately 6 hours a day for class. Hence, the time management is again is very important. As the comsumption of foods is crucial to give students energy for study, the foods and beverages service provider must ensure that they can provide a reasonable time of food preparation for the students especially for ala carte foods ordering system.

d. Quality of Services

Even though there is no specific concept to define quality, some researcher has always related it with the customer satisfaction on the services (Berhanu, 2019). Better quality of services will psotively impact the customer's satisfaction. Therefore, according to Mohamed, Shahabuddin & Mustafa (2007) customer satisfaction is a critical factor to ensure the survival and success of a business. Customers in a business needs to be treated as someone unique and special. Customers will compare their experience to perceived service, which is how well customers expect other competitors in the service to treat them. Other than that, study done by Suhartanto et al. (2019) discover that the quality of services is not just related to the treatment of food provider, but also related to the food quality presented to the customer. However, Bungatang et al. (2021) highlighted that, the quality of services also represented by the other tangibles factors that cannot be seen like responsiveness, empathy and the behavior of the services provider. Hence, the quality of services is one of the main factors to justify customer satisfaction.

3. Methodology

The sampling technique used in this research is the probability sampling. The sampling method is important as it is difficult for the data collection to involved all the students's at Mukah Polytechnic since the population is huge. Referring to the data provided by Jabatan Hal Ehwal dan Pembangunan Pelajar ("JHEPP") Mukah Polytechnic, the latest population of students Session I

2022/2023 is in Table 1.

Table 1. Students' population at Mukah polytechnic

Academic Department	Total
Commerce Department	722
Mechanical Engineering Department	351
Electrical and Electronic Engineering Department	239
Civil Engineering Department	355
Information technology and Communication Department	252
	1919

Researcher has opted to use one of the sampling techniques proposed by Krejcie dan Morgan (1970) to evaluate the number of samples to be selected for this research. By using this technique, 322 respondents will be selected from 5 different academic department. The number of samples from each department has been pro-rate by the total number of students' population in each academic department.

Table 2. Sampling of respondents

Academic Department	Total
Commerce Department	121
Mechanical Engineering Department	59
Electrical and Electronic Engineering Department	40
Civil Engineering Department	60
Information technology and Communication Department	42
	322

Quantitative research by using questionnaire has been selected as it can save timing and cost. The findings of this research are based on the responds of questionnaire that has been distributed using online platform, Google Form. This questionnaire using a likert scale method that shows the scale of 1 to 5, which 5 represented highly agree. This questionnaire has two parts which are part A and part B. Part A is about the demographics of the respondents while part B is the focus on the variables that will be tested in this study. In addition, quantitative research is also more appropriate to study the relationship between the variables discussed in the literature review section such as cleanliness, price, time and service quality. Researcher adopt and adapt questionnaires from previous studies prepared by Hartini et al. (2018) and Adibah et al. (2020). The results will be analyzed using SPSS statistical software by calculating the mean for each

statement. To interpret the Mean score, the researcher used the Moidunny (2009) method as illustrated in Table 3.

Table 3. Intrepretation of Mean Score Method

Mean	Level
1.00 – 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

Researcher has also determined the relationship between each variable tested in this study. The level of relationship will be analyse using the interpretation suggested by Richard (1990). The Cronbach's Alpha values for cleanliness (0.863), price (0.850), time (0.831), and quality of services (0.850) indicate that the variables in this study are reliable and acceptable, as they exceed the minimum threshold of 0.70. These reliability tests were conducted using SPSS statistical software, as stated by Adeniran (2019).

4. Findings and Discussion

The distribution of the questionnaire tooks approximately two months to get the adequate number of respondents as planned in methodology chapter. Below are the demographic details of the respondents as per items included in the Part A of the questionnaire as in Table 4. Based on Table 4, the majority of respondents are between 18-20 years old which represents 90.7% of the total respondents. This is because most of the students who continue their studies at Mukah Polytechnic are students who have graduated from Sijil Pelajaran Malaysia (SPM). For the gender item, the number of female respondents exceeded male respondents by 9.4%. In terms of academic department items, 37.6% of the respondents are students from the Department of Commerce. The majority of respondents are students from the Department of Commerce because almost half of the students studying at Mukah Polytechnic are students from the Department of Commerce. The researcher has succeeded in obtaining respondents based on the percentage of departments as planned at the beginning of the implementation of the research paper. The majority of respondents are 5th semester students which representing 30.4% respondents. Asnawi et.al (2022) stated that the institution food service which is the canteen is the main place where students get their food during the academic session. Therefore, the percentage of students who use canteen and cafe services 2 to 5 times a week is high with a percentage of 54.0%. In other words, at least, students will go to canteen and cafe once a day during weekdays.

Table 4. Demography of respondents

Item		N	%
Ages	<18	3	0.9
	18-20	292	90.7
	21-25	26	8.1
	>25	1	0.3
Gender	Male	146	45.3
	Female	176	54.7
Academic Department	Information Technology and Communication Department	42	13.0
	Civil Engineering Department	60	18.6
	Electrical Engineering Department	40	12.4
	Mechanical Engineering Department	59	18.3
	Commerce Department	121	37.6
Semester	1	78	24.2
	2	27	8.4
	3	53	16.6
	4	54	16.8
	5	98	30.4
	6	12	3.7
Frequency using the canteen and cafe	1 time a week	16	5.0
	2-5 times a week	174	54.0
	6 times and above a week	132	41.0

The questionnaire has also consisted of Part B which discover the level of satisfaction by the four variables mentioned in the literature review which are cleanliness, price, time and quality of services. The analysis for the first variables, cleanliness is shown in Table 5. Based on Table 5 above, the study shows that the respondents who are students at Mukah Polytechnic have a high level of satisfaction with the cleanliness of canteen and cafe. According to Yusoff & Hashim (2009), three factors that affected the determining students' perception of the cleanliness of canteen and cafe include the cleanliness of the food served, the cleanliness of the environment, the cleanliness of the facilities provided and the cleanliness of the food handlers or workers in the canteen and cafe. The highest mean score for students' level of satisfaction with cleanliness is 3.6677 where the students agreed that the food and drinks served are safe to eat. Premises is subjected to a compound under the Food Regulations 2009 if it is found that the food operator does not comply with the requirements for the preparation, packaging and serving of food to ensure that the food is safe to eat. This is why most of the food services operator are more aware on the safeness of the foods served. Meanwhile, the lowest mean score is 3.4193 which says that the cutlery sets such as plates, bowls, cups and spoons are clean.

Table 5. Students satisfaction level towards cleanliness

Item	Mean	SD
The environement of the canteen and cafe are clean.	3.4224	.9078
Cutlery sets such as plates, bowls, cups and spoons are clean.	3.4193	1.0268
The food and drinks served are safe to eat.	3.6677	.9094
The hygiene practices of the workers are satisfactory.	3.5745	.8873

Table 6 shows that the level of student's satisfaction with the price of food at Mukah Polytechnic is at a medium level with an average mean score of 3.0769. The highest mean score for this category is 3.2298. This shows that the students agree that the price of food in canteen and cafe is cheaper than food stalls outside the campus. As for the lowest mean score, a mean value of 3.0124 was recorded where the level of student's satisfaction was the lowest when faced with the labeling of price tags on food in the Mukah Polytechnic canteen and cafe. The existence of price tags at every dish is important as the customer will look on the pricing before order to ensure that the foods and beverages is within their budget (Ngan et al., 2022).

Table 6. Students satisfaction level towards price

Item	Mean	SD
The price to be paid corresponds to the quality of the food.	3.0155	1.1533
Food and drink prices are reasonable for students.	3.0497	1.1777
Price labels are provided for all food and beverages.	3.0124	1.2800
Food prices in canteen and cafe are cheaper than food stalls outside the campus.	3.2298	1.2036

Based on the Table 7, the level of student's satisfaction with the canteen and cafe time allocation as a whole is high. The question item stating that respondents feel the time required to order food is short has the lowest mean with a score of 3.2609. Meanwhile, the highest score of 3.6957 is for the item stating that respondents think that the time period to get a seat is not long. Bilgili et al. (2020) highlighted that the waiting time is a very important aspect that will be consider by the customer before choosing any restaurant. However, some of the foods and beverages provider tend to used the queing

customer with longer waiting time as a marketing strategy to attract the other potential customer (Liang, 2019).

Table 7. Students satisfaction level towards time

Item	Mean	SD
Food preparation time is reasonable.	3.2733	1.1301
The time required to deliver the food order is short.	3.2609	1.0737
The time period to get a seat is not long.	3.6957	1.0883
The time period for workers to restock the food is short.	3.4193	1.0799

Based on Table 8, the level of food service quality in canteen and cafe as a whole is high based on the opinion of respondents. The highest score of 3.8199 indicates that the employees' treatment in canteen and cafe is customer-friendly. Apart from the taste factor, one of the other ways to improve the level of service quality is to provide a high quality of customer service. The lowest score of 3.5621 was for the question item stating that the food and drinks provided are fresh and not stale. A concern for canteen and cafe is that there are respondents who feel that the food and drinks provided are stale. This is because, the result of the respondent's opinion is definitely based on the respondent's own experience or the experience of the closest person. According to Hayati and Khairul (2008), the failure of food products to provide safety guarantees to consumers will cause a decrease in consumer trust. If the customer has trusted the food provider, they tend to recommend it to others (Al-Ansi et al., 2019).

Table 8. Students satisfaction level towards quality of services

Item	Mean	SD
The food and drinks provided are fresh and not stale.	3.5621	1.0035
The employee is customer friendly.	3.8199	.9820
The method of taking orders is orderly and easier for customers.	3.7236	1.0478
The payment method is systematic and accurate.	3.7143	1.0586

Based on Table 9 which shows the analysis from Pearson Correlation coefficient test, researcher has found that students' satisfaction has significant positive relationship with all the variables studies. In line with Richard (1990), the rs value is used to determine the strength of the correlation coefficient for each variable. The correlation for all four variables which are

cleanliness, price, time and quality of services and the students' satisfaction is high as the correlation valued in the range of 0.68 to 0.9 (Richard, 1990).

Table 9. Pearson correlations for variables studies and students' satisfaction

Variables	Significant Value (p)	Pearson Correlation (rs)
Cleanliness	0.000	0.794
Price	0.000	0.838
Time	0.000	0.854
Quality of services	0.000	0.860

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

5. Conclusion and Recommendation

The results of a study on the level of students' satisfaction towards the food and beverages of canteen and cafe at the Mukah Polytechnic can be summarise as a study that can gather student responses based on four variables that have been selected for this study which are cleanliness, price, time and quality of service offered by canteen and cafe.

According to this study, students are highly satisfied with the cleanliness, timeliness, and quality of services offered in the canteen and cafe at Mukah Polytechnic. Although few studies have explored the same variables, previous research conducted by Yusoff & Hashim (2009), Bilgili et al. (2020), and Hayati and Khairul (2008) have emphasized the importance of these aspects. However, the mean score for the price aspect was relatively low, indicating moderate satisfaction. This study is expected to provide a scientific response to the top management and the Student Representative Council (MPP) of Mukah Polytechnic regarding the level of services provided by the canteen and cafe to the students. Furthermore, food providers can also use this feedback to enhance their services offered to students. It is hoped that the findings of this study will have a positive impact on the students' daily lives in the future, considering the high dependence of students on the canteen and cafe. Nevertheless, it is important to note that the results of this study may not be representative of all students at Mukah Polytechnic due to the sampling method used.

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Design of Jig for a Four-jaw Independent Chuck Lathe Machine

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Full Paper

Abstract

This study discusses the process of designing a jig for a four-jaw independent chuck on a lathe machine. The aim of this study is to provide a design of jig that can be used in the teaching and learning process for Mechanical Workshop Practice 2 course for students of Diploma in Mechanical Engineering program at the Department of Mechanical Engineering, Politeknik Mukah, Sarawak. The main factor in the development of the jig is to simplify the student's task and reduce the time taken for setting up the workpiece on the lathe machine. The process of designing this jig involves several stages, namely the study of the surface, angle and direction and the details design using CATIA software. By using the jig, the process of setting up the workpiece on the lathe machine is expected to be easier and faster. In addition, students are also able to understand the function and importance of tool angle. Indirectly, the level of students' understanding of the process could also be improved.

Keywords: - Innovation, jig, four-jaw chuck, lathe machine

1. Introduction

Mechanical Workshop Practice 2 offered to Diploma in Mechanical Engineering students at the Department of Mechanical Engineering, Mukah Polytechnic, Sarawak, can basically be divided into four main topics, i.e., Lathe, Foundry, Oxyacetylene Welding (OAW) and Shielded Metal Arc Welding (SMAW).

For the topic related to lathe machine, students have to complete a project using the lathe machine. However, before the lathe process begins, students have to mark on a workpiece and set up the workpiece on the four-jaw chuck of lathe machine. These processes could take a long time as it is done manually and sometimes could risk the students for having imprecise workpiece mounting as the project requires eccentric turning.

A method to assist and speed up the process for setting up the workpiece on the four-jaw chuck of lathe machine needs to be developed to overcome the problems as stated earlier (Lutsiv, Voloshyn & Bytsa, 2015). Therefore, it is

crucial to design the jig with a precise setting so that the exact center point of workpiece could be obtained. By having this jig, it will ease the mounting process and produce a workpiece with an acceptable tolerance (Miturska et al., 2020).

This jig design is developed to assist and ease the students for mounting the workpiece on the four-jaw independent chuck of lathe machine for eccentric turning process (Uysal, 2014).

2. Literature Review

In the early years lathe machine has become the most importance machines before CNC machines were invented (Jaiswal et al., 2017). This machine is able to produce various cylinder-shaped materials. One of the process this machine can produce is eccentric turning. The eccentric turning is a cylindrical part with two separate axes of rotation, i.e. one being out of the center of the other center (Patel & Chauhan, 2020). In simple

word, eccentric turning can be called as off-centered turning. The distance from one axis to another is called offset. Four jaw chucks are the most common device that will be used when executing an eccentric turning and this process has a unique set of challenges. An operator with specialized training, knowledge and experience is usually required for setting up an eccentric turning and carrying out the operations (Mukilan, Karthikeyan & Gowtham, 2014).

For an eccentric process, four jaws must be used and each jaw moves independently. Due to this, it will take a considerable amount of time to tighten each jaw precisely when setting up the workpiece (Shrikant, Wachtler & Read, 2009).

In the conventional manufacturing process, performing operations on an eccentric shaft is critical and it needs to hold the workpiece properly. This is important to hold the workpiece in proper to avoid any accident or final product damage. Learn how to control the 4-jaw chuck and understand how to align parts has a direct application on any machine tool with rotary elements (Tate, 2015). The experience person to handle the four-jaw chuck, usually will find the way how to make it quick but in same time maintain the quality of product (Rao, Prasad & Sreenivasulu, 2013). At some time, the expert also faces the difficulties and takes more time to set up a workpiece at the four-jaw chuck (Nanthakumar & Prabakaran, 2014). In order to assist the workpiece holding process, the jig and fixtures must be designed so that the process will be done correctly (Peshatwar & Raut, 2013).

In Politeknik Mukah, it is essential for students to use both of their hands for setting up eccentric turning process, i.e. right hand is used to hold the workpiece whereby left hand is used to tighten the chuck. Therefore, with the intention of improving this method, the jig needs to be designed to hold the workpiece precisely at its position by minimizing human error (Wang, 2014).

3. Methodology

This jig will be able to solve the problem stated above when the students using four-jaw lathe machines. The jig was designed so that it can be attached to the tail stock of lathe machines, which are available in the machine workshop, Politeknik Mukah, Sarawak.

Based on the current process for setting up the workpiece, the student requires to match the center of eccentric at the tail stock manually by holding the workpiece using hand. Fig. 1 shows the first step to set up the workpiece.

The next process is to push the tail stock forward and meanwhile need to hold the workpiece. When the workpiece is close to the four-jaw chucks, the student needs to tighten the chuck and in the same time still need to hold the workpiece. It is difficult to maintain the center position while tightening all four-jaw chucks. Fig. 2 shows the tightening process.
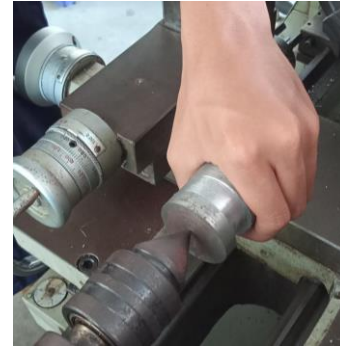

Fig. 1. First step to set up workpiece

Fig. 2. Existing tightening process (without jig)

Based on an existing manual process, it is crucial to design a jig, that could assist students to hold the workpiece. This jig will replace the manual process which holds the workpiece by using hand (Wang et al., 2017 and Liang et. al, 2013).
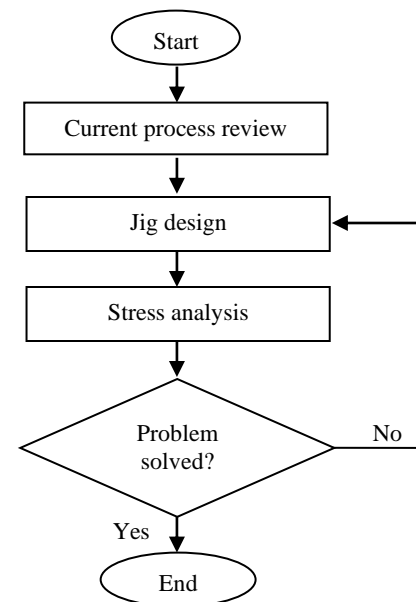

Fig. 3. Process flow chart for designing the four-jaw jig

In this study, the jig was designed by using CATIA software. The jig was assembled on tail stock design to simulate the feasibility of jig design (Pachbhai & Raut, 2014). This jig was designed based on the easiest method to assemble a workpiece for eccentric turning on four-jaw machines. It is easier to match the workpiece center point on tail stock and after that to place the workpiece at the correct position without having to hold it by hand. For this purpose, this jig was designed to be adjustable, i.e. it can be rotated and its height can also be adjusted (Kamarudin, 2017 and Shete & Gandhe, 2016). Fig. 3 shows the process flow chart to design jig for four-jaw independent chuck lathe machine.

4. Result and Discussion

Based on the researches done to assemble the workpiece on a four-jaw chuck, the new design of the four-jaw jig is as the followings. This jig is divided into three parts, that is base, connecting and front part.

Fig. 4 shows the base part for the jig. This base is attached to the tailstock. It is assembled to the tailstock at the bottom by using M10 bolt.
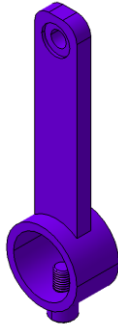
Fig. 4. Base part for four-jaw jig design

The next part is connecting part of the four-jaw jig. Fig. 5 shows the part design. This connecting part is used to connect and hold the front part and base part. This connecting part is assembled to the base part and front part also using M10 bolt.

Fig. 5. Connecting part for four-jaw jig design

The last part is front part design as shown in Fig. 6. This front part is used to hold the workpiece at its position. It is designed so that it can be rotated and its height can be adjusted easily.
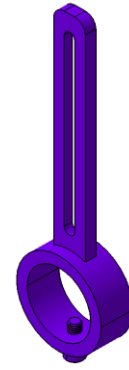

Fig. 6. Front part for four-jaw jig design

All three parts are assembled together and become a complete jig. The detail design is shown in Fig. 7 - Fig. 10.
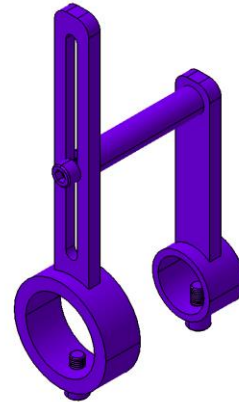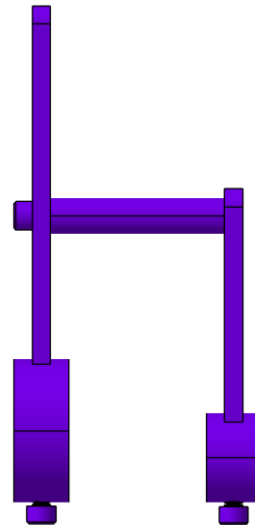

Fig. 7. Isometric view for four-jaw jig

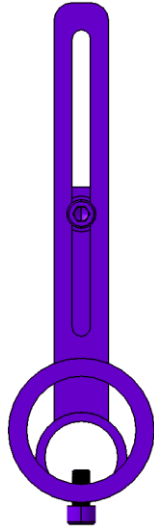Fig. 8. Side view for four-jaw jig

Fig. 9. Front view for four-jaw jig

Fig. 12. Isometric view (rear) of jig assembly to tail stock

Fig. 10. Top view for four-jaw jig

Fig. 13. Top view of jig assembly to tail stock
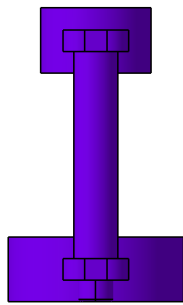
The design of this jig was simulated on tail stock to check its feasibility. The results from the simulation are shown in Fig. 11 to Fig. 15.
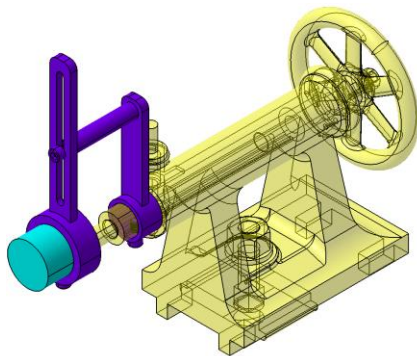

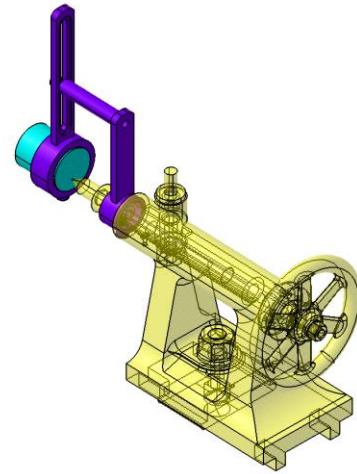Fig. 11. Isometric view (front) of jig assembly to tail stock
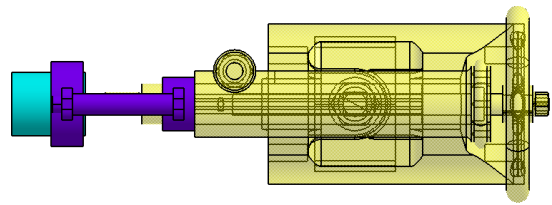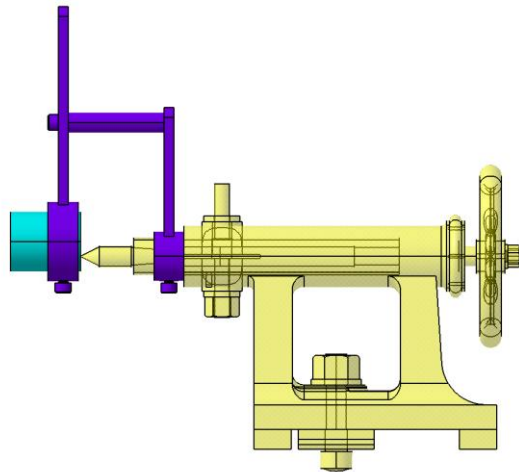

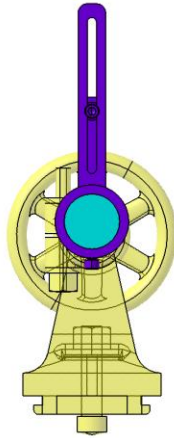Fig. 14. Side view of jig assembly to tail stock

Fig. 15. Front view of jig assembly to tail stock

The design of this jig will assist students to improve their understanding on the four-jaw chuck operation and also to learn the correct method for clamping the workpiece during eccentric turning process for Mechanical Workshop Practice 2 course.

Based on the design, connecting part is most critical because it attaches to base part and hold front part. Three types of material had selected which is aluminum, steel and iron. Static load analysis had conducted to see the best material to use for connecting part (Cheng et al., 2022 and Dhagate et al., 2017).

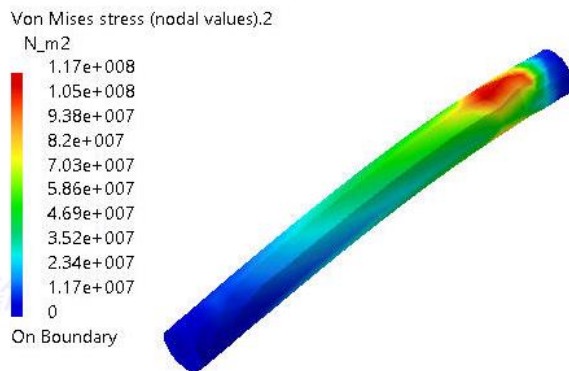Fig. 16 shows the result for aluminum. The maximum stress for aluminum is $1.17e^{+8}$ N/m^2.

Fig. 16. Von Mises stress result for aluminum

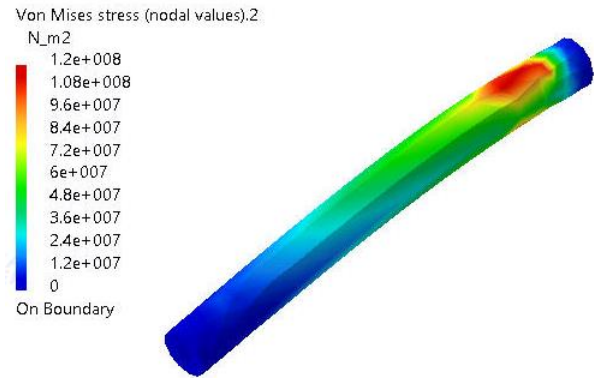Fig. 17 shows the result for iron. The maximum stress for iron is $1.2e^{+8}$ N/m^2.

Fig. 17. Von Mises stress result for iron

Fig. 18 shows the result for steel. The maximum stress for Steel is $1.21e^{+8}$ N/m^2.
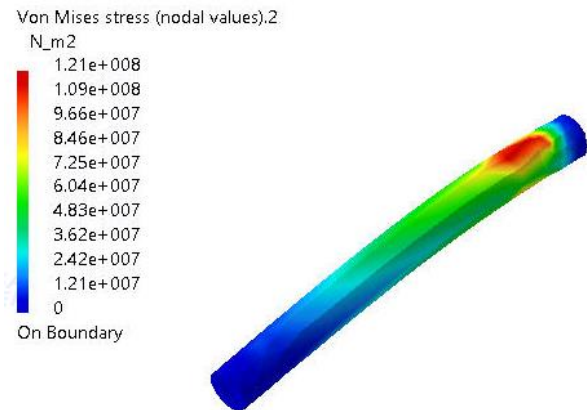

Fig. 18. Von Mises stress result for steel

By referring to Fig. 16 to Fig. 18, it shows steel is the suitable material to use develop the four-jaw jig since it can withstand the highest stress (Ashtekar Trupti & Gawande, 2014).

5. Conclusion and Recommendation

Based on the results of the jig design, the four-jaw jig for setting up an eccentric workpiece is suitable and meets the syllabus where it can help in improving teaching and learning methods. From the analysis done, it was found that the most suitable material to develop the actual four-jaw jig is steel as it is able to withstand the highest stress in comparison of aluminum and iron. In addition, the jig design also has the potential to be expanded its usage where it can prevent misalignment during the workpiece assembly on a three-jaw chuck lathe machine. Further research can be done with a focus on designing jigs that can be used on various types of lathe machine available in the market and can be used for various sizes and shapes of workpiece. Besides, analysis on deflection could also be carried out in the future for improving the material selection process.

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Design and Development of IoT Based Inventory Management System for Small Business

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Full Paper

Abstract

Nowadays, everything is made simpler with information and communication technological advancements. The Internet has been part of human lives with the rapid increase on the usage of internet over the past decade. With these technological advancements, almost everything around us is now automated. Humans tend to carry out their daily activities via portable smart devices or simply said a smart phone. It is preferable to track and monitor using these devices rather than perform it manually. This resulted in the rapid growth of Internet of Things (IoT) technology and relevant markets. Low cost IoT products have made access to IoT much easier and desirable. These low cost IoT devices and related technologies are widely used in areas such as educational, transportation, tracking, inventory management and many more. IoT has been a game changer in the inventory management system. However, some IoT developed inventory management systems have its own advantages and disadvantages. The use of Arduino and RFID in the inventory management system lacks in some areas including hardware limitations. In conjunction to the limitation of using Arduino and RFID technology, this project aims to develop an IoT based inventory management system that incorporates the uses of a NodeMCU and a Load Cell. In comparison of the NodeMCU to an Arduino, the NodeMCU stands out with the built in Wi-Fi module with much higher processor and additional properties of it being much smaller. While the use of a Load Cell is much more convenient as to suit all kinds of inventory management needs compared to the use of RFID that suits better to larger scale businesses with larger inventory and massive stocks. Towards the end, this project is expected to ease inventory management by the implementation of IoT. This project should generate stock count automatically and is accessible online. Data history and status should also be generated with notifications on stocks running low. There are several things that can be upgraded for future recommendation for design. The project has only one compartment to store the stock so in the future recommendation, more space/drawer that can be used to store product. Also, for the weight maximum in one drawer that is 1 kg only. It is unusable because 1kg can only put light objects, some small business owners store their stocks with a larger weight, hence the future recommendation is that the maximum value of the drawer will be upgraded to 5 kg or 10 kg.

Keywords: - Internet of Things, emergency switch, remote access

1. Introduction

Nowadays, during this pandemic attack of COVID-19, lots of people out there has lost their jobs because of unstable economic conditions. So, some of them started to find their own incomes by starting a small business. They probably store their own goods in their house and probably in a confined space. Some small businesses have started to grow their business with a lot of stocks, stored in their home but do not know how to have proper storage management (Lee et al., 2018; Dennert, Friedrich & Kumar, 2021 and Doss, Trujillo-Rasua & Piramuthu, 2020). Therefore, when it comes to counting their stocks, they have to count their stocks one by one manually and it will lead to man-made error. Not to mention, they cannot keep in touch with their stock when they are away from

home. Also, the situation becomes quite complex when they only notice the number of their stock is getting lower after they have checked their storage.

1.1 Design and Development of IoT Based Inventory Mangement

The system for small business is built to ease the small business owner to keep their stocks quantity and keep track of their stocks that will lead to proper pre-planning decision making. This design is the key to effective storage and can help lots of small businesses out there. The selection of this project aims to reduce costs and time by creating a more efficient system that can be used to all owner stores.

1.2 Project Background

Most small business owner store their goods at home or in a confined space. Some of them don't even learn how to have a proper storage keeping because they just have started to do some small business to earn some income. The storage place was small but sometimes small business owners tend to forget how much stock they have left. In Fig. 1 is the example of how small business owners store their goods in a narrow place or at home.

Fig. 1. Example of storage room

The project build is specially for the small business owner to store their goods/products easily. Some of the small business owners are new to business and never learn about a proper storage management. The problems came when they wanted to know the current quantity of their stocks. The owners must count one by one manually of their stocks. This process not only takes time but also introduces to man-made errors. In the case of small business that unable to hire any workers, this situation becomes very complicated. Not to mention when the stock of their goods reaches a low-level quantity, they will only notify it when they have checked the stocks manually and it will lead to less customer buying products at their store because it is always out of stock.

The entitled of this project is 'Design and Development of IoT Based Inventory Management System for Small Business' can be applicable to all small business owner, mini stores and housewife that wanted a proper organized storage. This project system can ease the

small business owner and make their business management easier. This system will replace the old traditional ways of counting stocks. The project will use the Load Cell and Node MCU ESP32 microcontroller that will automatically detect the number of stocks left/present on the shelves. This way will make less of stock counting error. Furthermore, this design won't let you worry about your stocks going low anymore. This design will notify/alarm you via email if your stocks reach a certain amount of low quantity level using the IFTTT. All the information about the stocks will be updated through our smartphones only (Patnaik, Yang & Sethi, 2021).

Back when the Industrial Revolution had not started, people had already started to buy and sell their things such as vegetables, clothing, and other raw materials. Hence, in logically thinking the seller back then had their own way on managing their business-like writing there in and out stock on their notebook or an anything else. Or perhaps they might have another way. This tells that the inventory management system has already exist when the high technology is still undeveloped (Shakhovska, 2017 and Shabandeh, 2021).

Inventory Management system is a process that you can track your stock till the end of the sales. After some years have passed when the technology has developed there's a lot of inventions have been made. The best invention was made are design by a team from Harvard back in 1930 that used a punch card that was inserted to a computer that would read and the information will be sent to the store. This system was very expensive, but it can manage the inventory system very well (Buntak, Kovačić & Mutavdžija, 2019; Panigrahi, Jena & Jena, 2020 and van Geest, Tekinerdogan & Catal, 2021)

Nowadays, the bar-coding and RFID system has been invented. Some of the business owner also use the micro-chips that transmit everything about the products information that are relevant to the business owner. The inventory management system was mandatory for all business owner who holds a lot of stocks such as Shein, Amazon, J&T Express and lots of other big company.

2. Methodology

This chapter consists of a way or method used to achieve the objectives and the purpose of this project. Methodology makes the conducted project more systematic, and the project journey becomes easier on achieving the objective. The researcher has planned the ways and the methodology used to find the information and the data through some sort of method. Also, will discuss in detail a few important things in the methodology and strategies used in completing the project in this chapter.

Design and Development of IoT Based Inventory Management System for Small business are used by small business owner to keep in track of their stock wherever they are away from the storage place/home. Also, the owner does not have to manually count their stocks anymore. This project functions by the load cell detecting

the weight measurement of the stock. The differences between this project with other inventory management systems is that this project used the IoT technology to send the information of the stock. Also, the design of this project is also suitable and that will help all the small business out there.

2.1 Project Design

The type of project that will be making is the real type project that is producing a prototype machine in inventory management system for small business owner. This project aims to ease the management of stock for small business owners. In completing this project, the researcher has constructed a flowchart for the project to show the process and the step.
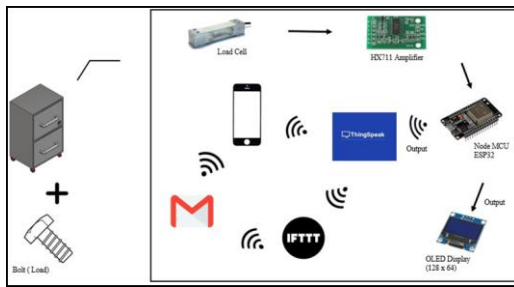

Fig. 2. Block diagram

3. Result and Discussion

Proceeding, Chapter 3 of the project progress report contains the results obtained from the project and discussions that can be made based on the achieved results. This chapter will cover the design concept of the IoT based inventory management system using load cell and Node MCU. A few discussions will also be included.

3.1 Study Findings

In this project the researcher has created a drawer that can automatically detect the number of stock left. Testing this project requires some samples to set as an example for the stock. An example of some objects that has been made to use as a sample is a nut and bolt (17pcs). This testing will prove which object is the most suitable to become an example for this project. The measurement used in this testing in grams (g) and there are some formulae that are used that is:

a. Nut Calculations

$$d = biggest\ value - lowest\ value \qquad (1)$$

$$= 23.1 - 20.6$$

$$= 2.5\ g$$

$$t = Plus\ Total\ Everything \qquad (2)$$

$$\begin{aligned} &= 20.6 + 21.1 + 21.1 + 21.3 + 21.3 + 21.1 + 21.1 \\ &\quad + 21.7 + 21.6 + 21.8 + 21.5 + 21.3 + 22.5 + 22.4 \\ &\quad + 23.1 + 22.1 + 22.5 \end{aligned}$$

$$= 368.1\ g$$

$$a = Total\ weight\ (g)\ /\ Number\ of\ quantity\ (17pcs) \qquad (3)$$

$$= 368.1\ /\ 17 = 21.6\ g$$

b. Bolt Calculation

$$d = biggest\ value - lowest\ value$$

$$= 44.1 - 43.7$$

$$= 0.4\ g$$

$$t = Plus\ total\ everything$$

$$\begin{aligned} &= 43.9 + 44.0 + 43.9 + 43.8 + 43.8 + 43.8 + 43.7 \\ &\quad + 43.9 + 44.1 + 43.7 + 43.8 + 43.9 + 44.0 + \\ &\quad 43.9 + 43.7 + 44.0 + 43.9 \end{aligned}$$

$$= 745.8\ g$$

$$a = Total\ weight\ (g)\ /\ Number\ of\ quantity\ (17pcs)$$

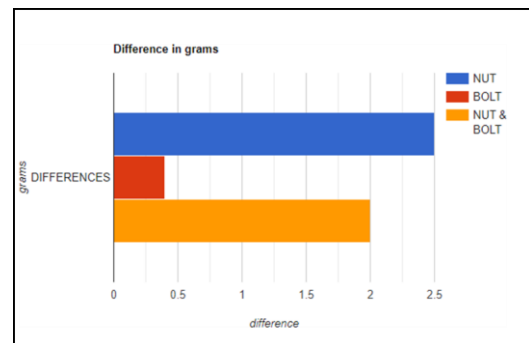$$= 745.8\ /\ 17 = 43.8\ g$$

Fig. 3. Nut data

Fig. 3 shows the difference in grams for nuts. In this project weight similarities between each stock are very important because the sensors that are used that is Load cell have a fewer sensitive senses. Hence it is not suitable to use project example with a big difference in weight with each other. The number of pieces left will give a different value that are wrong.

Refer to the graph, the bolt has the very lease different in weight with each other that is only 0.4 g. Next the nut shown on the graph, has a very big difference with each other that is 2.5 g. Lastly for the nut, the difference is not

that small, because the difference is 2.0 g. From the bar graph above we can clearly see the perfect object that can be used as an example for this project. This project will be using the bolt as an example for the project because the slight difference in weight can avoid any miscalculation when the sensor is reading the weight.

4. Conclusion

The summary that can be made based on the development of the project report is that the design of the IoT based inventory management system using load cell and NodeMCU was constructed successfully. The project aims to design an IoT based inventory management system that tackles the problem involving small items inventory. The implementation of this project will be useful for small stocking inventory as such a hardware department in a factory or a hardware store. The progress for is that the project's design was successfully constructed by using the Fritzing software. A circuitry connection on a breadboard and donut board and the schematic view of the connections was constructed and obtained. The programs for the microcontroller were also written. The code writing process was done using the Arduino IDE software successfully.

There are several things that can be upgraded for future recommendation that is from the design of the project have only one compartment to store the stock so in the future recommendation, more space/drawer that can be used to store product. Also, for the weight maximum in one drawer that is 1 kilogram only. It is unusable because 1kg can only put light objects, some of small business owner store their stocks with a larger weight, hence the future recommendation is that the maximum value of the drawer will be upgraded to 5 kg or 10 kg. To summarize all that has been indicated above, objective one of the IoT based inventory management system using load cell and NodeMCU which is to build the IoT based inventory management system using load cell and NodeMCU have been successfully achieved.

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Effort of Politeknik Malaysia as TVET institute in Attaining Sustainable Development Goals (SDGs) Through Twelfth Malaysia Plan

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Abstract

The introduction and accomplishment of Sustainable Development Goals (SDGs) has been a top priority in Malaysia. SDGs consists of seventeen goals which offers sustainable and good opportunity to reinvigorate in many sectors. Importance of SDGs is well reflected through the alignment of SDGs in the recent five-year national development plans, The Twelfth Malaysia Plan 2021-2025 (Twelfth Plan). Equipped with three themes, reinforced by four policy enablers and fourteen game changers, Twelfth Plan intents to solve current national issues besides rejuvenating Malaysia socioeconomic especially from the challenging period caused by Covid-19 pandemic. Based on Game Changer X stated in the Policy Enabler 1, this paper aims to focus on the role of Politeknik Malaysia as a TVET institute to be an effective tool in producing skilled human resources that can ultimately drive Malaysia to attain sustainable development. Based on this state of affairs, it was found that there are four common goals which can produce a healthy integration between SDGs, Twelfth Plan and Politeknik Malaysia. Through the integration, Politeknik Malaysia is hoped to update their outline and alter their strategy to demonstrate their significant contribution towards building a successful nation.

Keywords: - Sustainable Development Goals (SDGs), Technical and Vocational Education and Training (TVET), Politeknik Malaysia, Fourth Industrial Revolution (IR4.0)

1. Introduction

Sustainable Development Goals (SDGs) is one of the UN's 2030 agenda, consisting five crucial dimensions; People, Prosperity, Planet, Partnership and Peace (5P). The 2030 agenda envisions unequivocally humankind rights which mainly to eradicate poverty, create job opportunities, access to quality education at all levels, health coverage, gender equality achievement, women and girls empowerment and environmental balance (Canada ca, 2023). SDGs progressed from the Millennium Development Goals (MDGs), covering all outstanding objectives and taking into account new difficulties while taking advantage of lessons learned during the MDGs'

execution (Halkos & Gkampoura, 2021). Consisting 17 goals, SDGs offer an ambitious revolutionary action plan that addresses major issues pertaining to the socioeconomic and environmental facets of contemporary civilizations. SDGs framework plays a major influence in The Twelfth Malaysia Plan 2021-2025 (Twelfth Plan) where the priorities were created with the goal of "A Prosperous, Inclusive, Sustainable Malaysia" and based on the SDG's "leaving no one behind" theme. Twelfth Plan acts as a roadmap to direct the nation's investment together with the development plans and to track their accomplishment progress towards the designated goals within the 5 years time frame (12th Malaysian Plan, 2021). This comprehensive roadmap is expected to

overcome numerous obstacles, including prioritizing objectives and targets, customizing national strategies and policies, managing trade-offs, and securing enough funding to support the shift to more sustainable development agendas. The acquisition of knowledge and abilities to support development is crucial for positive growth which can be achieved through proper education only.

McGrath et al. and Sousa et al. denoted that education is a type of learning in which a group of people's knowledge, skills, and habits are passed down through teaching, training, or research from one generation to the next. Since it is a significant investment in human development, education has great impact on productivity and growth over the long term. (McGrath et al., 2018)(Sousa et al., 2022). Peaceful environment, sustainable development, and nation-building are seen as benefits of education. Compared to their peers who lack of proper education, children and adolescents who can read, write and count, are more likely to have a better future. Besides that, education has always been the major contributor to economic growth, income distribution, political stability, increased equality of opportunity, human resource skill development, improved health, and low crime rates (Ojiambo, 2009). Globalization necessitates that the world's population quickly adapt to new technologies and learn to use them. Education has an impact on sustainable development that extends beyond developing regions; but the entire world as a whole. The goal of SDG 4 is to provide everyone with an education that will help them improve their lives and the future of their communities (Forhad et al., 2022) (Kipli & Khairani, 2020).

The increased focus on Technical and Vocational Education and Training (TVET) in recent years are reflected via the prominence in the 11th and 12th Malaysian Plans (2016-2020 and 2021-2025, respectively) (Aziz & Subramaniam, 2023). Being touted as game changer, TVET which is the abecedarian means for technically accustoming the youth who'll steer the SDGs programmes towards eradicating poverty, enhancing food security, encouraging gender commission, perfecting quality of life, and sustainable progress (Ogwo, 2018). Strength of TVET institutions depends mostly on the practice of psychomotor skills that are competent with the current needs of industry in order to produce skillful workforce (Bakri & Zakaria, 2018). Recently on February 2023, the future about TVET issues was addressed by Prime Minister of Malaysia, Datuk Seri Anwar Ibrahim during a press met. Few issues were defined such as talent mismatch, unsatisfactory facilities and existing training that is not required by the industry. Immediate steps were proposed especially establishing better partnership involving the private and government agencies to empower TVET programs. It is important to meet the needs of the industry as well as well as preparing TVET students for a suitable jobs with reasonable income (Editorial, 2023). If these issues are not solved, it will cause controversy over the role of TVET in meeting

sustainable development goals (Editorial, 2023). As a TVET institute under Ministry of Higher Education Malaysia, Politeknik Malaysia is of the post-secondary education institute choice for Sijil Pelajaran Malaysia (SPM) graduates for those who are interested in technology and vocational skills-based studies. Politeknik Malaysia has 6 strategic cores where each of them focuses on the important context of National Higher Education. The 6 strategies are as follows; 1) produce quality TVET graduates, 2) strengthen responsive and sustainable governance, 3) enrich talent 4), led the education system through TVET4.0, 5) Strengthen industry and community collaboration and 6) cultivate applied research and innovation.

As far as the authors' knowledge, there is no study conducted in establishing a significant relationship between SDGs, Twelfth Malaysian Plan and Politeknik Malaysia. This review provides insight about the evolution, importance, impact and role of Politeknik Malaysia in attaining SDGs, thus helping in achieving Twelfth Malaysia Plan.

2. Politeknik Malaysia as TVET institute

As mentioned in the Malaysia Education Blueprint 2015-2025 (Higher Education), the Malaysian government has put immense effort in building up the TVET framework and to increase enrolment of students in TVET based institute (Wei & Jamil, 2019). The country's TVET began with the establishment of the Treacher Technical School (named after Sir William Treacher, the Resident General) managed by the Public Works Department Federated Malay States in 1905. After that, this technical school was taken over by the Education Department from 1931 until 1964. During that period, Technical and Vocational Education Division under Ministry Pelajaran Malaysia was established with the responsible of promoting technical education and vocational. In 1995, the Polytechnic Management Division under the supervision of the Technical Education Department (Jabatan Pendidikan Teknikal or JPTek) is responsible for managing polytechnics.

Polytechnic Education was first introduced in Malaysia through the United Nations Development Plan United in 1969 and was further strengthened through an agreement by the cabinet in the Education Plan Implementation (1979) and the National Industrial Plan in 1985-1995. At the year 1991, the Malaysian cabinet has decided to increase the number of polytechnics and graduate lists to meet the needs of semi-professional personnel in the field of engineering, trade and services. The first polytechnic established in Malaysia was Politeknik Ungku Omar, Ipoh, Perak Darul Ridzuan. The vision of Politeknik Malaysia is to be the leading-edge TVET institution and the missions are as follows; 1) To provide wide access to quality and recognized TVET programs, 2) To empower communities through lifelong learning, 3) To develop holistic, entrepreneurial and balanced graduates and 4) To capitalize on a smart

partnership with stakeholders. (Ministry of Education Malaysia, 2018). The current locations of 36 polytechnics in Malaysia are shown in   Fig.1.
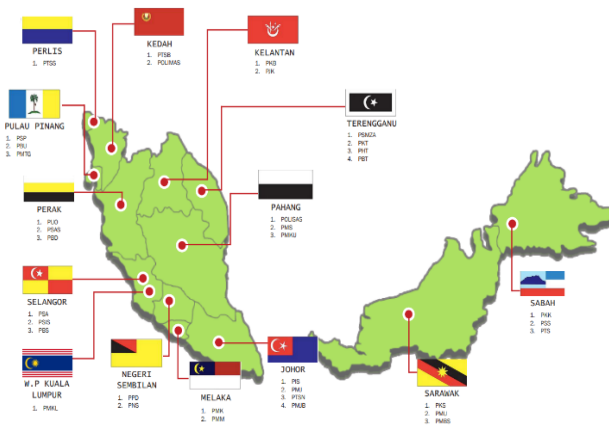

Fig. 1. Polytechnics in Malaysia

The Community Colleges were established on 5 July 2000 at each parliamentary constituency. This is intended to give alternative route to improve skills and techniques for high school graduates besides to improve the socio-economic level of the local community through short courses, certificate level in engineering, technology and services as well as a special skills certificate for students with disabilities. Community college begins operating with 12 pilot colleges in 2001 under the responsibility of JPTeK. In order to reunite the role of Polytechnics and Community Colleges as TVET institute, Polytechnics and Community Colleges were merged under one department on 24 March 2017. The new organizational structure of the Department of Polytechnic and Community College Education (also known as Jabatan Pendidikan Politeknik dan Kolej Komuniti - JPPKK) was approved by the Public Service Department (JPA) on 23 February 2018. Thus, the Polytechnic and Community College Strategic Plan (2018 – 2025) was developed by JPPKK to transform TVET in the national higher education system through strategic initiatives.

The implementation period of the Polytechnic and Community College Strategic Plan (2018 – 2025) is divided into two phases, namely: Phase I (2018 – 2020): Driving System Upgrades and Phase II (2021 – 2025): Moving Towards Excellence. The Strategic Plan consists of 6 core strategics which are to produce quality TVET graduates, strengthen responsive and sustainable governance, enriching talent, leading the education system through TVET 4.0, strengthen collaboration between industry - community and cultivating applied research and innovation (JPPKK, 2021). At present, Politeknik Malaysia offers 8 degrees, 77 diplomas, 2 pre-diplomas and 5 special skills certificate programs with almost 93.7% employability success rate. Based on the report from Economic Planning Unit Prime Minister's Department, TVET in Malaysia is delivered by various institutes from government and private sectors as

illustrated in Fig.2.

Public training institutions are under ministries namely the Ministry of Human Resource (MoHR), Ministry of Education (MoE), Ministry of Youth and Sports (MoYS), Ministry of Regional and Rural Development (MoRRD), Ministry of Agriculture and Agro-Based Industry (MoA), Ministry of Works (MoW) and Ministry of Defence (MINDEF). Recently JPPKK was reassigned under Ministry of Higher Education (MoHE) to conduct TVET programmes with varying quality and standards, parallel to public universities (Economic Planning Unit & Prime Minister's Department, 2015). Besides that, Politeknik Malaysia acts as a provider of skilled worker to meet industry needs besides enabling the students to further their studies in undergraduate degree studies.

3. Sustainable Development Goals (SDGs) and Twelfth Malaysia Plan

Sustainable Development Goals (SDGs) was introduced by the United Nations (UN) worldwide in 2015. Agenda of SDG is to transform the world via by ensuring human well-being, economic prosperity, ending poverty, and environmental protection by the year 2030. Implementation of SDG requires the collaboration of both developing and developed countries (The United Nations General Assembly, 2023). SDGs was evolved from the Millennium Development Goals (MDGs), focusing on all the unfinished agendas of MDGs. MDGs consist of 8 Goals only and focused with 21 targets. Meanwhile, SDGs include 17 Goals with 169 targets, mainly targeted to continue the pending agendas of MDGs, utilizing the experience gained during the implementation of the MDGs, establishing global partnership, sustaining the momentum and taking into account about additional challenges such as inclusiveness, equity, and urbanization (Kumar et al., 2016).   The goals under SDGs are as follows; GOAL 1: No Poverty, GOAL 2: Zero Hunger, GOAL 3: Good Health and Well-being, GOAL 4: Quality Education, GOAL 5: Gender Equality, GOAL 6: Clean Water and Sanitation, GOAL 7: Affordable and Clean Energy, GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure, GOAL 10: Reduced Inequality, GOAL 11: Sustainable Cities and Communities, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action, GOAL 14: Life Below Water, GOAL 15: Life on Land, GOAL 16: Peace and Justice Strong Institutions and GOAL 17: Partnerships to achieve the Goal.

SDGs is likely to show a pivotal role in 5 different dimensions, namely the People, Planet, Prosperity, Peace and Partnership over the next 15 years (2016 – 2030) as shown in Fig.3 (Economy, 2023). The priorities of the Twelfth Malaysia Plan were developed with the objective of 'A Prosperous, Inclusive, Sustainable Malaysia' and based on SDG's principle of "leaving no one behind". Besides that, the Twelfth Malaysia Plan stresses that SDGs should be implemented from the local level in order to benefit all the Malaysians. Introduced at the year 1965,

The Malaysia Plan (or known as Rancangan Malaysia) is a five-year development plan which assimilate government policies and strategies, guiding the government to achieve anticipated economic and socioeconomic goals. Currently, Malaysia is in the Twelfth Malaysia Plan 2021-2025 (Twelfth Plan) or known as Rancangan Malaysia Keduabelas 2021-2025, emphasizing on three key themes and underpinned by four catalytic policy enablers as shown in Fig.4. The role of these policy enablers is to form the foundation and building blocks of Twelfth Plan (INTAN, 2022).
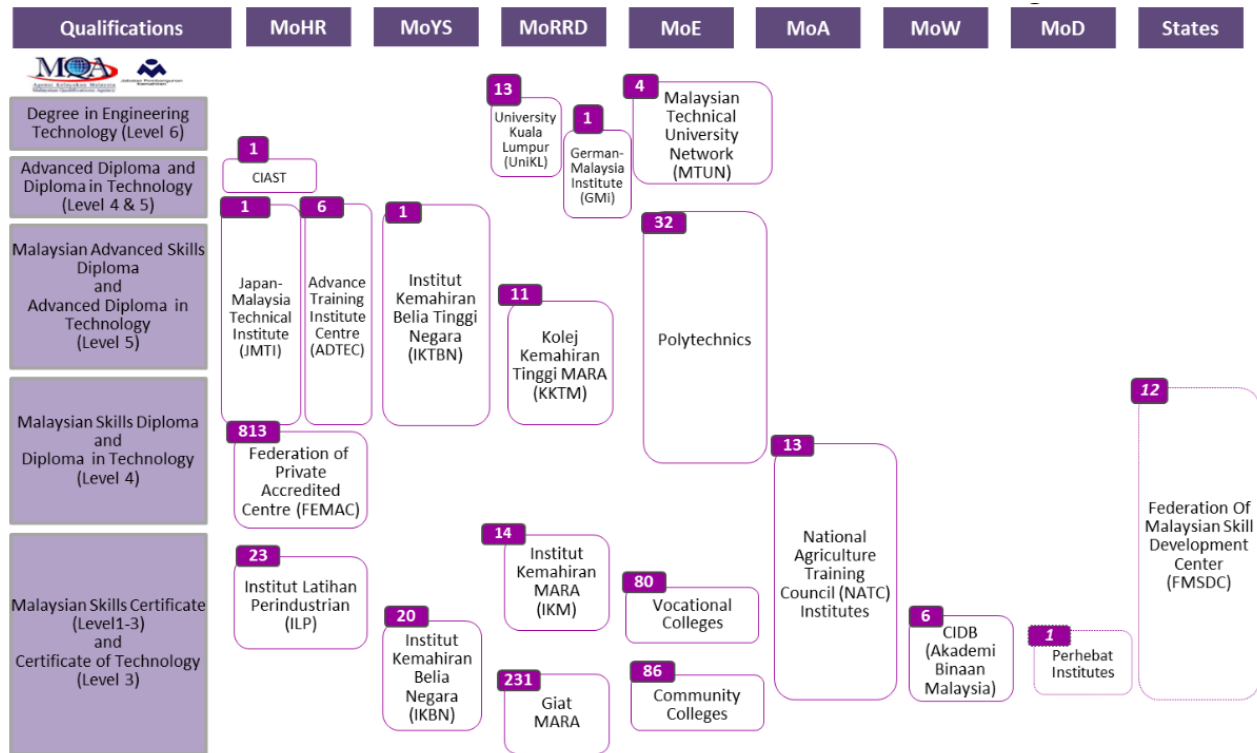

Fig. 2. TVET framework in Malaysia (Economic Planning Unit & Prime Minister's Department, 2015)

Fig. 3. Seventeen Goals in Sustainable Development Goals (Economy, 2023)

These themes and policy enablers will be supported by fourteen Game Changers. Each Game Changers represent bold and innovative actions to shift mindsets and change the approach to national development. The list of 14 Game Changers is as follows:

i. Game Changer I: Imperatives for Reform and Transformation
ii. Game Changer II: Catalysing Strategic and High Impact Industries to Boost Economic Growth

iii. Game Changer III: Transforming Micro, Small and Medium Enterprises as the New Driver of Growth
iv. Game Changer IV: Enhancing National Security and Unity for Nation-Building
v. Game Changer V: Revitalising the Healthcare System in Ensuring a Healthy and Productive Nation
vi. Game Changer VI: Transforming the Approach in Eradicating Hardcore Poverty
vii. Game Changer VII: Multiplying Growth in Less Developed States especially Sabah and Sarawak to Reduce Development Gap
viii. Game Changer VIII: Embracing the Circular Economy
ix. Game Changer IX: Accelerating Adoption of Integrated Water Resources Management
x. Game Changer X: Improving TVET Ecosystem to Produce Future-Ready Talent
xi. Game Changer XI: Enhancing Digital Connectivity for Inclusive Development
xii. Game Changer XII: Aligning Research and Development towards Commercialisation, Wealth Generation and Economic Growth
xiii. Game Changer XIII: Transforming the Logistics Ecosystem for Greater Efficiency
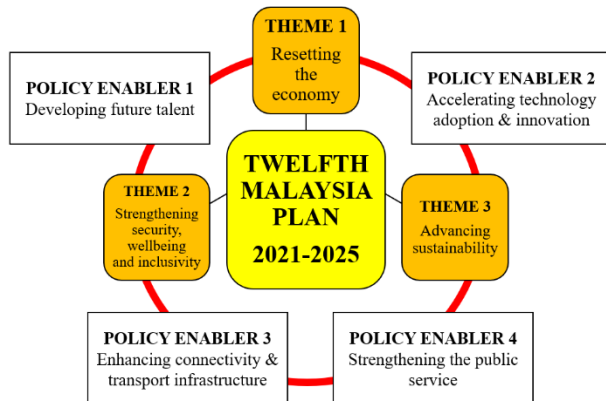xiv. Game Changer XIV: Transforming the Public Service through the Whole-of-Government Approach

Fig. 4. Twelfth Malaysia Plan (2021-2025)

4. Impact of Twelfth Malaysia Plan on TVET

The formulation of the Twelfth Plan was very critical since the Coronavirus disease (COVID 19) pandemic has altered commercial operations, how people interact and created inequalities in socioeconomic at global level (The Ministry of Economy, 2023). Therefore, The Twelfth Plan is a major national agenda to restore the economic stability as well as holistically regenerate and revive national economic, which will generate higher productivity growth, especially after the COVID 19. Henceforth, for better labour market conditions, most focus must be aligned with Fourth Industrial Revolution

4.0 (IR 4.0) by providing digital economy enabled economy, intensifying Research, Development, Commercialization and Innovation (R&D&C&I) as well as developing essential talent (12th Malaysian Plan, 2021). However, Economic Planning Unit of The Malaysian Government has highlighted many tenacious issues in the labour market and education sector. Some of the issues are low percentage of compensation of employees, incompetent labour market, limited access to quality education and weaknesses in the governance of educational institutions along. In addition, pandemic COVID 19 has also played a major role in creating new norms in work environment and business operation, besides increasing unemployment rate. Hence, the Twelfth Plan focuses on restoring the labour market, education and training through the implementation of Policy Enabler 1 (Developing Future Talent). Among the key initiatives for realigning and restrengthening labour market is by endorsing reasonable compensation for employees such as salary, wage, benefits, bonuses, paid leave, pension funds, and stock options. In addition, enriching the quality of education especially through leveraging emerging technologies based on IR4.0 are expected to improve the downside in education and training system. Policy Enabler 1 can be achieved with the support of Game Changer X, which is to improve TVET ecosystem to produce future-ready talent that can better meet the industry demand. Malaysia will be able to champion the adoption of IR4.0 with the accessibility of skilled technical workers in abundance as an imperative loophole in the existing TVET system could be reduced (Latif & Saari, 2023) (Ishar et al., 2020)(Wafi et al., 2023). To achieve this, TVET institutes should make sure their graduates to be future-ready talent through these strategies:

i. Enhancing the method and quality of delivery and training of TVET through improvement in accreditation, recognition and certification from authorized bodies such as Malaysia Board of Technologists (MBOT), Engineering Technology Accreditation Council (ETAC) and Asia Pacific Accreditation and Certification Commission (APACC). Besides these, The Human Resources Ministry's Department of Skills Development and Education Ministry's Malaysian Qualifications Agency (MQA) accredits the skills sectors and the vocational academic, respectively.

ii. Introduction of ranking system among TVET institutions to assist the allocation of fundings which will be determined based on employability, wage levels of graduates, industrial engagement and the implementation of social works (such as Corporate Social Responsibility related activities ~ CSR) in rural areas.

A strong TVET ecosystem will act as a vital accelerator for the nation's socioeconomic development, enabling Malaysia to effectively solve enduring concerns such as relying solely on foreign labour, low compensation for employees, and poor student

performance. As part of the emerging technologies, artificial intelligence, virtual reality, and augmented reality will soon leverage the traditional hands-on teaching and learning methods. These applies on laboratory research and development too. These adoption can raise the people's standard of living through flexible labour market like gig workers (Economic Planning Unit of The Malaysian Government, 2021).

TVET demonstrate crucial role in human resource development of a nation by incorporating technologies, sciences, practical skills, attitudes, understanding and knowledge related to current or upcoming occupations in various sectors (Islam, 2021) (Rajadurai et al., 2018). TVET institutions are required to produce high-quality workforce with the exposure of the latest technology to accommodate the request from high-value competing manufacturers (Sulaiman & Salleh, 2016) (Yaakob, 2017). Despite consisting of different vocational programs, IR4.0 pushes the TVET institutions to revise their academic curriculum based on the latest needs of industry for a unanimous goal which is significantly contributing to the national development through progressive economic progress (Ra et al., 2019). Combining formal, informal and non-formal learning, TVET is highly regarded to provide required knowledge and skills which are the value-added components for technical graduate marketability especially in middle-income countries such as Malaysia (Rajadurai et al., 2018). These findings were also highlighted by the Prime Minister of Malaysia, Dato'Seri Anwar Ibrahim where he stressed about the importance of TVET in nation development and the willingness of government to allocate more fundings to uplift TVET in Malaysia (RTM, 2023). Hence Politeknik Malaysia as part of TVET institutes also need to be alert, up-to-date and emerge as a competitive body for the benefit of the students. In other words, TVET-providing educational institutions, such polytechnics should meet the demand of global community by embedding youths with hands-on skills and job readiness through schooling and vocational training (D Cavanagh, G Shaw, 2013) (Victoria Levin et al., 2021). Forhad et al. also agreed in their studies that TVET has the highest ability to ameliorate the rate of employability, efficiency, and incomes of graduates (Forhad et al., 2022). More importantly, polytechnics could impart the proper mindset and attitude among trainees and the future workforce yet appropriate policies and skill-building initiatives need to be strengthened (UNESCO-UNEVOC, 2023).

5. Effort of Politeknik Malaysia in attaining the SDGs

Politeknik Malaysia acts as a TVET provider in Malaysia under the administration of JPPKK which is managed directly by Malaysian Higher Education Ministry (MOHE) as mentioned before. With the education goals of providing TVET graduates who are holistic, competent and capable of contributing to national development, Politeknik Malaysia is considered one of the leading TVET institute with various recognition from national and international bodies (JPPKK, 2023). The Twelfth Plan's education and training sector strategies include a number of goals for TVET impact, but Politeknik Malaysia's role and effort in achieving the SDGs are still largely unknown and unmentioned.

Nevertheless, Politeknik Malaysia has embarked into proactive commitment in ensuring the achievement of SDG through the launching of POLYGreen Blueprint Polytechnic Malaysia 2015-2020 (BPPM 2015-2020) on 1 April 2015 at Politeknik Merlimau Melaka. BPPM 2015-2020 is a guideline for green practices implementation with the intention of making polytechnic as a superior, excellent and sustainable institution in accordance with its role as a leader in TVET in Malaysia. One of the latest actions done by JPPKK was transforming BPPM 2015-2020 to Blueprint SmartGreen Polytechnic Community College 2021-2026 (BSGPC 2021-2026). BPPM 2015-2020 stresses more towards green technology and contains ten Focus Areas, meanwhile BSGPC 2021-2026 has wider, comprehensive coverage by emphasizing all 17 SDGs contained with seven (7) Areas Focus (JPPKK, 2020).

As a TVET institute, Politeknik Malaysia stands strong at a critical position as a fundamental pillar in addressing knowledge and skills challenges to achieve SDGs through Twelfth Plan as shown in Fig.5. According to the report published by the Commonwealth of Learning, it shows that all seventeen goals in SDGs can be attained through the competencies of TVET itself (Learning, 2022). They also discussed about the role of TVET programs, people engagement, additional skills needed and the best practice with appropriate awareness to assist the success of each goal.
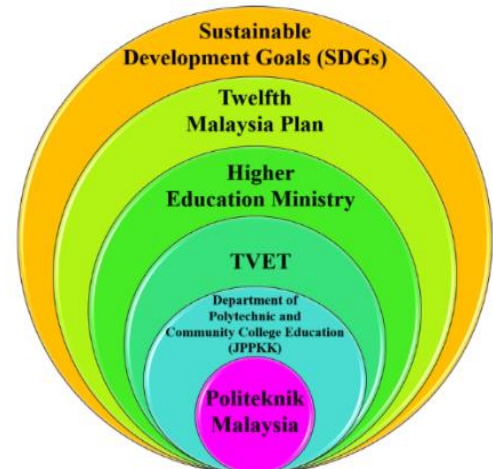

Fig. 5. Position of Politeknik Malaysia in attaining SDGs

This demonstrates that with a proper education system especially polytechnics, the future of any nation can be upgraded as long as the emerging technologies are complied and made-easy-to-access to all levels of human – from government, industries, schools until normal citizens. Anyhow, the present study focuses on the

possible common goals which can interlink TVET, SDGs and Twelfth Plan (Policy Enabler 1 and Game Changer X) with an expectation for decent job creation and economic development. Fig.6 summarizes the relationship which exhibits integration, thus revealing the potential goals between SDGs, Twelfth Plan and Politeknik Malaysia.
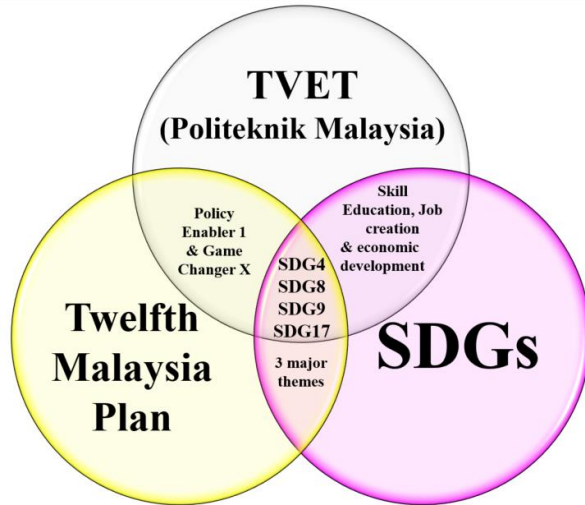

Fig. 6. Mapping between SDGs, 12th Malaysian Plan and Politeknik Malaysia

Based on the integration defined in Fig.4, Fig.5 and Fig.6, the identified potential common goals are SDG 4 (quality education), SDG 8 (decent work and economic growth), SDG 9 (innovation and infrastructure) and SDG17 (partnerships) due to their close relationship with TVET. These findings are also aligned with the report from Bang et al. (Bang & Park, 2021). As stated earlier, the syllabus of polytechnics is based on skills-based education and enhanced with the application of emerging technologies. Besides that, the syllabus and courses of each polytechnic are well monitored by selected industrial panels who ensures that the course outline, skills delivery, machines and laboratory works are at topnotch.

SDG 4 ensures inclusive, equitable quality education and promotes lifelong learning opportunities for all. The target is to increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship. Remarkably, SDG 8 displays interlinks with SDG 4 where SDG 8 promotes sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. For example, if a Green Technology based company has a job vacancy for Solar panel installation (SDG 8 compliance via decent job opportunity), any graduates with Diploma in Electrical Engineering (Green Energy) qualification can easily fill the job requirement as they are well exposed with a necessary technical education (SDG 4 compliance via equitable quality education and skills). Besides that, Politeknik Malaysia also involved in promoting local business through social innovation projects such as research work and collaborating with local food

manufacturers (Tempeh and Trigona Honey) which is SDG 8 compliant (Ismail, 2011). These can be applied in all the courses offered by Politeknik Malaysia such as Diploma in Food Service Halal Practice, Diploma in Urban and Regional Planning or International Business Diploma as it can provide life long learnings.

On the other hand, SDG 9 emphasizes in building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation such as IoT, Big Data, AI or development of electric vehicles (EV). These innovations will shift the market toward new smart technologies, thus increases the demand for the workforce with smart application development skills. To fulfil the demand, Politeknik Malaysia graduates are not only exposed with latest technology related syllabus but also had the opportunities to involve in many skills related competition such as FIRA RoboWorld Cup and WorldSkills Malaysia Belia (WSMB). Nevertheless, the impact of Covid-19 pandemic has forced rapid technological changes to the TVET system. All students and also educators are literally forced to be involved in hybrid or online based education, hence shifting the education style with the intense application of online infrastructures such as Zoom, MsTeams, Google Meet, cloud storage and Skype. Besides that, SDG 9 also targets on enhancing research and upgrading industrial technologies. Knowledge and skills related to emerging technologies are enhanced systematically through the expenditure from the ministry for researchers. With the findings, Malaysia will not only profit in terms of technology development, but also improvement in terms of humanity, culture, and society. R&D&C&I unit in JPPKK plays a key role that covers basic research, applied research, and experimental development for the benefit of the academicians and students by offering TVET Applied Research Grant Scheme (T-ARGS). T-ARGS provides a vast opportunity to members of Politeknik Malaysia to conduct beneficial researches for the community.

SDG 17 encourages and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships in order to achieve significant goals (Ritchie et al., 2018). Politeknik Malaysia has developed strong and close partnerships with industries, government agencies and other academic centers through successful collaboration in R&D which also consists of specific technology groups, industrial projects, funded research projects and consultancy projects. Besides establishing a work-integrated environment for the students, these partnerships are advantageous through sponsoring student internships, curriculum development and workforce training through competent workshops. One of an international partnership is with The Federation of International Sports Association (FIRA) through the annual participation of Politeknik Malaysia in the FIRA RoboWorld Cup. The goal of this collaboration is to use robotic sports as benchmark for state-of-the-art research in robotics which includes autonomous flying robots,

robotics research and urban search with rescue robots which prepare the graduates towards IR4.0. This strategic partnership serves as the main platform for sharing knowledge, carrying out collaborative activities, implementing corporate social responsibility (CSR) programs and conducting research, publication, and consultation.

SDG 4, SDG 8, SDG9 and SDG17 have the common that can be related to all courses in Politeknik which will assist in accomplishing the SDGs and Twelfth Malaysia Plan. Anyhow, other SDGs will not be neglected. Beside the potential common SDGs discussed above, there are still many courses in Politeknik which can contribute specifically to others SDGs. For example, Diploma in Environment Engineering offered by Politeknik Sultan Idris Shah can be related to SDG 13 together with SDG 4, SDG 8, SDG7 and SDG17 as this course is correlated with pollution, control, laws and quality maintenance of environment.

Basically, this research paper also calls for rethinking new approaches and improve current models in use. With this, Politeknik Malaysia is expected to embrace new or to update TVET frameworks that offer SDGs-oriented syllabus and gives good influence towards the marketability of technical graduates.

6. Conclusion

This paper has attempted to exhibit the reinvigoration of TVET system in achieving SDGs. This is greatly needed, since the principles and practices of SDG are important not only in accomplishing the Twelfth Malaysia Plan, but they are essential for the well-being of academician, staffs and graduates of Politeknik Malaysia. This study sought to examine how the SDGs were being implemented at every level and to urge TVET policymakers to give priority in embed SDGs in the curriculum. In this context, few suggestions can be taken note by the ministry especially JPPKK such as:

i. increasing the interdisciplinary and transdisciplinary among different courses such integrating knowledge of IOT with agriculture, hotel management or food technology courses offered by Politeknik Malaysia.

ii. to further develop local-level relationship with small & medium enterprise (SME) to properly recognize and manage the influences of local companies on sustainability.

iii. to bring research closer to community through student – society engagement via the final year student's project.

Moreover, collaboration, focus on research, networking and keeping up with emerging technologies reinvigorate the role of Politeknik Malaysia to represent TVET institute in attaining the SDGs and Twelfth Malaysia Plan. Achieving SDGs through TVET is a long-term process which entails preservation of environment, implementation of IR4.0 concept, capital investment, mindset changes, social equity, integration of SDGs into

existing TVET governance structures and allowing an abundance of R&D&C&I opportunity among the members.

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Development of Automated Recycle Bin for Domestic Use using Arduino Uno

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Abstract

Domestic waste is one of the biggest contributors to the nation's solid waste generation. It comprises of all solid waste material produced from household activities such as food waste, bottles, papers, plastic, and aluminum waste. The evolution of waste management has changed from time to time. Solid waste and public cleansing management that is efficient & effective is important to make sure the high quality of life environment stays clean and safe, as well as healthy. Therefore, an automated recycle bin has been developed to separate waste such as paper, plastic and aluminum then segregate it automatically and assign all the waste to its specific bin compartment according to their classes. This bin is operated by using an Arduino UNO microcontroller used together with three other sensors. The infrared sensor is used to detect the presence of paper waste, the LDR light sensor will detect the presence of plastic waste and the inductive proximity sensor will detect the presence of aluminum waste. The result from the test that was carried out shows that the automated recycle bin is reliable and can segregate domestic waste efficiently. It can detect and segregate an average of more than 83% of the waste that is being thrown away.

Keywords: - Automated recycle bin, smart bin, domestic waste, recycling, Arduino Uno

1. Introduction

Society in Malaysia is increasingly producing a lot of waste. In an article report by Raja Hisyam from Astro Awani, it mentioned that the Chairman of the Solid Waste Management and Public Cleaning Corporation (SWCorp), Datuk Rizalman Datuk Mokhtar estimated that more than 38,000 tons of domestic waste are produced by Malaysians every day. In fact, the amount will increase up to 20 percent each time before the festive season. This problem requires a change in the public's attitude to ensure more effective solid waste management.

Solid waste includes any scrap material or other unwanted surplus substance or rejected products arising from the application of any process or any substance required to be disposed of as being broken, worn out, contaminated, or otherwise spoiled. Household solid waste means any solid waste generated by a household, and of a kind that is ordinarily generated or produced by any premises when occupied as a dwelling house and includes garden waste. Recyclable solid waste means controlled solid waste which is suitable for recycling as may be prescribed (Solid Waste and Public Cleansing Management Act, 2007).

The concept of reduce, reuse, and recycle are encouraged to be practiced. Reduce is an effective environmental management through reduction of solid waste making. It means cutting down the number of products and types of products that are used and consumed so that less waste is generated. This may also refer to the reduction of use of natural resources.

Reuse, on the other hand, refers to the repeated reuse

of goods, and by doing so waste generation and disposal can be reduced. This refers to making use of items again and again, and by doing so less waste will be created and discarded. Using the same product or goods several times will help to ensure an environment that stays safe and clean. The last one is recycle where the word recycle is made up from two words that is 're' which means to do again and 'cycle' refers to round or to go around. So, recycle refers to putting things in a cycle or loop. Recycle is done by separating wastes, and then channeling them to organizations or manufacturing plants, which can re-process them into new products for consumption. The international symbol for recycling is the Mobius Loop, a special circle that suggests a continuous cycle. (Ministry of Housing and Local Government Malaysia, 2006).

Statistics from the National Solid Waste Management Department show that last year, the country only recorded a recycling rate of 31.52 percent while most developed countries recorded at least 60 percent. The inefficient recycling solutions to handle this waste have led to air, water, and even soil pollution, thus affecting the environment. It was highlighted that solid waste management is based on solid hierarchy. This hierarchy consists of a few elements that are important as shown in Fig. 1.

Fig. 1. Hierarchy of solid waste management (The Waste Management Association of Malaysia, 2011)

Returning recyclable materials from household waste will reduce the consumption of raw materials and protect the environment. The Waste Management Association of Malaysia has recommended three different bins for recycling purposes which are blue for paper, brown for glass and orange bin for plastics and metals. However, according to Zaini et al. (2008), waste disposal still does not reach 40% percentage of disposal according to their correct class. Society still finds difficulties identifying the type of waste material to be put in the correct bin thus making these waste cannot be separated correctly according to their correct classes. To provide three different bins will also involve a more expensive cost and a larger space. Therefore, an automated recycle bin is developed to segregate all these wastes and separate them automatically into its specific bin compartment according to the respective classes.

Fig. 2. Types of recycle bin in Malaysia

2. Methodology

The main components used in the development of this automated recycle bin is the use of Arduino Uno and three material detector sensors. The material detector sensors are used mainly for identifying the type of recycle waste. The mechanical work involved is the use of a channel particularly for the movement and sorting of the recycle waste into its compartment.
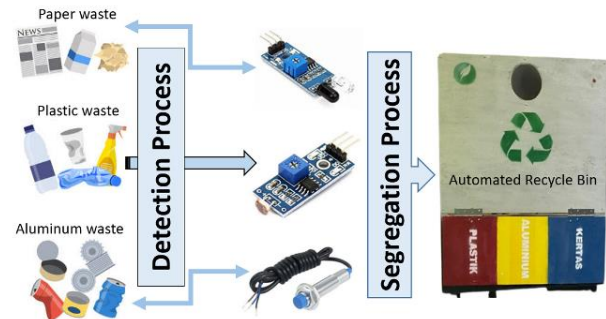

Fig. 3. Diagram of the system

2.1 Arduino UNO

Arduino UNO is a microcontroller development board and is known as the most basic board of the entire Arduino family. It is a simple sensor that is used to build the circuits and interfaces for interaction and telling the microcontroller how to interface with other components (Seneviratne, 2017).

Fig. 4. Arduino UNO

2.2 Infrared Sensor

An infrared (IR) sensor is an electronic device that emits and/or detects infrared radiation to sense some aspects of the surroundings. An infrared sensor can measure the heat of an object as well as detect the motion (Oyelami, Azeez & Abiyo, 2019).

The infrared sensor works the same way an object detection sensor does. This infrared sensor offers simple,

and fast obstacle detection via infrared reflection. As it is based on light reflection, the detection does vary with different surfaces. The output is digital signal, so it is easy to interface with Arduino UNO. This sensor typically has an IR LED & an IR photodiode.

Fig. 5. Infrared sensor

2.3 LDR Light Sensor

The LDR light sensor is a sensing device to detect the presence of plastic waste. It is used to capture the light intensity emitted by the LED attached opposite to it. Thus, when a plastic bottle which is a transparent object is thrown, the LDR will capture high light intensity and drop the plastic bottle into the plastic compartment. (Hassan et.al, 2018).

Fig. 6. LDR light sensor

2.4 Inductive Proximity Sensor

The inductive proximity sensor is a sensing device that detects metal targets using electromagnetic energy without any contact to the object. In this project, it is used to detect the presence of an aluminum can. The sensing range of an inductive proximity sensor changes based on the type of metal being detected. When the user throws the aluminum can into the bin, the sensor will detect the presence of the aluminum can and drop the aluminum can into the aluminum compartment.

Fig. 7. Inductive proximity sensor

2.5 Development of The Product

Figures below show the development of the product starting from the sketching process up to the completion stage. The bin is built based on the drawing design that was made. The framework of this bin uses iron material while the body of the bin was made from plywood. In order to make sure the sensors and the mechanical part can detect and segregate the waste, the programming part is required for the microcontroller. All the sensing circuit is connected to the Arduino Uno microcontroller board. The Arduino Uno will control the automated bin funnel system that eventually segregates the different types of recycle waste. Lastly, testing is done to make sure all the installation of the electronic part is perfectly fixed inside the bin.
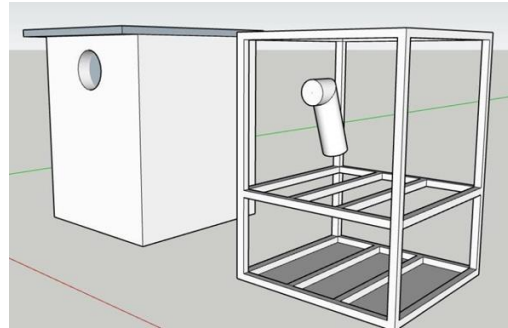

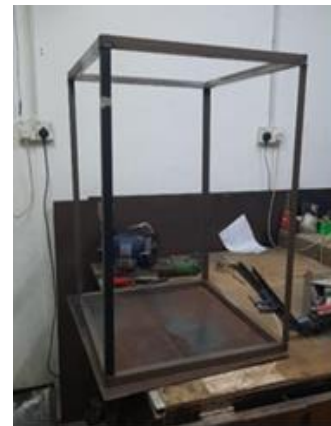Fig. 8. Sketching and designing process

Fig. 9. Building the bin framework

Fig. 10. Installing the plywood to the frame

Fig. 11. Connecting all the electronic part to the bin

Fig. 12. Product setup and testing

Fig. 13. Final appearance of the product

3. Result and Discussion

Table 1 - 3 shows the results obtained from the tests that were carried out for all the three types of waste. The test was done by throwing ten samples of paper, ten samples of plastic bottle and ten samples of aluminum can into the bin. Three attempts were made for each sample. Only the sample that dropped into the correct compartment is counted as a successful attempt. Then the percentage is calculated to find out the detection and segregation effectiveness for the bin.

Table 1 shows the result for paper waste. For sample no.1 until sample no.7, all seven samples in all the three

attempts were successfully detected and dropped into the correct compartment by the sensor. However, the sensor failed to detect all three attempts for sample no.8. For sample no.9 the first and second attempt were not successful but in the third attempt, the sensor managed to identify the presence of paper and segregate it correctly. Sample no.10 passed this test in all its three attempts.

Table 1. Test result for paper waste

Attempt	Paper Waste Sample									
	1	2	3	4	5	6	7	8	9	10
1	/	/	/	/	/	/	/	X	X	/
2	/	/	/	/	/	/	/	X	X	/
3	/	/	/	/	/	/	/	X	/	/

Table 2 shows the test result for plastic waste. Sample no.1 and no.2 were easily detected by the recycle bin. However, for sample no.3, the recycle bin failed to detect the presence of plastic in all the three attempts. Sample no.4, no.5 and no.6 were all successful in all the three attempts. For sample no.7, it failed the first and second attempt but passed on the third attempt. Sample no.8 and no.9 also failed the first attempt but the recycle bin managed to detect and segregate the sample correctly on the second and third attempt.

Table 2. Test result for plastic waste

Attempt	Plastic Waste Sample									
	1	2	3	4	5	6	7	8	9	10
1	/	/	X	/	/	/	X	X	X	/
2	/	/	X	/	/	/	X	/	/	/
3	/	/	X	/	/	/	/	/	/	/

The test result for aluminum waste was the most successful one. The automated recycle bin managed to detect and segregate correctly nine out of the ten samples that were thrown in the recycle bin. Although three attempts were made for sample no.4, the sensor still did not manage to detect the presence of aluminum or metal material for that sample.

Table 3. Test result for aluminum waste

Attempt	Aluminum Waste Sample									
	1	2	3	4	5	6	7	8	9	10
1	/	/	/	X	/	/	/	/	/	/
2	/	/	/	X	/	/	/	/	/	/
3	/	/	/	X	/	/	/	/	/	/

The percentage of successful attempts is calculated to determine the efficiency of the recycle bin. The table above shows the percentage of successful attempts for all the three types of waste material. Paper waste recorded a successful attempt rate of 83.3%, plastic waste recorded a successful rate of 76.7% and aluminum waste recorded a high success rate at 90%. On average, the success rate for the efficiency of the recycle bin was 83.3%.

Table 4. Successful attempt for each material

Waste Material	Successful Attempt (%)
Paper	83.3%
Plastic	76.7%
Aluminum	90.0%

4. Conclusion

From the test result, it can be concluded that the most successful attempt was from the aluminum material waste that recorded 90% of success rate. Out of 30 attempts, only three attempts did not drop into the correct compartment. This was because the aluminum material for that sample was too thin and light thus making the sensor could not detect the presence of metal for that sample. A better quality of inductive proximity sensor might be installed for better detection. Paper waste recorded a successful attempt rate at 83.3% while plastic waste was the least successful rate where it only recorded 76.7% success rate. It was then figured out that the LDR light sensor could not detect plastic material if the plastic bottle is covered with its wrapper. The wrapper will cause a low intensity light thus the sensor could not detect the presence of plastic.

The proposed concept and developed product have the potential to be utilized in improving solid waste disposal management in the future. This automated recycle bin is a new environmentally friendly product which provides a smart and convenient way for people to recycle. With the introduction of this recycle bin it will help society to promote recycle habits. At the same time, it benefits the environment, and this will reduce the impact on the environment.

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Gas Leak Detection and Monitoring System for Enhanced Safety in Laundry Services

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Abstract

Gas leaks are a significant hazard in the laundry service industry as they can lead to explosions, fires, and toxic gas exposure. This research project aims to develop a gas leak detection and monitoring system that utilizes MQ-2 sensors and an ESP32 controller board. The system includes a database to maintain real-time records of any gas leaks detected by the sensor using the XAMPP server platform. The sensor is placed behind the dryer machine and can detect gas leaks in the 20 cm-1000 cm range. Warning indicators such as LEDs and buzzers alert the user in case of gas leakage. Additionally, a mobile monitoring application named SIN application is developed using Kodular. The system includes a shut-off valve, which allows the user to turn off the gas source valve by switching off the red LED button in the SIN application. When the red LED on the gas leak detector is OFF, this indicates that the connected valve circuit will be closed. Therefore, this project helps laundry service operators improve the level of safety in their facilities by providing a reliable gas leak detection and monitoring system.

Keywords: - Gas leakage detector, gas outflow, Kodular, MQ-2 sensor

1. Introduction

The use of Liquid Petroleum Gas (LPG) is necessary in daily life whether for home use or commercial industry. Liquid petroleum gas, also known simply as propane or butane, is a mixture of flammable hydrocarbon gases used as fuel in heating appliances, cooking appliances and vehicles. LPG is denser than air itself meaning it will flow through the basement. When this situation occurs, the main danger that may be encountered is the possibility of explosion if there is a mixture of LPG and air in the presence of a spark source (Soh et al., 2019). Gas leaks cause impacts that can damage valuable property and human lives.

There have been several cases of explosions due to gas leaks in homes, businesses, and other places. The incident that happened in a residential house in Tasek Gelugor, Penang caused a female victim to burn almost all over her body and damaged the house due to a gas explosion from her kitchen (Berita Harian, December 13, 2022). Another case of an explosion due to a gas leak also occurred in a laundry shop. According to Berita Harian, on April 11, 2018, a gas leak occurred at the premises following the maintenance process on the gas pipeline. The use of non-standard cylinders, old valves, and careless use of gas cylinders are also major causes of such fires and explosions (Dewi & Somantri, 2018). Gas leaks in the premises are often not noticed by the owner until a serious situation such as a fire occurs. Thus, using sensors placed near gas barrels, this development system will help in detecting the presence of gas leaks in laundry shops. Overall, the purpose of this research is to:

   i. design a system that can detect gas leakage immediately.
  ii. develop a detector that will fabricate sound alarm and send notification alert during gas outflow.
 iii. develop mobiles applications for gas leakage monitoring systems using Kodular Apps.

2. Literature Review

In this section, the author summarizes similar studies that have been conducted in the past on LPG gas leak detection systems. Soh et al. (2019) emphasizes the importance of such systems for public safety due to the widespread use of LPG gas in domestic appliances. Paculanan & Carino (2019) and Dwibedi et al. (2020) both proposed LPG gas monitoring systems that use an MQ-2 sensor, an Arduino Uno board controller, and a GSM module for alert notification. Both studies also proposed closing the power supply connected to the gas source when a gas leak is detected. Dwibedi et al. (2020) added a circuit connection to a mini servo motor to open a window as a safety measure to prevent worse effects from occurring due to gas leakage.

Khan (2020) used an Arduino UNO R3, and an MQ-6 gas sensor, which is highly sensitive to propane, butane, and LPG, to detect gas leakage. The MQ-6 sensor updates the gas leakage status within 2 seconds, and an LCD display "Gas detected: Yes" if the sensor output is high and "Gas detected: No" if the sensor output is low.

Bagwe et al. (2018) developed a gas leakage detection system that includes database logging, prediction, and smart alerting features. The system utilizes a NodeMCU board controller, and an MQ-5 gas sensor to detect the concentration of gas in the air. Additionally, the system is integrated with a DHT22 sensor that measures the temperature and humidity of the atmosphere and sends the data to the board controller. The controller then sends the data to a database via XAMPP.

If the gas concentration exceeds a certain level, the system activates a buzzer, GSM module, and LED. The buzzer produces a sound indication, the LED turns on, and the GSM module sends an SMS to the relevant authorities. This project provides a more sophisticated gas detection system that not only alerts users but also logs and predicts gas levels.

3. Methodology

The proposed system architecture is shown in Fig.2 which includes hardware development, database system and mobile apps application.
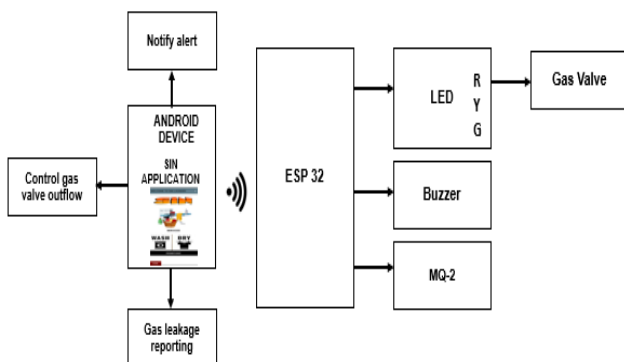

Fig. 1. Project block diagram

3.1 Hardware Development

The main component of the proposed project consists of ESP32 as a main controller, MQ-2 sensor, buzzer module, LED module and jumper wires. The ESP32 has dual-core and ultra-low power co-processor and can control and monitor a device with the help of wi-fi or Bluetooth at a very low price. All input and output components as in Fig.2 will connect to the ESP32 using jumper wire.

Fig. 2. Gas leakage detector component

The MQ-2 sensor has four (4) pins which are VCC, GND, D0 and A0. VCC powers the sensor and needs to be connected to 5V while GND is the ground pin of the sensor. D0 is a digital output pin, which shows the digital representation of the detected gas. While A0 is an analog output pin from which we can detect the type of gas by analyzing the analog value. MQ-2 gas detector is a device that detects the presence of gases in space, typically as part of a safety system. The MQ-2 module can detect H2, LPG, CH4, CO, alcohol, smoke, or propane and the detection range is around 20cm-1000cm (Dwibedi et al., 2020). The sensitivity of the sensor can be adjusted by using the potentiometer (Divyasree, 2019). This sensor was installed behind the dryer machine of laundry prototype.

The traffic light module is a semiconductor light source that emits light when current flows through it. This module has four pins which are pin G (ground), R (red), G (green) and Y (yellow).

Fig. 3. Validating the data entered into the database

The traffic lights and buzzer modules serve as warning indicators on the proposed project. As specified in the source code written in the Arduino IDE platform, pins 21, 22, and 23 on the ESP32 are connected to the traffic light

module. Meanwhile, the buzzer module has three (3) pins: GND, I/O, and VCC. The buzzer I/O pin must be connected to the ESP32's buzzer output pin setting.

3.2 Development of database and mobile monitoring system

This gas leak detector works with the help of the Arduino platform, communicates, and provides continuous feedback with the XAMPP platform to record the gas readings detected by the sensor. Fig 4. shows the platform used for the development of gas leakage detectors.

Fig. 4. The platform used for the development of gas leakage detector

The Arduino platform is a free and open-source platform for creating electronic projects (Divyasree, 2019). In our project, the Arduino platform was used to write source code for giving database responses, working without component errors, and controlling the application as developed. While the XAMPP platform serves as the database system's localhost, it sends each gas leakage data detected by the sensor to the web host. The XAMPP platform allows a local host or server to test a client's website before it is released to the main server. Fig. 6 shows the database records each gas value by displaying gas status, reading time, and location. Each gas detection value takes about 16 seconds to record.

The Kodular platform is an open-source online suite for mobile application development. It has an innovative component and block design that provides free drag-and-drop Android app creators without coding (Syarlisjiswan et al., 2021). This project uses Kodular to develop an application that allows user to monitor the outflow of gas leaks detected with a smartphone. If a gas leak is detected by the sensor, the user is notified via this application.

4. Result and Discussion

Overall, software and hardware parts of the systems have been developed and tested by installing this gas leakage detector to project prototype as shown in Fig. 5.
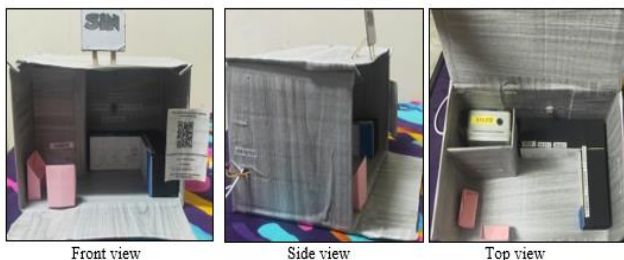

Fig. 5. Different views of the laundry service prototype

The authors created a prototype to demonstrate the project's functionality. This gas leakage detector is placed in the control room. While the gas sensor is placed close to the gas cylinder and dryer. The MQ2 sensor can detect leaking gas within range of 20 cm to 1000 cm. As shown in Fig.6, the database will store each data value detected by the sensor. There are three (3) gas level status values; status value: "Low" if the gas reading value is less than 500. If the gas reading falls between 501 ppm to 999 ppm, the status value will change to Normal. While the High status will record if the gas reading is greater than 1000 ppm. The sensor value will update the reading status every 10 seconds.

Fig. 6. Gas Leakage Detector reporting

The gas leak detection and monitoring system also includes a feature that triggers a buzzer sound and LED when the presence of LPG is detected by the sensor. The LED lighting corresponds to the gas reading level. If the reading value is normal (501 ppm – 999 ppm), the green LED lights up. The yellow LED lights up if the reading value is below the set level (< 500 ppm), and the red LED lights up if the gas level status is HIGH (> 1000 ppm). At the same time, the system sends an alert notification to the user. Fig. 7 displays the mobile monitoring application, named SIN application, which was developed using the Kodular platform. To access the SIN application, the user must log in using the correct username and password.
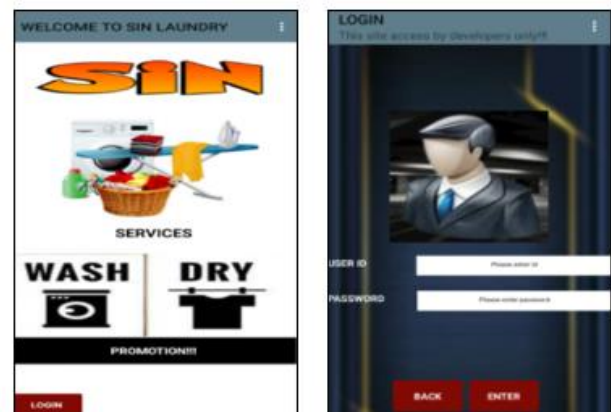

Fig. 7. SIN application security access interface

The gas level status and notifications will appear in a white text box after user slide ON the switch button. If the user does not open the SIN application, the alert message goes into the registered phone notification as shown in Fig. 8.
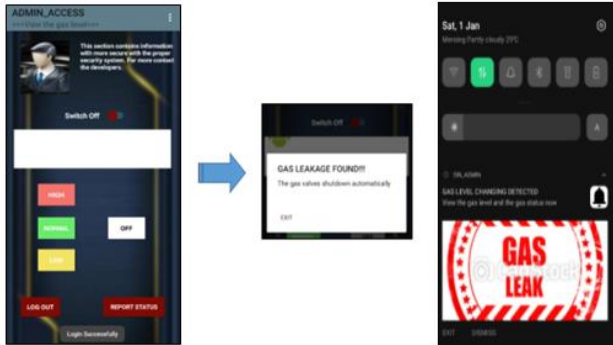

Fig. 8. Gas level status and alert notification

When the sensor detects a gas leak, it triggers a warning system consisting of a buzzer and LED. This alert signifies a potentially hazardous situation, where the gas can mix with a fuel source and cause an explosion. To address this, the project includes an application that enables the user to close the gas valve source quickly. By pressing the red LED button on the SIN application's display, the gas source valve can be closed, and the red LED on the gas leak detector will turn off. This indicates that the gas leak source has been shut down.

The SIN application allows users to view and download gas reading status reports by clicking the View Report and Download buttons. The gas reading report, as shown in Fig. 9, includes details such as the sensor ID, gas value, gas status, and time stamp. The time stamp corresponds to the sensor's real-time reading. If the user chooses to download the report, it is displayed in pdf format.

Fig. 9. Display of gas reading status

Table 1 indicates that the distance between the MQ-2 sensor and the gas source can affect the sensor's reading. Firstly, as the distance between the sensor and the gas increases, the gas concentration decreases, leading to lower readings from the sensor. Secondly, as the sensor's distance from the gas source increases, its sensitivity may decrease. This is especially true for long-distance readings or sensors that have not been calibrated accurately. Lastly, environmental factors like temperature and humidity can influence the sensor's reading at different distances, as mentioned by Bagwe et al. (2018). Fig. 10 shows the gas reading value and alert notification testing when the gas source is given based on the set distance of 1cm, 5cm, 10cm, 15cm and 20cm. In this study, the author uses a closed box as a laundry shop prototype. While the lighter is used as the source of the gas leak. The test is carried out according to the predetermined distance and time referring Table 1. This MQ-2 sensor is located in the control room and near to the gas piping system of drying machine.
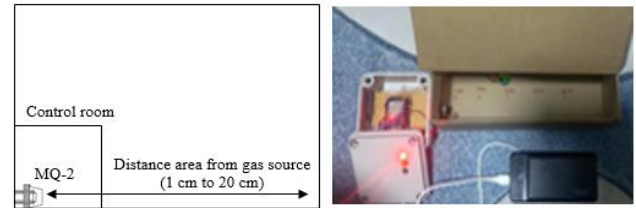

Fig. 10. Gas reading value based on gas leak source distance

The test results depicted in Figure 10 can be cross-referenced in Table 1. This testing specifically evaluates the functionality of the component, considering parameters such as the distance and time of the gas leak test on the sensor. These findings reveal variations in the status of LED lights, buzzer, and notification levels based on the gas leak readings detected by the MQ-2 sensor.

Table 1. Testing component functionality (MQ-2, LED, buzzer) and notification level

Distance (cm)	Preheat Time (minutes)	Status			
		LED	Buzzer	Gas reading value (ppm)	Level
1	1	Red : ON Yellow: OFF Green : OFF	ON	2403	HIGH
5	3	Red : ON Yellow: OFF Green : OFF	ON	1674	HIGH
10	5	Red : ON Yellow: OFF Green : OFF	ON	2003	HIGH
15	7	Red : ON Yellow: OFF Green : OFF	ON	1600	HIGH
20	7	Red : ON Yellow: OFF Green : OFF	ON	1800	HIGH

The gas readings recorded in this study may be less accurate due to the absence of temperature and humidity readings. Temperature changes, the presence of moisture in the air that indicated by the level of humidity can have an impact on gas properties and affect the accuracy of gas leak readings (Bagwe et al., 2018). To ensure the accuracy of gas leak detection, it is important to consider the influence of temperature and humidity on gas properties (Hanwei Electronics, 2006; Bagwe et al., 2018). By measuring these factors along with gas readings, a more comprehensive understanding of gas leaks can be obtained.

Although there are potential limitations in the accuracy of data recorded, this study can serve as a basic guide to understand changes in gas leak readings detected by sensors, as long as the logging data in the developed database is referenced as shown in Fig. 6. The data in Table 1 indicates a high level of sensitivity (High) for the MQ-2 sensor in detecting the presence of LPG gas in the prototype environment. A distance test is conducted, which reveals that the closer the gas source is detected, the higher gas reading is recorded. In summary, by referencing the logged data in the developed database and incorporating time, distance, LED lights, buzzers, and notifications, this study can offer valuable insights into gas detection and its corresponding measurements.

5. Conclusion

The gas leakage detector developed in this study is a useful tool in preventing any potential dangers from gas leaks in self-service laundry centers. It is also part of a system that enhances the safety of the premises. The developed system employs IoT to provide monitoring and control actions, activate alarms, and send warning messages to users in a timely manner. At present, the system enables users to monitor gas status in real-time and generate gas level sensor status reports. Additionally, the system allows users to close the gas valve through a button on the developed application. However, gas valve shut-off controllers connected to gas leak detectors do not yet support this feature. Therefore, the authors suggest that future studies should focus on improving the gas controller shutdown feature, either automatically in the event of a gas leak or through a developed application.

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