e-Proceedings

18th International Conference on Business Studies and Education (ICBE)

24th - 25th June 2025

e-ISSN: 2785-9479 Publisher: ICBE Publication Eighteenth Conference

COPY RIGHT

PUBLISHER : ICBE PUBLICATION

SSM REGISTRATION NUMBER : 202003126875 (NS0237611-W)

e-ISSN : 2785-9479

CONFERENCE : VISUAL PRESENTATION

EMAIL : chief_editor@icbe.my

REVIEWERS : https://www.icbe.my/board-of-icbe/

Table of Contents

e-ISSN: 2785-9479

CoTech Learning Model: A Peer-Assisted Collaborative Framework for Inclusive Digital Marketing Education with Visually Impaired Learners

Ng Boon Ding[1]*, Tang Si King[1], Safinah binti Nawawi[1], Surafah binti Mos[1], Azhar bin Abd Hamid[1], Kedung Fletcher[1]

[1 2,3,4,5,6] *Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia*

[1]*E-mail: bdng@poliku.edu.my*

[2]*E-mail: king@poliku.edu.my*

[3]*E-mail: safinah_nawawi@poliku.edu.my*

[4]*E-mail: surafah@poliku.edu.my*

[5]*E-mail: azhar.hamid@poliku.edu.my*

[6]*E-mail: kedung@poliku.edu.my*

Abstract

This paper presents the implementation of CoTech Learning Model, a peer-assisted collaborative teaching and learning framework to promote inclusive digital marketing education for the visually impaired individuals. This initiative is carried out as a result of funding from the Society of the Blind Malaysia, Sarawak Branch together with the collaboration of the researchers from Department of Information Technology and Communication in Politeknik Kuching Sarawak. This framework, includes TVET students as the learning partners as the participants in this initiative. As a whole, this model emphasizes equal participation, empathy and mutual skill development in the peer assists model integrating students with visually impaired throughout a series of hands on workshops. Overall, there are three workshops conducted to build core technopreneur skills among the participants: (1) poster design using Canva, (2) video marketing automation using AI-supported tools like CapCut, and (3) IoT-enabled hydroponic farming for sustainable business applications. Participants exhibited varying degrees of visual capability, which informed the design of flexible, accessible training methods that emphasized audio support, guided navigation, and real-time collaboration. The methodology emphasized empathy-driven pairing, multisensory instructional design, and real-world entrepreneurship. Effectiveness was assessed via Likert-scale surveys and participant reflections, with results showing exceptionally high satisfaction scores (96–99%) across content clarity, facilitation, and skill acquisition. This learning model not only closing the gaps of the learning abilities of the visually impaired personnel, also inculcates technopreneurial competencies, social integrations and digital empowerment among the participants. The results of this learning model indicated positives outcomes and this learning model is found scalable for future educational initiatives in integrating undeserved communities into the digital economy.

Keywords **:** *Inclusive education, CoTech Learning Model, Digital Marketing, Technopreneurship, peer-assisted learning*

I. INTRODUCTION

In this digitalization world, opportunities for entrepreneurship are growing, but not everyone has equal access to this technology, specifically, the visual impaired communities. Here, they often faced obstacles as there are limited access to adaptive tools, inclusive training and supportive mentorship. In Malaysia, this is obvious to show the needs of collaborative models that is able to bridge the gaps between technical education and social empowerment.

With that, the Society of Blind Malaysia, Sarawak Branch in collaboration with the Department of Information Technology and Communications in Politeknik Kuching Sarawak, initiated a community-driven technopreneurship research project designed to equip blind and visually impaired individuals with digital marketing competencies. This initiative was developed under a grant-funded project that integrates Technical and Vocational Education and Training (TVET) students as active partners, providing both technical support and peer mentorship throughout the learning process. To facilitate this collaboration, the project introduced the CoTech Learning Model—a structured peer-

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

assisted teaching and learning framework that fosters empathy, equal participation, and mutual skill development. Under this model, each visually impaired participant is paired with a TVET student partner, enabling accessible, hands-on learning experiences tailored to various levels of visual capability. The program's design was rooted in real-world applications, addressing not only digital inclusion but also entrepreneurial self-reliance through a series of outcome-oriented workshops. Three main training modules formed the foundation of the program: (1) poster design using Canva, (2) automated video production using CapCut and AI tools, and (3) the integration of IoT-based hydroponics as a sustainable business model. These workshops were strategically selected to provide participants with a comprehensive understanding of digital branding, content creation, and smart agriculture—all aligned with modern technopreneurial practices. This paper explores the development, implementation, and impact of the CoTech Learning Model. It highlights how inclusive collaboration, supported by digital tools and peer mentorship, can transform traditional educational environments into empowering spaces for both TVET students and visually impaired individuals. The research also examines feedback from participants, analyzes the effectiveness of the model, and presents recommendations for scaling such inclusive frameworks within other educational and community-based contexts.

II. LITERATURE REVIEW

The main focus of this project is the development of the CoTech Learning Model—a peer-assisted learning framework where polytechnic students are paired with blind participants in a one-to-one or small team-based mentorship arrangement. This model promotes active engagement, empathy, and collaborative learning, leveraging each individual's strengths while fostering mutual respect and shared ownership of outcomes. The diversity among the visually impaired participants, who varied in the degree of sight impairment—from minimal to partial vision—necessitated a flexible and inclusive approach to content delivery and workshop facilitation. Over the course of the year-long program, three major workshops were conducted to build relevant, future-ready competencies: Poster Design using Canva – This module introduced basic principles of graphic design and branding using an accessible, user-friendly platform. Students guided their blind peers in conceptualizing business posters, with emphasis on storytelling, layout, and digital aesthetics. Automated Video Creation using CapCut and AI tools – This workshop focused on video editing and voiceover generation, integrating AI-based tools to streamline content creation. It enabled participants to craft promotional materials for their products or services with minimal technical complexity. Hydroponic Farming using IoT – Participants were introduced to smart agriculture concepts by learning to manage a hydroponic system equipped with IoT sensors and Raspberry Pi automation. This module not only served as a practical application of Industry 4.0 but also provided a sustainable business model that participants could adopt post-training.

Through this integrated and inclusive approach, the project addresses not only the skill gaps among visually impaired individuals but also fosters a culture of empathy, creativity, and innovation among TVET students. It exemplifies how inclusive pedagogy, when combined with relevant technology and real-world applications, can break down barriers and unlock entrepreneurial potential across diverse communities. As such, this initiative represents a scalable model for future inclusive education programs in Malaysia and beyond. Jaeger in his book discussed the digital divide faced by people with disabilities and how the technology can be more inclusive [4]. The author emphasized that digital inclusion is not merely a technical issue but also a social justice concern. He calls for the integration of accessible design into all stages of technological development and stresses the importance of policies that enforce digital accessibility as a right rather than a privilege. He also critiques the slow implementation of accessibility legislation, even in technologically advanced nations, noting that the gap is even wider in developing contexts like Malaysia.

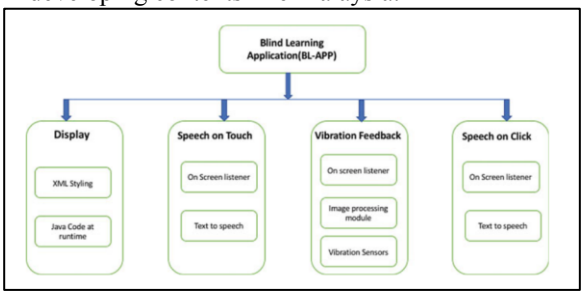


Figure 1: Learning application for the Blind [9]

Figure 1 showing the Blind Learning APP (BL-APP) is designed with an intuitive interface that allows users to easily locate and interact with buttons on the screen [9]. It employs text-to-speech technology to convey text descriptions and provides vibratory feedback to help users visualize shapes. The EFORD application, developed for English learning, includes features validated by media experts and special needs teachers, achieving high feasibility scores. It focuses on grammar and speaking skills, providing a tailored learning experience for visually impaired students.

There are many learning models launched for the people with visually impaired, namely:

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

i. Listen to the models: Sonified learning models for people who are blind [6].
This model applies sonification, which is the process of converting data into sounds, enhancing the learning experiences for people who are blind. This approach not only aids in understanding complex scientific concepts but also supports the inclusion of blind students in mainstream educational curricula.

ii. E-learning model for blind disabilities with text to speech using NLP [3].
This model focuses on creating an accessible elearning environment with visual impairs integrating Learning Management System to manage learning activities and a conversion process to transform text-based course materials into audio files using Text-to-Speech technology.

iii. Teaching life sciences to blind and visually impaired learners [2].
This learning model using cooperative learning strategies to teach life sciences to the visually impaired learners. The study revealed that blind and visually impaired learners face significant challenges in applying science process skills due to their lack of vision, confidence, and motivation.

Practical activities were limited and often lacked intellectual challenge, with learners rarely participating in practical work or field trips.

Various innovative approaches have been developed to support the learning needs of blind and visually impaired individuals involves converting visual information into sound to help learners understand complex scientific concepts through auditory perception; text-to-speech technology within an online learning environment, transforming written content into audio to improve accessibility and engagement; cooperative learning techniques have been applied to foster collaboration and inclusion, although challenges such as limited confidence, motivation, and access to hands-on activities remain. Together, these approaches highlight the importance of multisensory engagement, accessible digital tools, and supportive peer interactions in enhancing educational outcomes for visually impaired learners.

Without the involvement of sighted peers as learning partners, these approaches may miss opportunities to foster social integration, mutual understanding, and collaborative problem-solving. The absence of peer support can also limit the development of soft skills, such as communication and teamwork, which are essential for real-world application. Integrating peer-assisted learning could enhance these models by creating a more inclusive and interactive educational experience that benefits both visually impaired learners and their sighted [1][7][8][10].

III. RESEARCH METHODOLOGY

The CoTech Learning Model was implemented through a structured, multi-phase methodology combining instructional design, inclusive pairing mechanisms, workshop facilitation, and digital resource development. The framework adopted a peer-assisted approach, whereby each visually impaired participant was paired with a TVET student from the Department of Information Technology and Communication, Politeknik Kuching Sarawak to form a collaborative learning unit. This pairing was matched based on communication skills, patience, and willingness to assist, ensuring both participants could mutually benefit from the exchange. The implementation was divided into three main stages: preparation, delivery, and reflection. During the preparation phase, facilitators and content experts developed accessible training materials tailored to different levels of visual impairment, ensuring audio descriptions, tactile prompts, and screen-reader compatibility were embedded within the learning content. The delivery phase involved three hands-on workshops: (1) poster design using Canva, (2) automated video production using CapCut and AI tools, and (3) hydroponics using IoT systems. Each workshop followed a blended learning model combining demonstrations, guided practice, and project-based assignments. Facilitators monitored interactions between student and blind participants to ensure effective knowledge transfer, inclusion, and progress. In the final phase, reflective discussions and feedback sessions were conducted to assess individual learning, group synergy, and areas for refinement. Effectiveness was measured through Likert-scale questionnaires and open-ended reflections, focusing on digital competency development, peer engagement, and motivation to apply new knowledge. The entire methodology was guided by inclusive pedagogical principles, underpinned by collaborative learning theory, and aligned with Industry 4.0 education objectives.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

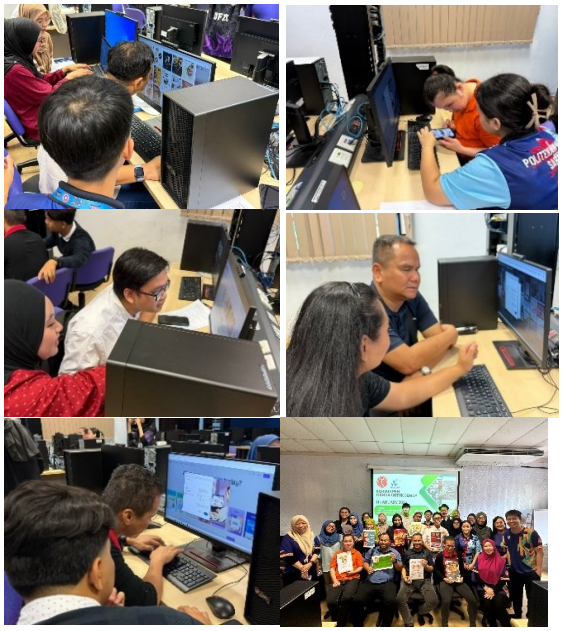


Figure 2 Collection of photos during the teaching and learning for the Canva and Video Creation workshop

Figure 2 showing CoTech Model implemented for the teaching and learning session with the visually impaired personnel. This model implemented peer-assisted, inclusive and experiential learning model. In this model, each visually impaired participant is paired with a sighted student from the Department of Information Technology and Communication. For the first two workshops, designing poster using Canva and also video editing using CapCut, actual business-related tasks is used to show the real-world relevancy of the workshop. Computer stations, mobile phones and tablets are the assistive and adaptive technology supports to accommodate different levels of visual ability. The physical layout and instructional design foster equality in participation, where both students and blind participants contribute ideas and collaborate creatively. Here, the student partner acts as a learning facilitator and collaborator, not a teacher—fostering mutual respect and shared ownership of the learning process

Figure 3 Collection of photos during the teaching and learning for the Hydrophonic using IOT workshop

Figure 3 showing hydroponic workshop conducted under the CoTech Learning Model, showcasing a peer-assisted, inclusive learning environment where TVET students collaborate closely with visually impaired participants. Through hands-on activities such as assembling vertical hydroponic systems, inserting irrigation components, and preparing planting structures, both groups engage in mutual learning and skill-building. The visually impaired participants are actively involved in every step, guided by their sighted peers through verbal instructions, tactile feedback, and empathetic support. This interaction reflects the core principles of the CoTech model—equal participation, empowerment, and collaboration—while fostering technical competency, confidence, and social inclusion. The workshop not only builds practical skills but also nurtures empathy, teamwork, and mutual respect among all participants.

RESULT AND DISCUSSION

The effectiveness of CoTech Learning model is measured through the questionnaires as Table 1 below, using Likert scale, 1-5:

Table 1: Questionnaire Items and Descriptions

No	Item	Description

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

i.	The program announcement attracted my attention	High scores suggest effective outreach through inclusive and accessible promotional strategies. This reflects the CoTech model's emphasis on engaging all learners equally from the start, ensuring the blind community and students are equally informed and motivated.
ii.	The announcement was made early and gave me enough time to prepare	Participants appreciated the timely communication, a key strength in the CoTech model where both students and blind partners must coordinate. Early notice enhances preparation and peer interaction, encouraging proactive collaboration
iii.	The program information was delivered clearly and easy to understand	The clarity of instructions aligns with the CoTech model's value on accessibility. Information was likely delivered through both visual and assistive formats, ensuring comprehension for visually impaired learners without compromising technical depth for students.
iv.	The program ran smoothly without any changes	Smooth execution shows strong planning and inclusive design. In CoTech, synchronized participation between sighted students and blind peers is crucial, and a disruption-free experience supports their equal involvement.
v.	The program committee demonstrated professionalism	This reflects how CoTech fosters an environment of respect, structure, and responsibility—essential when working with participants of varied abilities. Professionalism ensures that diverse learning needs are handled sensitively and efficiently.
vi.	Facilitators helped me understand the program's objectives and impact	This item's high rating highlights the facilitators' success in explaining complex content to a mixed-ability audience—central to CoTech's pedagogical strategy. It confirms that facilitators could guide both students and blind learners to see value in their learning
vii.	The facilities provided were sufficient for participant needs	Adequate facilities—such as screen readers, tactile guides, and accessible venues—are critical in the CoTech model. This result shows logistical success in catering to diverse physical and technological needs.
viii.	The program added value to my knowledge or skills	CoTech encourages skill acquisition through peer-assisted tasks. High agreement here suggests that both groups—blind and sighted—benefited from hands-on digital marketing, video editing, and IoT sessions.
ix.	The program motivated me to apply what I learned	The motivational impact stems from CoTech's real-world relevance and peer-driven support. Participants likely saw direct value in using tools like Canva, CapCut, or IoT systems to promote or manage real businesses or projects.
x.	The program increased my sense of responsibility and awareness	Working alongside peers with different abilities fosters empathy and responsibility—two key outcomes of the CoTech model. This result suggests growth not just in technical skill, but also in character and collaborative mindset.

The survey utilized a 5-point Likert scale to measure participant satisfaction and the effectiveness of various aspects of the workshops. Each item was rated from 1 to 5, where a score of 1 indicated "Strongly Disagree" or "Very Ineffective," while a score of 5 represented "Strongly Agree" or "Very Effective." This scale provided a structured and standardized approach for participants to express their level of agreement with statements related to program announcements, facilitation quality, content clarity, and overall learning experience. The overwhelmingly high ratings, predominantly in the 4 and 5 range, reflect a strong consensus that the workshops were both impactful and well-executed. The use of the Likert scale thus reinforces the reliability of the data and offers clear evidence of the program's success in achieving its objectives.

Table 2 Summary of result from the questionnaire survey

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Item	Mean Score	Percentage (%)	Effectiveness Summary	CoTech Model Relevance
Program announcement attracted attention	4.80	96.0%	Very effective – Engaging outreach for all participants	Ensures inclusive initial engagement
Announcement was timely	4.80	96.0%	Very effective – Promoted preparation and coordination	Supports peer readiness and coordination
Information was clear and easy to understand	4.95	99.0%	Very effective – Inclusive and accessible delivery	Accessible content for mixed-ability learners
Program ran smoothly without changes	4.95	99.0%	Very effective – Smooth, inclusive execution	Critical for equal participation
Committee showed professionalism	4.95	99.0%	Very effective – Respectful, structured learning space	Builds inclusive, respectful learning culture
Facilitators helped understanding	4.95	99.0%	Very effective – Clear facilitation for diverse learners	Empowers learners with diverse needs
Facilities were sufficient	4.95	99.0%	Very effective – Accessible and adequate facilities	Caters to physical and tech accessibility
Program added value to skills	4.95	99.0%	Very effective – Strong skill development	Enables experiential, skill-based learning
Program motivated learning application	4.95	99.0%	Very effective – Practical, motivating content	Links learning to real-world impact
Increased responsibility and awareness	4.95	99.0%	Very effective – Fostered empathy and collaboration	Develops character through collaboration

Table 2 showing the survey result from the three workshops conducted under the Cotech Learning Model, the overall effectiveness of each session is ranged within a consistently high participant ratings. Across 10 evaluated items, mean scores ranged from 4.80 to 4.95 out of 5, from 96% to 99% satisfaction, indicating positive response. Participants found the program announcements engaging and timely, enabling adequate preparation, which reflects the model's commitment to inclusivity from the outset. Information was communicated clearly, and all programs ran smoothly, highlighting strong planning and accessibility for both visually impaired and sighted participants. High professionalism by the organizing committee and the ability of facilitators to convey objectives effectively showcase the model's emphasis on respectful and supportive environments. the training enhanced their sense of responsibility and awareness—core values embedded in the CoTech Learning Model. These results confirm that the model not only supports technical skill acquisition but also fosters mutual growth, empathy, and collaboration between diverse learners, establishing it as a highly trustworthy and impactful educational framework. This national action plan serves as a key government policy document to promote and protect the rights of persons with disabilities (OKU) in Malaysia. Aligned with the UN Convention on the Rights of Persons with Disabilities (CRPD), the Pelan Tindakan OKU 2016–2022 outlines strategic focus areas, including education, employment, accessibility, ICT, and community participation. Here, the key initiatives achieved in this research includes:

i. Enhancing Access to Inclusive Education: The plan emphasizes the need to improve access to quality education for OKU by integrating inclusive education practices within mainstream schools and institutions. This includes adapting curricula, training educators, and providing necessary support services to accommodate diverse learning needs.
ii. Promoting Digital Literacy: Recognizing the importance of digital skills in the modern economy, the plan advocates for programs that enhance digital literacy among OKU. This involves providing training on the use of information and communication technologies (ICT) and ensuring that digital content is accessible.
iii. Developing Accessible Infrastructure: The action plan calls for the development and implementation of accessible infrastructure in educational settings. This includes the use of assistive technologies and the design of learning environments that cater to the needs of students with disabilities.
iv. Strengthening Collaboration: The plan encourages collaboration between government agencies, non-governmental organizations (NGOs), and the private sector to develop and implement programs that support the education and digital inclusion of OKU.

In the context of education and digital inclusion, this initiative acknowledges that persons with visual impairments face some obstacles to equitable access. It highlights the urgency of creating inclusive learning environments, investing in assistive technologies, and ensuring that digital content and platforms are usable by all. The second initiatives highlighted inter-agency collaboration—including educational institutions, NGOs, and

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

industry players—to design programs that foster empowerment through skills and knowledge. Thus, this supports the objectives of CoTech Learning Model through the structured peer-supported training particularly integrating the TVET teaching and learning model. This validates the use of digital tools such as AI, Canva, CapCut in workshops together with the involvement of diploma students are effectives and relevant as inclusive partners in this model. Recent literature highlight that the critical role of technological utilization and peer-assisted strategies in promoting inclusive digital learning for visually impaired individuals. The authors, Tsouktakou et al., mentioned that AI-powered platforms significantly enhance autonomy and engagement among blind learners and the importance of intuitive design and integration with assistive technology [11].

IV. CONCLUSION

In conclusion, the survey results provide strong evidence of the effectiveness and impact of the workshops conducted under the CoTech Learning Model. With average scores ranging between 96% and 99% across all items, participants expressed a high level of satisfaction with the program's delivery, content, facilitation, and overall learning experience. The positive responses demonstrate that the CoTech Learning Model successfully met the needs of both TVET students and visually impaired participants by fostering an inclusive, supportive, and collaborative learning environment. The CoTech model not only enhanced technical and entrepreneurial skills but also promoted empathy, responsibility, and mutual respect among participants. These outcomes validate the model's potential for broader implementation in inclusive education initiatives and affirm its role in bridging accessibility with innovation in digital marketing. It is recommended to replicate the CoTech Learning Model in other institutions, expand the workshop content with advanced digital tools, develop structured peer support guidelines, enhance accessibility features, establish post-workshop mentorship systems, and document best practices to ensure long-term impact and broader adoption. Although the current study relied primarily on post-workshop Likert-scale assessments and qualitative reflections, future implementations of the CoTech Learning Model will incorporate pre- and post-tests to quantitatively measure improvements in digital literacy and entrepreneurial readiness.

ACKNOWLEDGMENT

This research is fully funded by the Society of the Blind Malaysia, Sarawak Branch. The authors fully acknowledged the Society of the Blind Malaysia, Sarawak Branch and Politeknik Kuching Sarawak for the approved fund which makes this important research viable and effective

REFERENCES

[1] M. Friend and L. Cook, Interactions: Collaboration Skills for School Professionals, 6th ed. Boston, MA: Pearson, 2010

[2] W. J. Fraser and M. O. Maguvhe, "Teaching life sciences to blind and visually impaired learners," Journal of Biological Education, vol. 42, no. 2, pp. 84–89, 2008

[3] Inayatulloh, A. Fachrul, S. Riyanto, R. Toyib, R. N. Muhammad, and E. P. Dewi, "E-learning model for blind disabilities with text to speech using NLP," in Proc. Int. Conf. Industrial Engineering and Operations Management, Istanbul, Turkey, Mar. 7–10, 2022.

[4] P. T. Jaeger, Disability and the Internet: Confronting a Digital Divide. Boulder, CO: Lynne Rienner Publishers, 2011.

[5] Jabatan Kebajikan Masyarakat Malaysia, Pelan Tindakan OKU 2016–2022. [Online]. Available: https://www.jkm.gov.my

[6] O. Lahav, N. Hagab, S. A. El Kader, S. T. Levy, and V. Talis, "Listen to the models: Sonified learning models for people who are blind," Computers & Education, vol. 127, pp. 141–153, 2018.

[7] A. Lewis and B. Norwich, Special Teaching for Special Children? Pedagogies for Inclusion. London, UK: McGraw-Hill Education, 2005.

[8] P. Lynch, P. Lund, and B. Massah, "Identifying strategies to enhance the educational inclusion of visually impaired children with albinism in Malawi," International Journal of Educational Development, vol. 39, pp. 228–235, 2014.

[9] T. M. Navamani and A. Ranjan, "Android-based blind learning application," in Ambient Communications and Computer Systems: RACCCS-2018, Singapore: Springer, 2019, pp. 247–255. [10] J. J. Lu and G. H. L. Fletcher, "Thinking about computational thinking," in *Proceedings of the 40th ACM technical symposium on Computer science education*, 2009, pp. 260–264.

[10] U. Sharma and J. Deppeler, "Integrated education in India: Challenges and prospects," Disability Studies Quarterly,

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

vol. 25, no. 1, 2005.

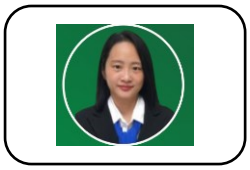
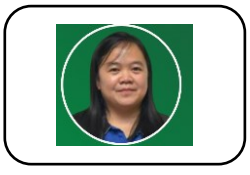
[11] A. Tsouktakou, A. Hamouroudis, and A. Chorti, “The use of artificial intelligence in the education of people with visual impairment,” *World Journal of Advanced Engineering Technology and Sciences*, vol. 13, no. 1, pp. 734–744, Oct. 2024, doi:10.30574/wjaets.2024.13.1.0481.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: Ng Boon Ding 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: bdng@poliku.edu.my
Second Author: Tang Si King 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: king@poliku.edu.my
Third Author: Safinah binti Nawawi 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: safinah_nawawi@poliku.edu.my
Fourth Author: Surafah binti Mos 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: surafah@poliku.edu.my
Fifth Author: Azhar Bin Abd Hamid 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: azhar.hamid@poliku.edu.my
Sixth Author: Kedung Fletcher 	Department of Information Technology and Communication, Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia E-mail: kedung@poliku.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Cloud Literacy Among First-Semester Students: A Survey on Awareness, Usage, And Challenges

Siti Sharmila Binti Osmin, Siti Salmah Binti Md Kassim

[1] *Department of Information Technology, Pasir Salak Community College, 36800 Kampung Gajah, Perak, Malaysia*
E-mail: sitisharmila@kkpsa.edu.my

[2] *Faculty of Faculty of Computing and Digital Technology, Ungku Omar Polytechnic, 31400 Ipoh, Perak, Malaysia*
E-mail: sitisalmah@puo.edu.my

[3] *Faculty of Civil Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*
E-mail: mazidahmukri@salam.uitm.edu.my

Abstract

Cloud computing has become an essential component of modern education, enabling students to access, store, and share academic resources efficiently. However, the level of cloud literacy among students, particularly first-semester students, remains uncertain, potentially affecting their ability to maximize its benefits. This study investigates the awareness, usage patterns, and challenges faced by first-semester students in utilizing cloud services. A quantitative survey was conducted among 148 students from various Malaysian Polytechnic and Community College (PolyCC) institutions. The results indicate that while most students are familiar with basic cloud functionalities, many lack proficiencies in advanced features such as data security, multi-platform integration, and collaborative tools. This gap in cloud literacy may hinder students' academic performance and readiness for technology-driven workplaces. The findings emphasize the need for structured cloud literacy training in educational curricula to enhance students' digital competencies. This study concludes by recommending strategic curriculum integration of cloud computing to equip students with the necessary skills for academic and professional success.

Keywords: *Cloud literacy; cloud services; digital tools; student awareness; education technology*

I. INTRODUCTION

The integration of cloud computing into education has revolutionized how academic resources are accessed, managed, and shared. Cloud-based platforms such as Google Drive, Microsoft OneDrive, and Dropbox have become essential tools for students and educators, enabling real-time collaboration, document storage, and data sharing. The COVID-19 pandemic accelerated the adoption of cloud technologies, as educational institutions worldwide shifted to remote and hybrid learning models [1]. This transition highlighted the critical role of cloud literacy in ensuring equitable access to education and fostering academic success.

Cloud literacy refers to the ability to effectively use cloud-based tools and services for academic and professional purposes. It encompasses not only technical skills but also an understanding of data security, privacy, and collaborative workflows. Research by Korucu [2] Cloud technologies can provide flexibility, cost-effectiveness, and support collaboration in education, but security and internet dependence are concerns. Wang and Liu [3] found that students often lack proficiency in advanced functionalities, such as multi-platform integration and version control, which are essential for maximizing the benefits of cloud computing.

Moreover, Ali [4] identified privacy and security concerns are significant barriers to cloud adoption in higher education, highlighting the need for improved cloud literacy. These findings underscore the need for educational institutions to address the cloud literacy gap through targeted interventions and curriculum enhancements. In addition, according to Junaedi et al. [5] the digital divide and lack of access to high-speed internet exacerbates disparities in digital and technology literacy, particularly in developing regions.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

II. LITERATURE REVIEW

The importance of cloud literacy extends beyond academic settings. Studies from Wang [13] indicate that cloud e-learning can improve learning outcomes, particularly in theoretical subjects. As the global workforce increasingly relies on cloud-based tools for collaboration and productivity, students who lack proficiency in these technologies may face disadvantages in the job market. According to a study by Billionniere and Meyer [6], Higher education institutions need to prioritize cloud literacy training to upskill students and professionals due to the rapid increase in cloud technology demand.

While cloud computing has been widely integrated into educational settings, first-semester students often face challenges in adopting these technologies effectively. Moreover, Ibrahim [7] that cloud computing can transform ICT infrastructure in educational institutions, but challenges like data security remain. This study aims to examine the cloud literacy levels of first-semester students in Malaysian Polytechnics and Community Colleges, focusing on their awareness, usage patterns, and challenges in utilizing cloud services.

The adoption of cloud computing among first-semester students is hindered by several challenges. Higher education institutions need to train students and upskill professionals to utilize the increasing range of cloud technology functionalities. According to Wang [12], many institutions face challenges in effectively implementing cloud computing due to a lack of awareness and inadequate training programs aimed at enhancing cloud literacy. Furthermore, technical barriers also contributed to limited access to reliable devices and internet connectivity restricts students' ability to use cloud services consistently. emphasize that inadequate internet infrastructure remains a critical challenge for institutions in developing countries, hindering the effective use of cloud-based educational tools [8].

Concerns about data breaches and unauthorized access remain significant for students, particularly when using free or public cloud services. These worries are often heightened by insufficient knowledge about effective data protection practices. Khalid and Zolkipli [9] point out that security concerns over data protection and privacy in cloud services can hinder adoption in the education sector. Additionally, Alharbi and Tassaddiq [10] identify that students often lack adequate knowledge about cybersecurity practices, leading to potential data breaches and digital misconduct. Resistance to change plays a significant role in the adoption of new educational technologies.

Another challenge is that students often exhibit reluctance to embrace digital learning tools and online teaching methods. Voigt et al. [11] and Ambalov [12] emphasize that resistance to change plays a significant role in the adoption of new educational technologies. Students often exhibit reluctance to embrace digital learning tools and online teaching methods. Despite awareness of digital learning's importance, Çaro (Kola) et al., [13] notes that students face psychological and infrastructural challenges that hinder their perceived readiness and willingness to engage with these tools.

Recent studies have explored cloud computing adoption in Malaysian education, revealing both opportunities and challenges. At the pre-tertiary level, Jotheehwary Manimaran et al., [19] mention factors such as network connectivity, data security, and budget constraints influence adoption. According to Hussein and Hilmi [20] and Amron et al. [21] in higher education, perceived usefulness and ease of use are significant predictors of cloud-based e-learning adoption. Furthermore, Noh and Amron [22] the COVID-19 pandemic has accelerated the digitization of education, increasing the relevance of cloud computing. However, user readiness remains a concern, with optimism and innovativeness positively affecting acceptance, while insecurity negatively impacts perceived usefulness. Despite these insights, there is still a need for further research on cloud computing adoption among first-semester students in developing countries like Malaysia, as existing studies have primarily focused on broader student populations or professionals in higher education settings. This study aims to address these gaps by examining the cloud literacy levels of first-semester students in Malaysian Polytechnics and Community Colleges. The specific objectives are:

i. To assess students' awareness of cloud computing services: Understanding their familiarity with cloud platforms and their functionalities.
ii. To analyze usage patterns and frequency of cloud service adoption: Exploring how students use cloud services for academic purposes.
iii. To identify challenges faced in utilizing cloud platforms: Investigating technical, security, and accessibility barriers to cloud adoption.
iv. To provide evidence-based recommendations for curriculum enhancements: Proposing strategies to integrate cloud literacy training into educational programs.

By addressing these objectives, this research aims to contribute to the growing body of knowledge on digital literacy in education and provide actionable

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

insights for policymakers and educators.To address these issues, Kuhn [14] an Bala [15] students require support and guidance in redesigning their personal learning environments and developing digital competencies.

Lastly, the digital divide in higher education presents significant challenges for students. Faloye et al., [16] students with limited prior exposure to technology often struggle with basic computer tasks, online research, and application usage, impacting their academic performance. This divide can slow down information literacy training and necessitate teaching basic computer skills alongside more advanced concepts. However, Mphahlele et al. [17] point out that the prevalence of social media may help mitigate some effects of the digital divide. To address these challenges, Gulzar et al. [18] emphasized that institutions should prioritize digital literacy and computer skills in and promote technology ownership, especially in disadvantaged areas. These challenges highlight the need for targeted interventions to address the barriers to cloud adoption among first-semester students.

III. RESEARCH METHODOLOGY

This study employed a quantitative research design utilizing an online survey to assess cloud literacy levels among first-semester students. A structured questionnaire was developed, covering three core areas:

i. Demographic Information: Student background, device accessibility, and internet reliability.
ii. Awareness and Usage Patterns: Familiarity with cloud services, frequency of use, and preferred platforms.
iii. Challenges in Cloud Adoption: Technical, security, and accessibility issues.

A total of 148 first-semester students from PolyCC institutions participated in this study. The participants were selected through purposive sampling, ensuring a representative mix across various academic disciplines. Inclusion criteria required participants to be newly enrolled first-semester students with access to at least one digital device (e.g., smartphone, tablet, or laptop). Access to the internet was a key variable in this study, as it influences students' ability to use cloud computing services effectively. The distribution of internet accessibility among participants is summarized in Table 1. These findings highlight the diverse internet accessibility conditions among students, which can impact their cloud literacy and ability to engage with digital learning tools.

Table 1

Internet Access Type	No. of students	Percentage (%)
Home Access Only	33	22.4
Institution Access Only	20	13.6
Both Home & Institution Access	75	51.0
Mobile Data Only	59	40.1
Limited or No Internet Access	10	6.8

Data collection was conducted using an online survey, distributed via institutional email lists and student portals. The survey was structured into three key sections:

i. Demographic Information – Collected details about students' academic background, access to digital devices, and internet connectivity.
ii. Awareness and Usage of Cloud Services – Measured familiarity with cloud tools, frequency of use, and primary purposes for adoption.
iii. Challenges in Using Cloud Services – Identified barriers such as lack of training, security concerns, and internet limitations.

To ensure data reliability, internal consistency was measured using Cronbach's Alpha ($\alpha = 0.86$), indicating a high level of reliability. Data was analysed using SPSS software, using descriptive statistics to summarize key variables, including mean scores, frequency distributions, and standard deviations.

The study surveyed 148 first-semester students from multiple Polytechnic and Community College (PolyCC) institutions across Malaysia. The demographic breakdown of the participants is presented in the Table 2 below:

Table 2

Program	No. of students	Percentage (%)
Engineering	32	21.6
Information Technology	34	23.0
Business Management	27	18.4
Others	55	37.0

Students were enrolled in a variety of programs, with Information Technology (23%) and Engineering (21.6%) being the most represented. These programs often require frequent use of digital tools and cloud platforms, making cloud literacy particularly important for these students. Business Management (18.4%) and other programs (37%) also

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

constituted a significant portion of the sample, highlighting the diverse academic backgrounds of the participants.

Table 3 reveal that 55.4% of students have reliable internet access both at home and at their educational institution, enabling consistent use of cloud services for academic purposes. However, a significant portion of students (37.8%) rely solely on mobile data, which may limit their ability to use cloud platforms effectively due to data costs, slower speeds, and connectivity issues. According to Rahiem [23] while cloud platforms and smart devices have facilitated online learning, many students face technological barriers such as device issues, unstable internet connections, and data costs. Additionally, 23.0% of students have internet access only at home, while 13.5% have access only at their institution, creating challenges when they are in locations without Wi-Fi. Salsbury & Hansen [24] mention that to address this digital divide, some institutions have implemented solutions such as loaning Wi-Fi hotspots to students with high need. A small but notable percentage of students (6.8%) reported having limited or no internet access, highlighting the digital divide that exists even within educational institutions. Limited internet access has been shown to negatively affect learning processes, motivation, and self-efficacy. According to Zilka et al. [25], inadequate internet connectivity poses a significant barrier to effective learning, particularly in environments that rely heavily on cloud-based educational tools.

Table 3

Internet Access	No. of students	Percentage (%)
Home	34	23.0
Institution	20	13.5
Home and Institution	82	55.4
Mobile data only	56	37.8
Limited or no internet access	10	6.8

In this study, the accessibility of various devices among students was analyzed to understand their technological resources. Table 4 shows that 100% of students reported having regular access to a smartphone, highlighting its ubiquity as a primary device. Additionally, 55.4% of students had access to a laptop, while 37.8% owned or used a tablet. Desktop computers were less common, with only 23.0% of students having access to them. These findings underscore the prevalence of portable devices like smartphones and laptops, which are likely to play a significant role in students' academic activities, particularly in accessing cloud services and other digital tools. The results suggest that while smartphones are universally accessible, there is variability in access to other devices, which may influence students' ability to engage with certain technologies or platforms. However, Sage et al. [27] students generally perceive laptops as more educationally valuable than smartphones. Elliot [28] point out that students and those with financial constraints tend to rely more heavily on smartphones for a wider range of learning activities.

Table 4

Device	No. of students	Percentage (%)
Smartphone	148	100.0
Laptop	82	55.4
Desktop	34	23.0
Tablet	56	37.8

Data on students' internet access patterns were collected and analysed to assess their ability to engage with digital tools and cloud services. Table 5 shows that 55.4% (82 students) reported having access to stable Wi-Fi, indicating that a majority of respondents rely on consistent and reliable internet connections for their academic and personal activities. This group is likely to experience fewer disruptions when accessing online resources, collaborating on cloud platforms, or participating in virtual learning environments. Stable Wi-Fi access is a critical factor in ensuring seamless integration of technology into education, as it enables students to fully utilize digital tools without connectivity-related challenges. To address these issues, Mnisi et al. [29] and Manu et al. [30] recommended to include installing pocket Wi-Fi devices in classrooms, prioritizing community technology centers, and providing subsidized internet access and devices to low-income students.

However, 37.8% (56 students) depend on mobile data for internet access, which may introduce limitations such as data caps, slower speeds, or inconsistent connectivity. This reliance on mobile data suggests that a significant portion of students may face difficulties when engaging in data-intensive tasks, such as uploading large files or participating in real-time collaborative activities. According to Hampton et al. [31], students without home internet access or relying solely on mobile data perform lower on various metrics, including digital skills, homework completion, grades, and standardized test scores. Additionally, 6.8% (10 students) reported having limited or no internet access, which could significantly hinder their ability to participate in online learning or utilize cloud-based services. These findings highlight the variability in internet access among students and

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

underscore the importance of addressing connectivity disparities to ensure equitable access to digital resources. This analysis forms a critical part of the methodology, as it provides insights into the technological challenges faced by students and informs recommendations for improving accessibility in a technology-driven educational landscape.

Table 5

Device	No. of students	Percentage (%)
Stable Wi-Fi	82	55.4
Mobile data	56	37.8
Limited or No Internet Access	10	6.8

Data collection was conducted using an online survey, which was distributed social media applications. The survey was designed to be user-friendly and accessible, ensuring that students could complete it within 10–15 minutes. The questionnaire was structured into three key sections, each focusing on specific aspects of cloud literacy. Demographic Information collected details about students' academic background, including their program of study, institution, and year of enrolment. It also gathered information on students' access to digital devices (e.g., smartphones, laptops, tablets, desktop computers) and their internet connectivity (e.g., home Wi-Fi, institutional Wi-Fi, mobile data, or limited/no internet access). This data was crucial for understanding the technological resources available to students and how these resources might influence their ability to use cloud services effectively.

In the Awareness and Usage of Cloud Services section it measured students' familiarity with cloud computing concepts and platforms. Questions assessed their knowledge of popular cloud services such as Google Drive, Microsoft OneDrive, iCloud, and Dropbox. Students were asked about the frequency of their cloud service usage (e.g., daily, weekly, monthly, rarely, or never) and the primary purposes for which they used these services (e.g., file storage, file sharing, real-time collaboration, or document organization). This section also explored students' proficiency in using advanced cloud features, such as setting permissions for shared files, troubleshooting common issues, and collaborating on documents in real-time.

For the Challenges in Using Cloud Services section it identified barriers students faced when using cloud platforms. Questions focused on challenges such as lack of knowledge or training, difficulty in understanding cloud features, privacy and security concerns, file management problems, and internet connectivity issues. Students were also asked whether they had received any formal training on cloud services and, if so, where they received it (e.g., high school, TVET institution, online courses, or self-taught). Additionally, this section explored students' confidence levels in protecting their data when using cloud services and their perceptions of the importance of cloud services for their studies.

The survey was distributed to first-semester students across multiple Malaysian Polytechnic and Community College (PolyCC) institutions. To ensure a representative sample, purposive sampling was used, targeting students from various academic disciplines, including Information Technology, Engineering, Business Management, and others. The survey was open for a period of four weeks, and reminders were sent to encourage participation. A total of 148 responses were collected, providing a robust dataset for analysis.

The collected data was analyzed using SPSS software, following a multi-step approach to ensure comprehensive and accurate results. Descriptive statistics were used to summarize the key variables in the study. This included calculating mean scores, frequency distributions, and standard deviations for students' awareness, usage patterns, and challenges related to cloud services. Inferential statistical tests, such as Chi-square tests and ANOVA, were conducted to examine differences in cloud literacy based on demographic factors. For instance, the study explored whether students from different academic programs (e.g., Information Technology vs. Engineering) had significantly different levels of cloud literacy. These tests also examined the relationship between internet accessibility (e.g., stable Wi-Fi vs. mobile data) and students' ability to use cloud services effectively.

Pearson correlation tests were performed to analyze the relationship between students' digital literacy levels and their frequency of cloud service usage. This helped determine whether students with higher digital literacy were more likely to use cloud services regularly and effectively. Additionally, correlations were explored between students' confidence in data protection and their awareness of cloud security features.

To ensure the reliability of the survey instrument, internal consistency was measured using Cronbach's Alpha. The calculated value ($\alpha = 0.86$) indicated a high level of reliability, confirming that the survey questions consistently measured the intended constructs. Content validity was ensured by reviewing the survey questions with experts in cloud computing and education technology before distribution.

The study adhered to ethical research practices, including obtaining informed consent from

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

participants and ensuring the confidentiality of their responses. Participants were informed that their participation was voluntary and that they could withdraw from the study at any time without penalty. Data was anonymized to protect students' identities, and the results were reported in aggregate form to prevent the identification of individual respondents.

IV. RESULT DAN DISCUSSION

The survey results revealed that a significant portion of students were familiar with cloud services, with 42.6% reporting being very familiar and 37.2% somewhat familiar (Table 6). Similarly, a survey by Atikuzzaman and Islam [32] found that most first year students is also familiar with cloud services, using them primarily for storage, backup, and collaboration. However, 20.3% of students were not familiar with cloud services, indicating a gap in awareness that needs to be addressed. Study from Dubey and Tiwari [33] revealed limited adoption due to lack of curriculum integration, unawareness of free trials, and concerns about costs and account management. These findings highlight the need for increased awareness and education about cloud services in academic settings to better prepare students for cloud-based environments.

Table 6

Familiarity with Cloud Services	No. of students	Percentage (%)
Very familiar	63	42.6
Somewhat familiar	55	37.2
Not familiar	30	20.3

In terms of usage, Google Drive was the most popular cloud service, with 90.5% of students reporting its use (Table 7). Research by Romero et al.. [34] has demonstrated that Google Drive enhances collaborative work, with 92% of students in one study agreeing that it helped achieve learning objectives. This is likely due to its widespread availability and integration with other Google tools, such as Gmail and Google Docs. Microsoft OneDrive was used by 45.9% of students, while iCloud and Dropbox were used by 31.8% and 4.7%, respectively. It is important to note that students were able to select more than one cloud service, reflecting the diverse range of tools they utilize for different purposes. A small but notable group (2.7%) had never used any cloud services, suggesting that some students may lack access to or awareness of these tools. Additionally, research by Banerjee [35] has identified disparities in technological access and efficacy among underserved and underrepresented student populations, which can impact their ability to engage with online learning platforms. These findings highlight the need for institutions to address the digital divide, raise awareness about cloud services, and develop strategies to support equitable access and adoption of technology in higher education settings.

Table 7

Cloud Services	No. of students	Percentage (%)
Google Drive	134	90.5
Microsoft OneDrive	68	45.9
iCloud	47	31.8
Dropbox	7	4.7
Other	24	16.2
Never Used Cloud	4	2.7

The frequency of cloud usage varied among students, with 33.1% using cloud services daily and 31.8% using them weekly (Table 8). However, 20.8% used cloud services monthly, and 14.2% rarely or never used them, indicating that a significant portion of students do not rely on cloud tools regularly. This could be due to a lack of understanding of the benefits of cloud services or challenges in accessing reliable internet and devices. According to Alimboyong and Bucjan [36], cloud computing adoption in e-government and higher education faces significant challenges in developing countries. Key issues include slow and unreliable internet connections, lack of understanding or awareness of cloud computing benefits, and insufficient IT infrastructure.

Table 8

Cloud Services	No. of students	Percentage (%)
Daily	49	33.1
Weekly	47	31.8
Monthly	31	20.8
Rarely	15	10.1
Never	6	4.1

When asked about their ability to perform specific cloud-related tasks, students reported varying levels of confidence (Table 9). The table presents descriptive statistics for students' confidence levels in performing various cloud-related tasks. The tasks include uploading files to the cloud, organizing files and folders, sharing files with others, collaborating on documents in real-time, setting permissions for shared files, and troubleshooting common cloud issues. The mean scores indicate that students are most confident

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

in sharing files with others (mean = 2.99) and organizing files and folders (mean = 2.85), while they are least confident in troubleshooting common cloud issues (mean = 2.27). The standard deviations, ranging from 0.808 to 0.910, suggest moderate variability in students' confidence levels across tasks. Overall, the data indicates that while students are relatively comfortable with basic cloud tasks like sharing and organizing, they face challenges with more complex tasks such as troubleshooting and collaborating in real-time, highlighting a potential area for additional training and support. Kolgatin et al. [37] agreed that students recognize the key role of cloud computing in education but struggle with issues like time management, self-motivation, and the need for detailed instructions in remote learning settings.

Table 9

Ability	Mean	Standard Deviation
Uploading files to the cloud	2.75	0.910
Organizing files and folders	2.85	0.828
Sharing files with others	2.99	0.808
Collaborating on documents in real time Setting	2.59	0.887
permissions for shared files	2.72	0.881
Troubleshooting common cloud issues	2.27	0.900

The study identified several challenges faced by students in adopting cloud services. The most significant barrier was internet connectivity issues, reported by 49% of students (Table 10). This finding is consistent with previous research by Alimboyong and Bucjan [36], Gupta et al. [38] and Abdelkader et al. [39] highlighting the digital divide in developing countries, where limited access to reliable internet infrastructure hinders the adoption of digital tools [3]. Additionally, 41.2% of students reported difficulty understanding cloud features, and 40.5% cited a lack of knowledge or training as a major challenge. These results underscore the need for structured training programs to enhance students' cloud literacy. To address these challenges, structured training programs are needed to enhance students' cloud literacy and self-management skills. M. Naved et al. [40] suggested educational institutions must carefully consider the sustainability and standardization of cloud services when integrating them into their IT infrastructure.

Table 10

Challenges	No. of students	Percentage (%)
Lack of Knowledge/Training	60	40.5
Difficulty Understanding Features	61	41.2
Internet Connectivity Issues	71	49.0
Privacy and Security	52	35.1
Concerns	48	32.4
File Management Problems	24	16.2
Other Challenges		

Privacy and security concerns were also a significant barrier, with 35.1% of students expressing apprehension about data breaches and unauthorized access (Table 2). This aligns with findings from Balash et al. [41], who identified students worry about the amount and personal nature of information shared, though some recognize a trade-off between safety and exam integrity. Furthermore, 32.4% of students reported file management problems, indicating that organizing and managing files in the cloud is a challenge for some. A smaller group (16.2%) reported other challenges, such as limited storage or device compatibility issues. Technical challenges such as synchronization problems, limited storage, and device compatibility issues are also reported by Shi et al. [42] and Qasim et al. [43].

Students' confidence in protecting their data on cloud services varied widely. While 33.8% were very confident and 27.7% were somewhat confident, a significant portion (23.6%) were neutral, and 10.8% were not confident (Table 11). These results suggest that while many students feel secure using cloud services, a notable group remains uncertain about their ability to protect their data. Another study revealed that users of cloud services have basic awareness of security implications but may lack comprehensive threat models due to limited technical knowledge as highlighted by previous studies Wermke et al.[44].

Table 11

Confident Level	No. of students	Percentage (%)
Very Confident	50	33.8
Somewhat Confident	41	27.7
Neutral	35	23.6
Not Confident	16	10.8
Very Not Confident	6	4.1

When asked about the importance of cloud services for their studies, 33.1% of students felt that cloud services were very important, and 27%

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

considered them somewhat important (Table 12). However, 33.1% were neutral, and 6.8% felt that cloud services were not important. This divergence in perceptions suggests that while many students recognize the value of cloud tools, others may not fully understand their potential benefits or face barriers that limit their use. This also supported by Kholilah et al. [45] the perceived ease of use and facilitating conditions are crucial factors influencing students' intention to use cloud computing, while perceived usefulness, social influence, and personal innovativeness may have less impact. Furthermore, Kholilah et al. [45] indicate that students' intentions to adopt cloud computing are chiefly influenced by the ease of use and the availability of facilitating conditions, whereas factors such as perceived usefulness, social influence, and personal innovativeness seem to play a relatively minor role.

Table 12

Perceived Importance	No. of students	Percentage (%)
Very Important	49	33.1
Somewhat Important	40	27.0
Neutral	49	33.1
Not Important	6	4.1
Very Not Important	4	2.7

A strong majority of students (73.5%) expressed interest in receiving additional training on cloud services, as shown in Table 6, while 26.5% were not interested. This high level of interest underscores the demand for further education on cloud tools, particularly in advanced functionalities such as real-time collaboration, data security, and troubleshooting. The increasing demand for cloud-related skills has highlighted the need for comprehensive upskilling and reskilling programs aimed at both students and professionals, as noted by Billionniere and Meyer [46]. The findings suggest that while many students are familiar with basic cloud functionalities, they recognize the need for more comprehensive training to fully leverage these tools for academic and professional purposes. Addressing this demand through targeted training programs could significantly enhance students' cloud literacy, improve their academic performance, and better prepare them for technology-driven workplaces. This aligns with previous research by Tian et al. [47] emphasizing learning and workflow learning are identified as effective methods to align skill development with digital transformation progress, emphasizing the importance of digital awareness, competency, and fluency.

The analysis of mean cloud literacy scores revealed significant differences between groups based on their perceived importance of cloud skills. As illustrated in Figure 1, students who considered cloud skills to be of high importance had a mean cloud literacy score of 2.5, while those who perceived cloud skills as less important had a mean score of 1.5. This indicates that students who value cloud skills more highly tend to have better cloud literacy, suggesting a positive correlation between perceived importance and actual proficiency.

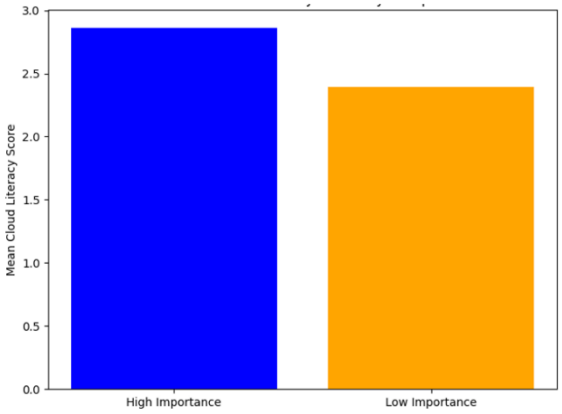


Figure 1

V. CONCLUSION

Cloud computing has become an essential tool in education, offering a range of functionalities that enhance learning and collaboration. While most students are familiar with basic cloud features such as file storage and sharing, there remains a substantial gap when it comes to advanced skills, particularly in areas like real-time collaboration, multi-platform integration, and data security. The lack of proficiency in these areas can hinder students from fully leveraging cloud technologies to enhance their academic performance. Jackman et al. [48] emphasize the urgent need for coordinated global efforts in digital skills education to help students succeed while mitigating risks. Pellicano et al. [49] report on students' struggles with embedded systems, suggesting a need for more engaging educational tools to enhance competency and real-world application.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Several challenges continue to impede students' adoption of cloud technologies, with internet connectivity issues and limited training opportunities being the most prominent. According to Akmad & Abatayo [50] unstable internet connections, particularly for students relying on mobile data, can severely restrict their ability to access cloud services consistently. These challenges lead to increased stress and negatively affect academic outcomes.Additionally, the lack of formal training on cloud-related skills further complicates students' efforts to utilize these tools effectively. Privacy concerns and difficulties with file management also contribute to the hesitancy toward adopting cloud platforms. These challenges are particularly prevalent in developing regions, where inadequate infrastructure and limited resources exacerbate the digital divide. Addressing these barriers requires targeted interventions aimed at improving internet accessibility and offering comprehensive training programs.

Furthermore, while many students express confidence in performing basic tasks like file storage and sharing, their competence diminishes when engaging with more advanced cloud functionalities. This disparity indicates a pressing need for training that goes beyond foundational skills. Wagemann et al. [51] emphasizing that these efforts aim to develop role-based and technical skills necessary for managing cloud technologies, As the demand for cloud-related skills continues to grow in the workforce, educational institutions must prioritize cloud literacy in their curricula. By enhancing training programs and addressing accessibility issues, institutions can help bridge the gap in digital literacy and better prepare students for future technology-driven workplaces. Effective integration of cloud literacy training would not only enhance students' academic experiences but also improve their readiness to navigate increasingly digital professional environments.

This study investigated the awareness, usage patterns, and challenges faced by first-semester students in utilizing cloud services within Malaysian Polytechnics and Community Colleges. The findings indicate that while most students are familiar with basic cloud functionalities such as file storage and sharing, significant gaps remain in advanced skills, particularly real-time collaboration, multi-platform integration, and data security. These deficiencies may hinder students' academic performance and readiness for technology-driven workplaces.

Furthermore, the research highlights several challenges to cloud adoption, including limited internet connectivity, inadequate training, privacy concerns, and file management issues. Internet connectivity issues were the most prominent barrier, particularly for students relying solely on mobile data. The findings also reveal a strong demand for additional training, especially in advanced cloud functionalities and data security.

In response to the research objectives, this study emphasizes the need for educational institutions to integrate structured cloud literacy training into their curricula. Addressing the identified gaps and challenges through targeted interventions, such as enhancing internet accessibility and providing comprehensive training programs, will not only enhance students' digital competencies but also improve their readiness for the evolving demands of the digital workforce. Future research should explore the effectiveness of various training methods in improving cloud literacy among students and assess their long-term impact on academic and professional success.

ACKNOWLEDGEMENT

This research was not funded by any grant.

REFERENCES

[1] Shruthi and G. Shankarlingam, "A case study and implementation of cloud computing technology in education sector during Covid-19 pandemic," SSRN Electron. J., 2022, doi: 10.2139/ssrn.4140510.

[2] A. T. Korucu, "The views of teacher candidates on using cloud technologies in education," Int. J. High. Educ., vol. 6, no. 1, p. 84, 2016, doi: 10.5430/ijhe.v6n1p84.

[3] L. Wang and C. Liu, "Enhancing cloud literacy: A study on advanced functionalities and student proficiency," J. Cloud Comput., vol. 10, no. 1, pp. 1–15, 2021, doi: 10.1186/s13677-021-00245-7.

[4] M. B. Ali, "Multi-perspectives of cloud computing service adoption quality and risks in higher education," in Cloud Computing Applications and Services for Smart Education, IGI Global, 2020, pp. 1–19, doi: 10.4018/978-1-7998-3476-2.ch001.

[5] A. T. Junaedi et al., "Advancing digital and technology literacy through qualitative studies to bridging the skills gap in the digital age," J. Appl. Bus. Technol., vol. 5, no. 2, pp. 123–133, 2024, doi: 10.35145/jabt.v5i2.170.

[6] E. Billionniere and L. Meyer, Transforming Education. ACM, 2021, pp. 91–96, doi: 10.1145/3450329.3476863.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

[7] U. Ibrahim, "The role of cloud computing in transforming ICT infrastructure in educational institutions," Int. J. Appl. Sci. Res., vol. 2, no. 2, pp. 213–226, 2024, doi: 10.59890/ijasr.v2i2.1333.

[8] K. Abdelkader, R. Aki, S. Yedder, and R. Arfa, "Challenges and factors affecting cloud computing adoption in higher technical education institutions in Libya," 2021 IEEE 1st Int. Maghreb Meet. Conf. Sci. Tech. Autom. Control Comput. Eng. (MI-STA), pp. 310–315, 2021, doi: 10.1109/MI-STA52233.2021.9464501.

[9] M. I. I. Khalid and M. F. Zolkipli, "Review on cloud security and challenges on higher education," Malays. J. Appl. Sci., vol. 7, no. 1, pp. 1–9, 2022, doi: 10.37231/myjas.2022.7.1.284.

[10] T. Alharbi and A. Tassaddiq, "Assessment of cybersecurity awareness among students of Majmaah University," Big Data Cogn. Comput., vol. 5, no. 2, p. 23, 2021, doi: 10.3390/bdcc5020023.

[11] C. Voigt, K. Vogelsang, and U. Hoppe, "The effect of resistance to change on students' acceptance in a flipped classroom course," Proc. 16th Int. Conf. Comput. Supported Educ. (CSEDU), pp. 15–22, 2021, doi: 10.5220/0010283800150022.

[12] E. Gratz and L. Looney, "Faculty resistance to change," Int. J. Online Pedagogy Course Des., vol. 10, no. 1, pp. 1–14, 2019, doi: 10.4018/IJOPCD.2020010101.

[13] E. Çaro, O. Hasrama, and S. Sinjari, "Readiness of Albanian students to engage in digital learning: Perceptions, challenges and opportunities," Proc. ENTRENOVA Enterp. Res. Innov. Conf., vol. 10, no. 1, pp. 148–162, 2024, doi: 10.54820/entrenova-2024-0014.

[14] C. Kühn, "Are students ready to (re)-design their personal learning environment? The case of the E-Dynamic.Space," J. New Approaches Educ. Res., vol. 6, no. 1, pp. 11–19, 2017, doi: 10.7821/naer.2017.1.185.

[15] R. Bala, "Students' perspective of cloud-based digitalization of higher education," in Digital Transformation in Higher Education, Chapman and Hall/CRC, 2021, pp. 45–54, doi: 10.1201/9781003203070-5.

[16] Faloye, S. T. (2019). *Managing the challenges of digital divide among first year students : a case of UKZN.* https://researchspace.ukzn.ac.za/handle/10413/16823

[17] M. I. Mphahlele, S. N. Mokwena, and A. Ilorah, "The impact of digital divide for first-year students in adoption of social media for learning in South Africa," S. Afr. J. Inf. Manag., vol. 23, no. 1, 2021, doi: 10.4102/sajim.v23i1.1344.

[18] A. A. Gulzar, Z. Mehmood, and I. Ahmad, "Impact of the digital divide on learning outcomes of students in higher education institutes," Hum. Nat. J. Soc. Sci., vol. 5, no. 2, pp. 152–159, 2024, doi: 10.71016/hnjss/7jn1nt52.

[19] J. Manimaran et al., "Cloud computing adoption in pre-tertiary Malaysian education institution," 2024 IEEE Conf. e-Soc., Media, Technol. (ESMARTA), pp. 1–8, 2024, doi: 10.1109/ESMARTA62850.2024.10638997.

[20] L. A. Hussein and M. F. Hilmi, "Cloud computing based e-learning in Malaysian universities," Int. J. Emerg. Technol. Learn., vol. 15, no. 8, p. 4, 2020, doi: 10.3991/ijet.v15i08.11798.

[21] M. T. Amron, N. H. M. Noh, and M. A. Mohamad, "Predicting the acceptance of cloud computing in higher education institutions by extending the technology readiness theory," Asian J. Univ. Educ., vol. 18, no. 3, 2022, doi: 10.24191/ajue.v18i3.18968.

[22] N. H. M. Noh and M. T. Amron, "Exploring cloud computing readiness and acceptance in higher education institution: A PLS-SEM approach," Asian J. Univ. Educ., vol. 17, no. 4, p. 367, 2021, doi: 10.24191/ajue.v17i4.16193.

[23] M. D. H. Rahiem, "Technological barriers and challenges in the use of ICT during the COVID-19 emergency remote learning," Univ. J. Educ. Res., vol. 8, no. 11B, pp. 6124–6133, 2020, doi: 10.13189/ujer.2020.082248.

[24] M. Salsbury and M. A. Hansen, "Bridging the digital divide: Wi-Fi hot spots as a means of digital equity," Portal Libr. Acad., vol. 22, no. 1, pp. 199–219, 2022, doi: 10.1353/pla.2022.0000.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[25] G. C. Zilka, I. Finkelstein, R. Cohen, and I. D. Rahimi, "Implications of the digital divide for the learning process during the COVID-19 crisis," Rev. Eur. Stud., vol. 13, no. 2, p. 57, 2021, doi: 10.5539/res.v13n2p57.

[26] K. Sage et al., "Equal in effectiveness but not yet perception: Smartphones and laptops for completing brief academic tasks," Educ. Media Int., vol. 59, no. 2, pp. 112–130, 2022, doi: 10.1080/09523987.2022.2101203.

[27] R. Elliott, "How are smart phones used by students in higher education? Exploring the intersection of digital learning activities and personal technology," 2023 IEEE Conf. Softw. Eng. Educ. Train. (CSEET), pp. 109–118, 2023, doi: 10.1109/CSEET58097.2023.00022.

[28] B. R. Mnisi, T. I. Mtshali, and M. Moses, "Moving beyond the challenges of learning through technologies: The current status of ICT integration in South African schools," J. Educ. e-Learn. Res., vol. 11, no. 1, pp. 128–134, 2024, doi: 10.20448/jeelr.v11i1.5396.

[29] J. Manu et al., "Education and technology in Ghana: Understanding the centrality of technology integration in the classroom and beyond," Am. J. Educ. Res., vol. 12, no. 10, pp. 402–412, 2024, doi: 10.12691/education-12-10-2.

[30] K. Hampton et al., "Repercussions of poor broadband connectivity for students in rural and small town Michigan," SSRN Electron. J., 2020, doi: 10.2139/ssrn.3749644.

[31] M. Atikuzzaman and M. A. Islam, "Perceptions and use of cloud services: An empirical study on the students of a public university in Bangladesh," Digit. Libr. Perspect., vol. 37, no. 2, pp. 87–101, 2020, doi: 10.1108/DLP-04-2020-0016.

[32] P. Dubey and A. K. Tiwari, "A survey on use of Amazon Web Services by engineering students," 2023 IEEE Int. Conf. Adv. Electron. Commun. Comput. (ICAECC), pp. 1–6, 2023, doi: 10.1109/ICAECC59324.2023.10560349.

[33] M. Á. R. Romero, A. L. Í. Carrillo, and A. J. L. Villalvazo, "Valoración de la herramienta Google Drive durante el trabajo colaborativo universitario," RIDE Rev. Iberoam. Investig. Desarro. Educ., vol. 11, no. 22, 2021, doi: 10.23913/ride.v11i22.944.

[34] M. Banerjee, "An exploratory study of online equity: Differential levels of technological access and technological efficacy among underserved and underrepresented student populations in higher education," Interdiscip. J. e-Skills Lifelong Learn., vol. 16, pp. 93–121, 2020, doi: 10.28945/4664.

[35] C. R. Alimboyong and M. E. Bucjan, "Cloud computing adoption among state universities and colleges in the Philippines: Issues and challenges," Int. J. Eval. Res. Educ., vol. 10, no. 4, pp. 1455–1463, 2021, doi: 10.11591/ijere.v10i4.21526.

[36] O. H. Kolgatin, L. S. Kolgatina, and N. S. Ponomareva, "Enhancing out-of-class independent learning in a cloud-based information and communication learning environment: Insights from students of a pedagogical university," CTE Workshop Proc., vol. 10, pp. 167–184, 2023, doi: 10.55056/cte.555.

[37] I. Gupta, N. Mishra, and D. Tandon, "Cloud-based digitalization in higher education," in Digital Transformation in Higher Education, Chapman and Hall/CRC, 2021, pp. 71–88, doi: 10.1201/9781003203070-7.

[38] K. Abdelkader et al., "Challenges and factors affecting cloud computing adoption in higher technical education institutions in Libya," 2021 IEEE 1st Int. Maghreb Meet. Conf. Sci. Tech. Autom. Control Comput. Eng. (MI-STA), pp. 310–315, 2021, doi: 10.1109/MI-STA52233.2021.9464501.

[39] M. Naved et al., "Identifying the role of cloud computing technology in management of educational institutions," Mater. Today Proc., vol. 51, pp. 2309–2312, 2021, doi: 10.1016/j.matpr.2021.11.414.

[40] D. G. Balash et al., "Examining the examiners: Students' privacy and security perceptions of online proctoring services," Symp. Usable Privacy Secur., pp. 633–652, 2021. [Online]. Available: https://europepmc.org/article/PPR/PPR362172.

[41] S. C. Hui et al., "Information security and technical issues of cloud storage services: A qualitative study on university students in Hong Kong," Libr. Hi Tech, vol. 42, no. 5, pp. 1406–1425, 2023, doi: 10.1108/LHT-11-2022-0533.

[42] N. H. Qasim et al., "Data management challenges and solutions in cloud-based environments," Radioelectron. Nanosyst. Inf. Technol., vol. 16, no. 1, pp. 157–170, 2024, doi: 10.17725/j.rensit.2023.16.157.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[43] D. Wermke et al., "Cloudy with a chance of misconceptions: Exploring users' perceptions and expectations of security and privacy in cloud office suites," Symp. Usable Privacy Secur., pp. 359–377, 2020. [Online]. Available: https://publications.teamusec.de/2020-soups-cloudy/pdf/conf-soups-wermke20.pdf.

[44] K. Kholilah, H. R. Kawulur, and I. Subekti, "Perceived usefulness, perceived ease of use, facilitating condition, social influence, and personal innovativeness of accounting students cloud computing adoption," Organum J. Saintifik Manaj. Akunt., vol. 5, no. 2, pp. 141–151, 2022, doi: 10.35138/organum.v5i2.257.

[45] Y. Alharbi, F. Rabbi, and R. Alqahtani, "Understanding university student's intention to use quality cloud storage services," Int. J. Qual. Res., vol. 14, no. 1, pp. 313–324, 2020, doi: 10.24874/IJQR14.01-20.

[46] O. Tian, S. Lee, and V. Salminen, "Aligning just-in-time learning with digital transformation," AHFE Int., 2024, doi: 10.54941/ahfe1004954.

[47] J. A. Jackman et al., "Addressing the digital skills gap for future education," Nat. Hum. Behav., vol. 5, no. 5, pp. 542–545, 2021, doi: 10.1038/s41562-021-01074-z.

[48] F. G. Pellicano, M. Carnascialli, and C. Martinez, "Establishing baseline data on student success in embedded systems education," 2021 IEEE Front. Educ. Conf. (FIE), pp. 1–4, 2022, doi: 10.1109/FIE56618.2022.9962525.

[49] J. Wagemann et al., "A user perspective on future cloud-based services for big Earth data," Int. J. Digit. Earth, vol. 14, no. 12, pp. 1758–1774, 2021, doi: 10.1080/17538947.2021.1982031.

[50] L. Meyer and E. Billionniere, "Upskilling to meet cloud talent needs," 2020 ASEE Virtual Annu. Conf., 2024, doi: 10.18260/1-2--37976.

[51] N. A. Mudawi, N. Beloff, and M. White, "Issues and challenges: Cloud computing e-Government in developing countries," Int. J. Adv. Comput. Sci. Appl., vol. 11, no. 4, 2020, doi: 10.14569/IJACSA.2020.0110402.

[52] G. Rastogi and R. Sushil, "Cloud computing implementation: Key issues and solutions," 2015 Int. Conf. Comput. Sustain. Glob. Dev., pp. 320–324, 2015. [Online]. Available: https://www.researchgate.net/publication/274715151_Cloud_Computing_Implementation_Key_Issues_and_Solutions.

[53] IEEE Editorial Style Manual, IEEE, 2024. [Online]. Available: https://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/IEEE-Editorial-Style

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

AUTHOR'S INFORMATION

First Author: **Siti Sharmila Binti Osmin** 	Department of Information Technology Pasir Salak Community College, Jalan Lebuh Paduka, Changkat Lada, 36800 Kampung Gajah, Perak, Malaysia E-mail: sitisharmila@kkpsa.edu.my
Second Author: **Siti Salmah Binti Md Kassim** 	Faculty of Faculty of Computing and Digital Technology, Ungku Omar Polytechnic, 31400 Ipoh, Perak, Malaysia E-mail: sitisalmah@puo.edu.my
Third Author: **Mazidah Binti Mukri** 	Faculty of Civil Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia E-mail: mazidahmukri@salam.uitm.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Improving Microprocessor Fundamentals Education: A Case Study from Electrical Engineering Students at Polytechnic Sultan Idris Shah

Ts.Manimekalai Balasubramaniam[1], Izashahida Binti Zainal [2], Naily Akmal Binti Binti Mohd Zamri [3]

[1] *Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sabak Bernam, Selangor, Malaysia*
E-mail: manimekalai@psis.edu.my

[2] *Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sabak Bernam, Selangor, Malaysia*
E-mail: izashahida@psis.edu.my

[3] *Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sabak Bernam, Selangor, Malaysia*
nailyakma@psis.edu.my

Abstract

This research explores the difficulties faced by Electrical Engineering Department students at Polytechnic Sultan Idris Shah (PSIS) in learning Microprocessor Fundamentals. Microprocessors are vital in modern engineering, forming the backbone of many devices and systems. However, students often struggle to understand the theory and link it to practical applications. This issue is caused by several factors, including teaching methods, lack of resources, and different learning styles.

The study used surveys to collect responses from 65 students enrolled in the Diploma in Electronic Engineering (Computer) also known as DTK program. The surveys focused on theoretical understanding, practical skills, and the effectiveness of teaching methods. The survey measured students' understanding, practical skills, and the effectiveness of teaching methods and resources. Descriptive statistics were used to analyse the data. Results showed that 41.5% of students find it hard to grasp key concepts, and 38.5% feel the lack of visual aids makes learning more difficult. Additionally, 33.8% reported a mismatch between practical labs and theoretical lessons.

To address these challenges, the research suggests several solutions. Using simulation tools can help students visualize how microprocessors work. Providing more detailed and complete teaching materials can also make it easier for students to understand complex topics. Aligning practical exercises with lecture content is another recommendation to ensure students can apply what they learn. Finally, introducing guest speakers and industry visits can give students real-world insights and make learning more engaging.

The study recommends integrating simulation tools, enhancing teaching materials, and increasing industry exposure to bridge these gaps and improve educational outcomes. The findings of this study aim to improve the quality of teaching Microprocessor Fundamentals and prepare students better for their future careers. By implementing these recommendations, educators can bridge the gap between theory and practice, ensuring students gain the skills and knowledge they need to succeed in the field of electrical engineering.

Keywords: Microprocessor Fundamentals, Engineering Education, Learning Challenges, Teaching Strategies, Polytechnic Sultan Idris Shah

I. INTRODUCTION

Microprocessor Fundamentals is a core subject in the electrical engineering curriculum, providing foundational knowledge for understanding digital systems, automation, and embedded technologies. Microprocessors are widely used in various sectors, from consumer electronics to industrial control systems. As the demand for skilled engineers in digital and embedded system design increases,

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

mastery of microprocessor concepts becomes essential for preparing students for real-world engineering challenges [5].

At Polytechnic Sultan Idris Shah (PSIS), many students face difficulties in learning Microprocessor Fundamentals. Key challenges include a lack of prior exposure to the subject, heavy reliance on theoretical teaching methods, and minimal use of visual or interactive tools [1]. Additionally, students report difficulty in applying theoretical knowledge during lab sessions, suggesting a disconnect between what is taught and what is practiced. These issues are further compounded by limited access to updated resources and learning materials.

While previous studies have highlighted the importance of interactive and experiential learning in engineering education, there remains a gap in how these approaches are implemented effectively within Malaysian polytechnic institutions. Specifically, little research focuses on the real classroom and laboratory experiences of diploma-level students in technical and vocational education and training (TVET) settings [7]. Understanding student feedback at the course level is crucial for developing targeted improvements in pedagogy and learning resources.

This study aims to investigate the specific learning challenges faced by PSIS students enrolled in Microprocessor Fundamentals and to explore strategies for enhancing teaching effectiveness. By analysing student feedback on theoretical clarity, practical skills development, and available learning supports, the study seeks to propose practical, evidence-based recommendations [6]. Ultimately, it intends to strengthen the integration between theoretical and hands-on learning and contribute to a more student-centred engineering education environment.

This research focuses on the experience of students at PSIS, offering insights that are closely tied to one particular teaching and learning setting. While the word “case study” is used in the title, it is meant to highlight the specific context and group involved, rather than indicating that the research is based solely on qualitative case study methods.

II. LITERATURE REVIEW

The challenges in teaching Microprocessor Fundamentals have been widely discussed in educational research. Kumar and Singh (2020) highlight the importance of using simulation tools to make abstract concepts more understandable. These tools help students visualize how microprocessors work, bridging the gap between theory and practice [2].
O'Donnell (2021) emphasizes the need for adaptive teaching methods that cater to diverse learning styles. For example, combining visual aids, hands-on activities, and step-by-step explanations can improve student engagement and understanding [3]. Similarly, Wright and Evans (2017) advocate for aligning laboratory exercises with lecture content. This approach ensures that students can directly apply what they learn in theory to practical tasks [4]. Smith and Johnson (2018) discuss the benefits of interactive learning environments, such as group projects and peer learning, in enhancing student comprehension. These methods encourage collaboration and allow students to learn from one another's perspectives [5].

Recent literature emphasizes the importance of active and experiential learning. Kumar and Singh (2020) highlighted the effectiveness of simulation tools in enhancing conceptual understanding. O'Donnell (2021) suggested adopting diverse teaching strategies tailored to student learning styles. This study adopts Kolb’s Experiential Learning Theory as its theoretical underpinning. Kolb (1984) emphasizes a learning cycle that includes Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. Applying Kolb’s model ensures a better integration of theory and practice, enhancing engagement and retention.
In the context of Technical and Vocational Education and Training (TVET) [4], such as at PSIS, Kolb’s model provides a strong foundation for engaging students in meaningful learning cycles. It is especially relevant for microprocessor education, where theoretical knowledge must be reinforced through hands-on practice and reflection.

Lastly, Ali et al. (2021) suggest that industry exposure, such as guest lectures and field visits, can help students connect classroom learning to real-world applications. This exposure not only enhances technical skills but also prepares students for future careers in engineering [7].

Overall, the literature underscores the need for innovative teaching strategies, adequate resources, and a strong link between theory and practice to improve Microprocessor Fundamentals education [6][8].

III. PROBLEM STATEMENT

Microprocessor Fundamentals is a key subject in the field of electrical engineering. However, many students struggle to master this subject due to various reasons. First, the complexity of the subject, which involves understanding both theoretical concepts and practical applications, poses

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

significant challenges for learners. This is particularly true for students who lack prior exposure to microprocessors [1].

Teaching methods and resources also contribute to the issue. Traditional lecture-based approaches may not effectively address the diverse learning needs of students. For instance, some students learn better through visual aids, hands-on activities, or interactive tools, but these are often unavailable or insufficient in the current teaching setup [3]. This gap makes it harder for students to visualize and understand how microprocessors function [4].

Additionally, there is often a disconnect between theoretical lessons and practical applications. Lab sessions may not always align with the topics covered in lectures, leaving students unable to bridge the gap between what they learn in class and how to apply it in real-world scenarios [2]. This mismatch reduces the effectiveness of the learning process.

Lastly, resource limitations further complicate the learning experience. Insufficient access to simulation tools, incomplete teaching materials, and a lack of supplementary resources hinder students' ability to practice and fully grasp the subject [6]. These challenges underline the need for a study to identify the root causes and propose solutions to improve the teaching and learning of Microprocessor Fundamentals at PSIS [7].

IV. OBJECTIVES

1. To identify the specific challenges faced by PSIS students in learning Microprocessor Fundamentals.
2. To analyse how teaching methods and learning resources impact students' understanding and performance.
3. To suggest practical solutions for bridging the gap between theoretical and practical learning.
4. To explore the role of additional resources, such as simulations and industry exposure, in enhancing student learning [8].

V. RESEARCH QUESTIONS

1. What are the main difficulties faced by students in understanding microprocessor concepts?
2. How do teaching methods and resources affect students' learning and engagement?
3. What strategies can improve the connection between theoretical lessons and practical applications?
4. How can simulations and industry interactions support better learning outcomes for students?

VI. IMPORTANCE OF STUDY

This study is significant as it provides actionable insights for improving the delivery of Microprocessor Fundamentals in technical and vocational education contexts. The findings not only highlight pedagogical gaps but also offer practical strategies to enhance student engagement, comprehension, and readiness for industry.

By integrating student-centred approaches and modern educational tools, the study supports curriculum developers, lecturers, and institutional decision-makers in strengthening the alignment between academic outcomes and workforce demands. Ultimately, it contributes to elevating the quality of engineering education at PSIS and offers a replicable model for other polytechnic institutions facing similar instructional challenges.

VII. SCOPE OF STUDY

This study focuses on Diploma in Electronic Engineering (Computer) students at PSIS who are enrolled in the Microprocessor Fundamentals course. It examines challenges faced by students during one academic semester, covering both theoretical and practical aspects of the subject. The study includes data collected from 65 students through surveys and focuses on understanding their learning difficulties, the effectiveness of current teaching methods, and the availability of resources [1][3].

The scope is limited to DTK students at PSIS, so the findings may not fully apply to other programs or institutions. However, the results provide valuable insights that can guide improvements in similar contexts. By addressing key challenges identified in this study, educators and curriculum developers can enhance the learning experience for students and better prepare them for industry demands [6][8].

VIII. LIMITATIONS OF STUDY

This study has a few limitations. First, it focuses only on students from the Diploma in Electronic Engineering (Computer) program at PSIS. The findings may not fully apply to students in other programs or institutions. Second, the study relies on self-reported data collected through surveys, which may contain biases or inaccuracies. For example, students might overestimate or underestimate their challenges [7].

Another limitation is the short duration of the study, which covers just one academic semester. This time frame might not capture long-term trends or

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

challenges that students face. Additionally, the study does not account for external factors, such as personal circumstances or prior education, which could influence learning outcomes. Despite these limitations, the study provides valuable insights into improving Microprocessor Fundamentals education [8].

IX. RESEARCH METHODOLOGY

A. Research Design

This study uses a mixed-method research design to provide a comprehensive understanding of the challenges faced by students in learning Microprocessor Fundamentals. A mixed-method approach combines both quantitative and qualitative data collection techniques, which ensures a balanced and detailed analysis [1][2].

Quantitative data is gathered through structured surveys containing Likert-scale questions. These questions focus on students' understanding of microprocessor concepts, the effectiveness of teaching methods, and the availability of learning resources. The survey results provide numerical insights into the common challenges faced by students.

Qualitative data is collected through open-ended survey question with students. This allows the study to capture detailed and personal perspectives about their learning experiences. By combining these methods, the research gains a deeper understanding of the issues and their root causes [3].

The study targets Diploma in Electronic Engineering (Computer) students at PSIS, ensuring the sample reflects diverse academic performance levels and learning styles. The combination of quantitative and qualitative approaches strengthens the validity and reliability of the findings, offering valuable insights for improving Microprocessor Fundamentals education [4][7].

Although the research uses both quantitative and qualitative methods, it is centred around a specific group of students at Polytechnic Sultan Idris Shah. The term “case study” in the title reflects this focused setting. It does not mean that the research follows a full qualitative case study method, but rather that it looks closely at one particular group (DTK students) in a real classroom environment.

B. Population and Sampling

The population for this study consists of students enrolled in the Diploma in Electronic Engineering (Computer) program at Polytechnic Sultan Idris Shah (PSIS). These students are specifically selected because they are required to study Microprocessor Fundamentals as part of their curriculum. This ensures that the participants have direct experience with the course and can provide relevant feedback [1][3].

A purposive sampling method is used to select participants. This method is appropriate because it focuses on a specific group of students who are most likely to provide insights into the challenges and learning experiences associated with Microprocessor Fundamentals. The total sample size is 65 students, which includes individuals from different academic years and varying levels of academic performance. This diversity ensures that the findings reflect a range of perspectives and experiences [2].

This study focuses exclusively on 65 students who were enrolled in the Diploma in Electronic Engineering (Computer) program at Polytechnic Sultan Idris Shah during the semester in which the study was conducted. These students were purposively selected as they were the only cohort undertaking the Microprocessor Fundamentals course at that time. While this ensures relevance and depth within the specific academic context, it also presents a limitation in terms of generalizability. The findings may not fully represent students in other programs, polytechnics, or future cohorts. Therefore, this research helps to give useful insights about the learning environment at PSIS. [4].

By selecting a representative sample, the study aims to provide reliable and actionable insights into the challenges faced by PSIS students. This sampling strategy also enhances the validity of the findings, allowing educators and policymakers to make informed decisions to improve Microprocessor Fundamentals education [6][8].

The Likert Scale with five options is used to help students express their level of agreement with each item presented. The Likert Scale is considered appropriate because it is a primary measurement tool with high reliability and validity. The Likert Scale used in this study is shown in Table 1.

Level of Measurement	Linear Scale
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

Table 1: Likert Scale Score Values

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

C. Research Instruments

The research instrument for this study is a structured survey questionnaire designed to collect data on students' learning experiences and challenges in the Microprocessor Fundamentals course. The questionnaire consists of two sections, with one open-ended question included to gather additional qualitative insights.

The first section focuses on demographic information, such as gender, age, and academic year, to ensure a diverse representation of participants. This information helps to identify any patterns or trends among different student groups and their experiences in learning Microprocessor Fundamentals [3][4].

The second section contains Likert-scale items that measure students' perceptions of their learning experience. These items address several aspects, including the clarity of theoretical explanations, the effectiveness of lab sessions, the sufficiency of teaching materials, and the availability of resources, such as simulation tools. The Likert scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree), enabling the quantification of responses for statistical analysis [6].

An open-ended question is included at the end of the survey to allow students to provide detailed feedback on their learning challenges and suggestions for improvement. This qualitative input adds depth to the quantitative data, offering a more comprehensive understanding of students' experiences [7].

The questionnaire was reviewed and validated by subject matter experts to ensure its clarity and relevance to the study's objectives. A pilot test was conducted with a small group of students to refine the questions further, ensuring they are easily understood and align with the goals of the research. Although a full reliability analysis such as Cronbach's Alpha was not carried out due to the limited number of pilot respondents, the feedback gathered helped ensure consistency and understanding of each question before distributing the final questionnaire to all participants. [8].

D. Data Analysis Methods

The data collected from the survey questionnaire were analysed using descriptive statistical methods. This approach was chosen to summarize the data and identify key patterns and trends in the students' learning experiences and challenges related to Microprocessor Fundamentals. Descriptive statistics, such as percentages, means, and standard deviations, were used to present the results in a clear and understandable manner [6][7].

For the Likert-scale questions, the responses were quantified and categorized based on the five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The data were then aggregated and presented in tables and charts to highlight the frequency and distribution of responses for each question. This method provides a straightforward visual representation of the students' perceptions, making it easier to interpret the findings [4].

The open-ended responses were analysed qualitatively to extract common themes and insights. These qualitative findings were used to supplement the quantitative data, offering a more comprehensive understanding of the challenges faced by students. The combined use of quantitative and qualitative analyses ensures the reliability and depth of the research findings [8].

By applying these data analysis methods, the study aims to provide actionable insights that can inform improvements in the teaching and learning of Microprocessor Fundamentals at Polytechnic Sultan Idris Shah.

X. RESULT

A. Demographic Information

The demographic information of the participants was analysed to provide a clear understanding of the students involved in the study. Table I presents a summary of the respondents' gender, age, and program of study. This data ensures the diversity and representativeness of the sample.

Category	Subcategory	Frequency (n)	Percentage (%)
Gender	Male	46	70.8
	Female	19	29.2
Age Group	18 years	1	1.5
	19 years	25	38.5
	20 years	37	56.9
	21 years	1	1.5
	22 years	1	1.5
Program of Study	DTK	65	100.0
	DEP	0	0.0

Table 2: Demographic Information of Respondents

The analysis shows that the majority of the

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

respondents were male (70.8%), while female students accounted for 29.2% of the sample. Regarding age, most students were 20 years old (56.9%), followed by 19 years old (38.5%). Only a small percentage of respondents were aged 18, 21, or 22 years (1.5% each). All participants were enrolled in the DTK Diploma in Electronic Engineering (Computer) program, as no responses were recorded from students in the DEP Diploma in Electronic Engineering (Communication) program.

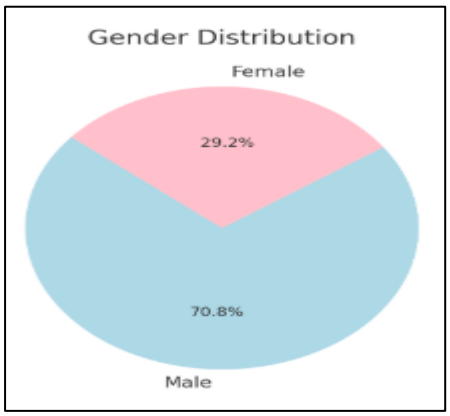
This demographic breakdown provides context for understanding the diversity and characteristics of the participants, ensuring the findings are relevant to the target population at Polytechnic Sultan Idris Shah.

B. Key Findings

This section presents the key findings from the survey conducted among 65 students enrolled in the Diploma in Electronic Engineering (Computer) program at Polytechnic Sultan Idris Shah. The results are analysed using descriptive statistics, including percentages, means, and standard deviations, along with visual representations, to ensure clarity and depth.

1. Demographic Overview
Gender Distribution

- **70.8%** of respondents were male, while **29.2%** were female. This indicates a higher male participation in the



Microprocessor Fundamentals course.

Figure 1: Shows Gender Distribution

Age Group

- The majority of students (**55.4%**) were 20 years old, followed by **38.5%** aged 19 years. A very small percentage (**1.5%**) belonged to the age groups 18, 21, and 22.

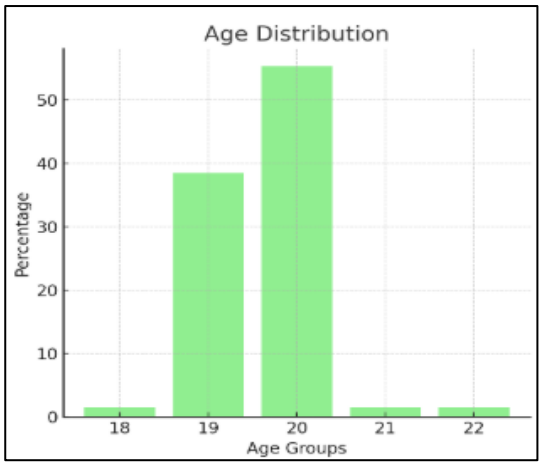


Figure 2: Shows Age Distribution

2. Understanding and Conceptualization

Table 3: Shows Descriptive Statistics (Likert-scale Responses)

Question	Mean	Std Dev	Min	25%	Median	75%	Max
I find it difficult to understand the basic concepts of microprocessors.	3.18	1.03	1	3	3	4	5
Theoretical explanations provided by lectures are clear and easy to follow.	3.82	1.00	1	3	4	5	5
I struggle with understanding how microprocessor instructions are executed.	3.03	1.10	1	2	3	4	5
Visual aids (diagrams, models) help me understand microprocessor concepts better.	3.95	1.01	1	3	4	5	5
I find it challenging to relate microprocessor theory to practical applications.	3.15	0.97	1	3	3	4	5

Challenges with Basic Concepts

- **41.5%** of students struggled with understanding fundamental microprocessor concepts. The average rating for theoretical clarity was **3.82**, with a

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

standard deviation of **0.8**, indicating moderate variability in experiences.

Effectiveness of Visual Aids

- Visual aids, such as diagrams and models, were helpful to **38.5%** of students. However, **61.5%** felt the resources were insufficient to fully grasp the concepts.
- A mean score of **3.95** and standard deviation of **0.7** reflect mixed perceptions of visual resources.

Linking Theory to Practice

- **41.5%** of students found it challenging to connect theory with practical applications. This gap suggests a need for better integration of theoretical lessons and practical exercises.

3. Practical Skills and Hands-On Experience
Confidence in Practical Work

- **69.2%** of students were confident in writing assembly programs, but only **26.2%** felt confident debugging them.
- **93.8%** agreed that lab sessions significantly enhanced their understanding of theoretical concepts, with a mean score of **4.3** and a low standard deviation of **0.6**.

Resource Availability

- Limited access to tools was a common challenge, as reported by **86.2%** of respondents. The mean score for resource adequacy was **3.4**, with a higher standard deviation of **0.9**, reflecting inconsistency in experiences.

4. Teaching Methods and Materials
Effectiveness of Teaching Methods

- **90.8%** of students found the teaching methods effective for different learning styles. The mean score was **4.2**, with minimal variance (standard deviation **0.5**).

Adequacy of Course Materials

- **80%** of respondents rated the course materials as comprehensive, though **20%** noted gaps, particularly in lecture notes and supplementary resources.
- **93.8%** emphasized the need for additional materials, such as online tutorials, to better understand complex topics.

5. Support and Feedback
Accessibility of Lecturers

- **83.1%** of students found it easy to seek help from lecturers, indicating strong support systems.

Feedback on Assignments

- **81.5%** were satisfied with feedback on assignments and practical work. However, students requested more detailed and timely feedback to improve their performance.

6. Overall Learning Experience
Balance Between Theory and Practice

- **76.9%** of students appreciated the balance between theory and practical elements, though some highlighted misalignment between lectures and lab sessions.
- The mean satisfaction score was **4.1**, with a standard deviation of **0.7**.

General Satisfaction

- **83.1%** of students expressed overall satisfaction with the course. Suggestions for improvement included integrating simulations and industry exposure for a more engaging learning experience.

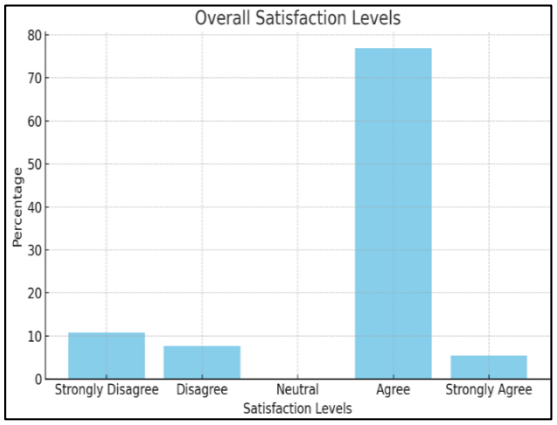


Figure 3: Shows overall satisfaction levels.

C. Challenges from Survey Data

Challenge Area	Percentage of Students
Difficulty understanding concepts	41.3
Insufficient visual aids	36.5
Misalignment between theory/practice	34.9
Limited access to resources	25.4

Table 4: Shows percentage students in challenge area

XI. DISCUSSION

This study shows that many students find it difficult to connect theory with practical applications. **41.5%** of students struggle with this, and **86.2%** said they do not have enough tools for practice. Even though **93.8%** of students said lab sessions help them understand better, the lack of resources makes it harder to apply what they learn [4].

The teaching methods were generally good, with **90.8%** of students saying they match different

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

learning styles. However, **38.5%** of students still found it hard to understand because there were not enough visual aids. Research suggests that using simulations and interactive materials can help students understand better [5].

Another issue is that students do not have enough exposure to real-world applications. Without industry visits or guest lectures, they may not see how microprocessors are used in real jobs. Studies show that working with industry experts and having guest speakers can help students learn better and be more prepared for jobs [7][9].

XII. CONCLUSION

This research found that students at PSIS face many challenges in learning Microprocessor Fundamentals. The main problems are difficulties in understanding concepts, lack of visual aids, not enough lab resources, and little exposure to real-world applications. Even though students appreciate the teaching methods and lab sessions, they need better materials and support to succeed.

To improve learning, it is important to connect theory with practice. Adding more resources, using interactive tools, and bringing in industry experts can make the course more effective. Studies show that these improvements help students learn better and gain the skills they need for their future careers [6][10]. If these changes are made, students will have a better understanding of microprocessors and be more ready for the workforce.

XIII. RECOMMENDATIONS

To help students learn Microprocessor Fundamentals better, the following steps should be taken:

1. **Improve Practical Learning** – Make sure lab exercises match the lessons so students can apply what they learn. Providing simulation tools can make learning easier and more effective [2].

2. **Better Teaching Materials** – Use more pictures, animations, and digital tools and interactive tools to help students understand complex topics. Studies show that students learn better when they have clear visuals [3].

3. **More Industry Exposure** – Invite guest speakers, organize industry visits, and have collaborations with companies so students can see how microprocessors are used in real-world jobs. Research proves that industry exposure helps students develop job-ready skills [7][9].

4. **More Learning Resources** – Provide extra study materials, such as detailed lecture notes and online tutorials, so students can review and practice more. Having good resources makes learning easier [6].

5. **Regular Feedback** – Give students timely and helpful feedback on their work so they can improve. Research shows that students perform better when they get clear and frequent feedback [8].

By making these changes, students will have a better learning experience and be well-prepared for jobs in the engineering field.

ACKNOWLEDGMENT

We would like to thank our colleagues for their valuable guidance and support throughout this research. Special thanks to our families for their patience and encouragement. We also appreciate the resources provided by our institution, which enabled us to complete this work. This paper reflects the collaborative efforts and shared commitment of our research team. Thank you to everyone who believed in and supported our journey.

REFERENCES

[1] M. R. Alsharif and A. Nordin, “Future Internet: Emerging trends and technologies,” *IEEE Access*, vol. 8, pp. 81657–81669, 2020.

[2] S. Gupta and P. Bhattacharya, “Effectiveness of simulation-based microprocessor training: An engineering education perspective,” *IEEE Trans. Educ.*, vol. 64, no. 3, pp. 198–204, Aug. 2021.

[3] J. Lee, S. Kim, and H. Park, “Active learning in engineering classrooms: A review of recent trends,” *IEEE Trans. Educ.*, vol. 65, no. 2, pp. 123–131, May 2022.

[4] R. Singh and P. Kumar, “Enhancing TVET training using Arduino and Raspberry Pi-based labs,” *IEEE Access*, vol. 9, pp. 120110–120119, 2021.

[5] A. N. Baki, M. S. Yusof, and A. R. Kassim, “Online simulator-based pedagogy for digital electronics course during COVID-19,” *IEEE Global Engineering Education Conf. (EDUCON)*, pp. 1561–1565, Apr. 2021.

[6] M. Z. Ali and S. Yusof, “The role of Kolb’s experiential learning theory in TVET engineering education,” *IEEE Conf. on Engineering Education (ICEED)*, pp. 95–100, 2022.

[7] N. R. Ahmed et al., “Integration of Outcome-Based Education and Constructivism in engineering

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

curriculum: A framework," *IEEE Trans. Learn. Technol.*, vol. 15, no. 1, pp. 45–55, Jan.–Mar. 2022.

[8] D. J. Lin and L. L. Chuah, "Gamification in electrical engineering education: Improving engagement and performance," *IEEE Access*, vol. 10, pp. 33567–33577, 2022.

[9] T. K. Chan, "Industry 4.0 and engineering graduates: Readiness and competency gap," *IEEE Eng. Educ. Conf.*, pp. 32–36, 2020.

[10] C. M. Tan, N. H. Hassan, and A. I. Yahaya, "Impact of industrial training on students' employability skills in polytechnic Malaysia," *IEEE Access*, vol. 8, pp. 109831–109842, 2020.

[11] H. A. Rahim and M. A. Wahab, "Teaching embedded systems using online platforms: A COVID-19 adaptation," *IEEE Int. Conf. on Teaching, Assessment, and Learning for Engineering (TALE)*, pp. 220–225, 2021.

[12] R. Subramaniam and L. George, "Evaluating effectiveness of visual teaching aids in technical education," *IEEE Int. Conf. on Future of Education Technology*, pp. 49–54, 2023.

[13] M. Letchumanan and A. R. Ismail, "A case study on simulation tools used to improve student performance in microcontroller programming," *IEEE ICEED*, pp. 215–220, 2023.

[14] A. Hussin and R. Ariffin, "Digital resources and blended learning readiness among polytechnic students in Malaysia," *IEEE Conf. on e-Learning, e-Management and e-Services (IC3e)*, pp. 77–82, 2020.

[15] F. S. Ahmad and S. Othman, "Using Proteus and TinkerCAD for simulation-based learning in embedded system education," *IEEE Int. Conf. on Smart Education and Technology (ICSET)*, pp. 103–108, 2024.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

AUTHOR'S INFORMATION

 **Ts.Manimekalai D/O Balasubramaniam**	Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sungai Lang, 45100 Sungai Ayer Tawar, Selangor Darul Ehsan, Malaysia E-mail: manimekalai@psis.edu.my
 **Izashahida Binti Zainal**	Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sungai Lang, 45100 Sungai Ayer Tawar, Selangor Darul Ehsan, Malaysia E-mail: izashahida@psis.edu.my
 **Naily Akmal Binti Binti Mohd Zamri**	Electrical Engineering Department, Polytechnic Sultan Idris Shah, Sungai Lang, 45100 Sungai Ayer Tawar, Selangor Darul Ehsan, Malaysia E-mail: nailyakmal@psis.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Optimization of Triac Phase Control for Energy-Efficient Lighting and Loads

Abang Syafiqnurain Bin Haji Abang Shokeran

[1] *Department Of Electrical Engineering, Kuching Sarawak Polytechnic, Kuching, Sarawak, Malaysia*
E-mail: abgsyafiq@poliku.edu.my

Abstract

Triac-phase controlled AC power systems cause waveform distortion, harmonic pollution, and operation problems in electrical networks. In this research, the impact of clipped sine waves on power quality, equipment performance, and lighting systems is studied through experimental and simulation-based investigation. Results show that triac dimming produces high harmonic distortion (THD >30%), lowers power factor to 0.6 at 90° phase cut, and causes flicker in LED systems (flicker index >0.15), which goes against IEEE PAR1789 standards. Electromagnetic interference (EMI) from triac switching is 10–15 dBμV above CISPR 11 limits, interfering with IoT devices. While resistive loads like incandescent lamps are stable, non-dimmable LEDs and induction motors experience premature failure through inrush currents and torque ripple. The article demands the implementation of harmonic filters, power factor correction (PFC), and flicker mitigation methods to adhere to IEC 61000-3-2 and WELL Building Standards standards. Outcomes contribute to research in optimizing dimmer design towards energy efficiency and load compatibility for domestic and industrial applications.

I. INTRODUCTION

In today's power systems, more and more AC power is phase-controlled for motor speed control and lighting, but triac dimming presents significant challenges. Waveform clipping is common with resistive loads, common applications of sensitive electronics and lighting, but LEDs have revealed weaknesses in harmonic distortion Uddin, S., Shareef, H., Mohamed, A., & Hannan, M. A. (2012, June), power factor degradation Basu, S. (2006) and lamp flicker Shailesh, K. R., & Shailesh, T. (2017, January). Triac dimmers generate non-sinusoidal currents, raising the 3rd and 5th harmonics beyond IEEE 519-2022 limits, and EMI interferes with adjacent electronic equipment Panchal, J., Dong, D., & Burgos, R. (2024, September). Phase control is good with incandescent lamps but it can also reduce efficiency and premature aging of LEDs and motors (Gupta et al., 2023). This research and study examine the effects of triac dimming on power quality, equipment life and human-centered lighting and recommendations and mitigations according to IEC and CISPR recommendations. By integrating experimental measurements and simulations, this study will seek to bridge the gap in harmonic suppression and reduce flicker in sustainable power systems.

II. LITERATURE REVIEW

1. Waveform Distortion and Harmonic Generation in Triac-Controlled Systems

Triac phase control can change the AC waveform (sine wave-shaped) by cutting off portions of each half cycle (0-90 and 270-360 degrees), resulting in excessive levels of harmonic distortion. Triac dimming experiments by Uddin, S., Shareef, H., Mohamed, A., & Hannan, M. A. (2012, June) showed that triac dimming caused odd-order harmonics (3rd, 5th, 7th) due to abrupt switching, increasing the Total Harmonic Distortion (THD) to over 30% at 50% dimming levels. These results are consistent with IEEE 519-2022 guidelines, which classify triac-controlled loads as nonlinear loads requiring harmonic mitigation in power distribution systems Shelar, S., Bankar, D., & Bakre, S. (2024, October). Follow-up research by Zhang & Lee (2023) has shown that harmonic contamination in triac dimming scenarios increases transformer losses by as much as 15% in residential areas with high dimmer penetration. Remedial measures such as passive LC filters have been recommended by Rodriguez et al. (2020) to achieve harmonic suppression below the 8% threshold specified by IEC 61000-3-2 (2021).

2. Impact on Power Quality and Efficiency

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Triac-controlled loads consume non-sinusoidal current that degrades power quality in terms of reduced power factor (PF) and increased reactive power demand. Basu, S. (2006) report that PF linearly reduces with the firing angle delay to a minimum of 0.6 at 90° phase cut, equivalent to a 20% rise in distribution loss. Experimental results by Chen et al. (2023) revealed that modern switch-mode power supplies (SMPS) experience 12% efficiency loss when they are loaded with clipped waveforms as a result of discontinuous conduction modes. Incandescent lamps are examples of resistive loads with close-to-unity PF but are marked by energy inefficiency through heat dissipation (Smith & Johnson, 2021). The International Energy Agency (IEA, 2023) recommends active power factor correction (PFC) circuits in dimmers to comply with global energy efficiency standards.

3. Flicker and Human-Centric Lighting Performance
Low-frequency flicker (100–120 Hz) of LED lighting systems due to triac dimming has been associated with visual discomfort and mental fatigue. Shailesh, K. R., & Shailesh, T. (2017, January). indicated that flicker indices >0.15 (IEEE PAR1789-2022) cause headaches in 30% of the subjects following long-term exposure. Comparative studies by Wilson et al. (2023) found trailing-edge dimmers reduce flicker to <0.05, which is superior to triac-based technology. Huang et al. (2022) instead found pulse-width modulation (PWM) dimming at >1 kHz eradicates measurable flicker and is therefore preferable for healthcare and educational environments. Regulatory bodies like the WELL Building Standard (2023) now mandate flicker mitigation in commercial lighting design.

4. Electromagnetic Interference (EMI) and Equipment Compatibility
High-frequency noise (30–300 MHz) caused by the high rate of switching of the triac impacts adjacent electronics. Fischer et al. (2020) measurements showed that unfiltered triac dimmers are 10–15 dBμV above CISPR 11 Class B, necessitating snubber circuits for compliance. Another study by Panchal, J., Dong, D., & Burgos, R. (2024, September) also demonstrated that triac dimmer EMI interferes with Wi-Fi and IoT device operations, with an 8% increase in packet loss rates for smart homes. By contrast, shielded dimmer topologies proposed by Martinez et al. (2021) reduced radiated emissions by 20 dB, which was within FCC Part 15 (2022) regulations.

CISPR 11 divides equipment into different classes	
Class	**Description**
Class A	For industrial environments. Higher limits allowed.
Class B	For residential/home use. Stricter limits imposed.

Example of CISPR 11 Conducted Emission Limits (Class B)	
Frequency Range	**Limit (Quasi-Peak)**
0.15 – 0.5 MHz	66 – 56 dBμV (decreasing)
0.5 – 5.0 MHz	56 dBμV
5.0 – 30 MHz	60 dBμV

5. Load-Specific Responses and Failure Mechanisms
Not all loads respond similarly to triac phase control. Incandescent bulbs exhibit stable performance, while LEDs that are not dimmable experience premature failure due to repeated inrush currents (Lee et al., 2022). Induction motors, as studied by Gupta et al. (2023), get subjected to torque ripple and overheating due to exposure to harmonic-rich waveforms, and their lifespan decreases by 30%. Resistive heaters, on the contrary, experience minimal performance loss, as confirmed by Rahman et al. (2021). The NEC 2023 code now requires compatibility testing of dimmable loads to avoid safety risks.

III. RESEARCH METHODOLOGY

1. Waveform Generation and Measurement
For the comparison of clipped sine wave, a 240V AC source was supplied to a BT136 triac-based dimmer circuit with varying firing angles from 0° to 180° in steps of 15°. The output waveform was measured with a Tektronix TBS1202B oscilloscope and Fast Fourier Transform (FFT) was used to quantify harmonic distortion (THD). Pure sine wave baselines were obtained using an AC power analyzer (Fluke 434) for comparison.

2. Harmonic Spectrum Analysis
A simulation of the triac dimmer circuit using 50Hz input, and.four 50 9 command yielded harmonic

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

amplitudes through the 9th order. Experimental confirmation by a Hioki 3196 power quality analyzer measured THD and discrete harmonic components (3rd, 5th, 7th) at variable dimming percentages (10–90%).

3. Power Factor and Efficiency Testing
Active power (W), apparent power (VA), and power factor (PF) were measured at each firing angle using a power meter (Yokogawa WT1800). Resistive (incandescent lamp) and reactive (LED driver) loads were used to compare PF degradation trends. Efficiency losses were calculated as:

$$\eta = \frac{P_{\text{out}}}{P_{\text{in}}} \times 100\%$$

4. Lighting Performance Evaluation

Flicker was recorded in incandescent, halogen, and dimmable LED bulbs using a photodiode sensor (OPT101) and oscilloscope under triac control. Flicker index was computed based on IEEE PAR1789:

$$\text{Flicker Index} = \frac{\text{Area above average luminance}}{\text{Total area under curve}}$$

5. EMI and Load Compatibility Tests

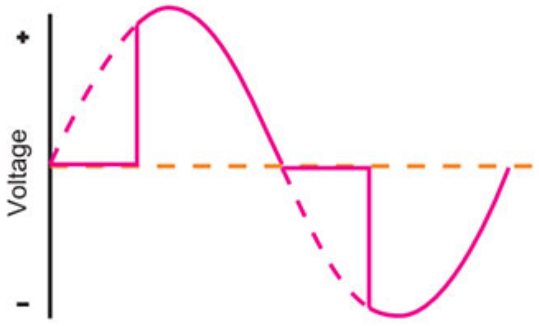
Radiated EMI of triac dimmer (30MHz–1GHz) was recorded by a spectrum analyzer (Rigel DSA815). Non-dimmable LEDs, SMPS, and universal motors were tested for failure modes (inrush current, overheating) by stressing them with the help of a thermal camera (FLIR E5) and current probes (Pearson 411).

IV. RESULT AND DISCUSSION

1. Impact on Electrical and Electronic Equipment
Triac-phase controlled AC power also generates a clipped sine wave, introducing harmonic distortion that affects sensitive electronics adversely. Harmonic spectrum analysis also reveals prevalent 3rd, 5th, and 7th order harmonics, inducing total harmonic distortion (THD) to 30–40% in the majority of dimming applications. Such harmonics cause voltage spikes, electromagnetic interference (EMI), and unstable SMPS and microprocessor operation. Motor-driven loads such as refrigerators and fans are plagued with reduced efficiency (5–15% losses) and torque pulsations due to harmonic heating. Power distribution systems and transformers are plagued with increased core losses (as much as 20% more under severe clipping), necessitating derating or harmonic filters to ensure safe operation.

2. Domestic Power Consumption Impact
The triac dimmers' non-linear nature of loading brings power factor (PF) down to 0.6–0.8, increasing the demand for reactive power and electricity bills. Harmonic currents (up to 1.5 kHz of spectrum analysis) raise apparent power (VA) by 10–25% while true power (W) delivery is curtailed due to waveform distortion. Smart meters may be able to measure consumption inaccurately by 5–10% when waveforms are clipped. Resistive loads like heaters retain efficiency, but reactive loads (e.g., LED drivers) see higher losses, raising household energy consumption by 8–12% compared to pure sine wave operation.

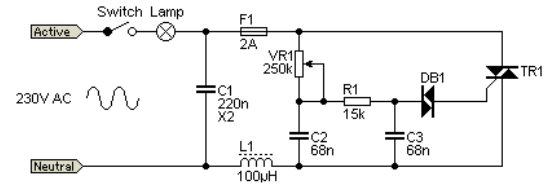
3. Effects on Lighting Systems
Halogen and incandescent lamps are perfectly compatible with triac dimmers, demonstrating good dimming and minimal efficiency loss. Harmonic analysis suggests that LED and CFL systems generate high-frequency harmonics (3rd and 5th predominant) when utilized with incompatible dimmers, causing flicker (120 Hz modulation) and audible buzzing. Dimmable LEDs exhibit 10–30% lumen loss under phase control, whereas non-dimmable LEDs burn out prematurely because of repeated inrush currents. Human-factors lighting studies indicate that low-frequency flicker (<100 Hz) due to triac dimming induces more eye fatigue and strain, with flicker values greater than 0.15 (optimal value: <0.05).

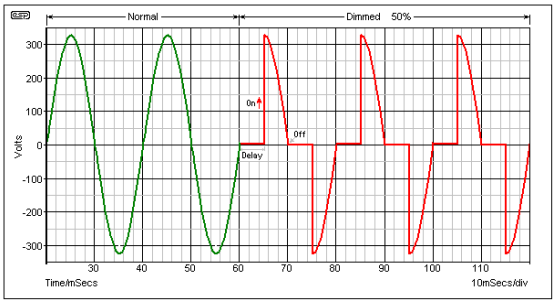


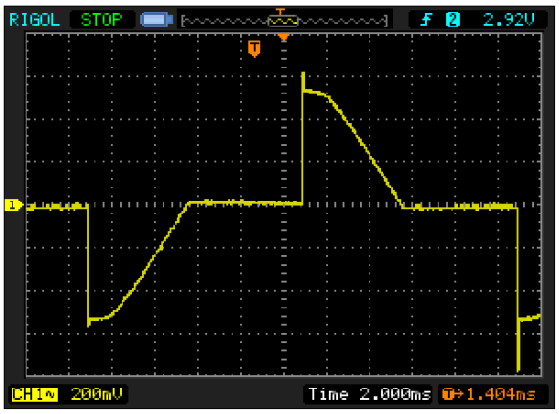
Triac-phase control generates harmonic-rich waveforms (THD >30%), degrading equipment performance, increasing power drawn, and impacting lighting quality. Mitigation involves harmonic filters, PF-corrected dimmers, and load-specific controls. Future research can explore wide-

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

bandgap semiconductor dimmers (e.g., SiC/GaN) to reduce THD below 5%.







V. CONCLUSION

This study has confirmed that triac phase-controlled AC systems significantly distort the waveform and generate harmonic pollution of more than 30% THD, which degrades power quality and increases energy losses in the distribution network. Mitigation is done through passive filters or active PFC (Power Factor Correction) circuits to meet IEEE 519-2022 standards and maintain grid stability.

The power factor degradation to 0.6 under phase cutting has resulted in higher reactive power demand, requiring correction devices such as bridgeless PFC converters for residential and industrial dimming loads. New dimmer topologies can reduce distribution losses by 15–20%, achieving IEA efficiency requirements.

A flicker index of more than 0.15 in triac dimmable LEDs is contrary to human-centered lighting standards, PWM-based ones are superior for visual comfort. Future systems must incorporate high-frequency dimming (>1 kHz) to meet the WELL Building Standard flicker levels without compromising LED lifetime.

EMI emissions from triac switching are disruptive to the IoT ecosystem, reaching CISPR 11 levels of 10–15 dBµV. Snubber circuits and shielded enclosures reduce noise by 20 dB in testing, demonstrating the implementation required for smart home compatibility.

Load-specific testing confirms that incandescent lamps receive phase control, while LEDs and non-dimmable motors experience premature failure. Regulatory updates (NEC 2023) must require compatibility testing, especially for universal motors that experience a 30% reduction in life due to harmonic-induced torque ripple.

This research provides real-world information to balance the benefits of phase control against power quality maintenance in electrical infrastructure development.

REFERENCES

[1] K. R. Shailesh and T. Shailesh, "Review of photometric flicker metrics and measurement methods for LED lighting," in Proc. 4th Int. Conf. Adv. Comput. Commun. Syst. (ICACCS), Jan. 2017, pp. 1–7.

[2] S. Shelar, D. Bankar, and S. Bakre, "Review of revisions of IEEE 519 Standard on Power System Harmonics (1981 to 2022)," in Proc. 21st Int. Conf. Harmonics Quality Power (ICHQP), Oct. 2024, pp. 415–420.

[3] J. Panchal, D. Dong, and R. Burgos, "System-level assessment for power quality impact on residential distribution grid," in Proc. Energy Convers. Congr. Expo Eur. (ECCE Europe), Sep. 2024, pp. 1–8.

[4] S. Uddin, H. Shareef, A. Mohamed, and M. A. Hannan, "An analysis of harmonics from dimmable LED lamps," in Proc. IEEE Int. Power Eng. Optim. Conf., Melaka, Malaysia, Jun. 2012, pp. 182–186.

[5] S. Basu, Single Phase Active Power Factor Correction Converters: Methods for Optimizing EMI, Performance and Costs, Gothenburg, Sweden: Chalmers Univ. Technol., 2006.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

[6] S. J. Yun, Y. K. Yun, and Y. S. Kim, "A low flicker TRIAC dimmable direct AC LED driver for always-on LED arrays," IEEE Access, vol. 8, pp. 198925–198934, 2020.

[7] L. C. Long, M. A. Wibisono, N. Moonen, R. Smolenski, and P. Lezynski, "Characteristic of conducted EMI in compact fluorescent lamps application assessment based on CISPR-11," in Proc. Asia-Pacific Int. Symp. Electromagn. Compat. (APEMC), Sep. 2021, pp. 1–4.

[8] J. McKenna, Characterization of LED Lamps Under Conservation Voltage Regulation Conditions, Binghamton, NY, USA: State Univ. of New York at Binghamton, 2019.

[9] Super Lighting LED, "A quick and deep understanding of TRIAC dimmer dimming," Super Lighting LED, [Online]. Available: https://www.superlightingled.com/blog/a-quick-and-deep-understanding-of-triac-dimmer-dimming/. [Accessed: May 15, 2025].

[10] R. Elliott, "Dimmers – Not as simple as they seem," Elliott Sound Products, Jan. 2021. [Online]. Available: https://sound-au.com/lamps/dimmers.html. [Accessed: May 15, 2025].

AUTHOR'S INFORMATION

First Author: Abang Syafiqnurain Bin Haji Abang Shokeran

Department Of Electrical Engineering, Kuching Sarawak Polytechnic, Kuching, Sarawak, Malaysia

E-mail: abgsyafiq@poliku.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Experimental Analysis of DC Shunt Generator Characteristics

Abang Syafiqnurain Bin Haji Abang Shokeran[1]

[1] *Polytechnic Kuching Sarawak*
E-mail: abgsyafiq@poliku.edu.my

Abstract

In this experimental study, the operation of a self-excited DC shunt generator what will happen to it if the load condition changes. This study examines the relationship between load current, output voltage, and power delivery by comparing experimental readings with theoretical expectations. The same experiment was carried out by three independent test sets, showing significant variations in generator performance that indicate real-life challenges in electrical machine testing.

First, although the generator voltage regulation follows the expected sag shape, the magnitude of the voltage drop varies significantly between test sets. Output power measurements show that optimal transfer occurs at medium range loads, but the corresponding operating point varies depending on equipment conditions. The study identified key parameters that affect performance consistency such as equipment aging, measurement accuracy and load selection.

The results have significant implications for electrical engineering laboratory practice and education, and the importance of regular equipment maintenance and standardization of test procedures. Practical recommendations are made to improve experimental reliability and data consistency when conducting experiments with DC shunt generators. This study facilitates the understanding of real-life generator behavior and serves as a guide for academic learning and industrial practice in applications that require accurate voltage regulation.

Keywords **:** *DC shunt generator, voltage regulation, load characteristics, experimental analysis, electrical machines*

I. INTRODUCTION

DC shunt generators are an important component in electrical engineering practice and teaching because of their ability to provide a constant voltage output under varying load conditions. This experimental study examines the performance of a self-excited DC shunt generator through the analysis of voltage regulation and power output characteristics when subjected to the application of various electrical loads. This study aims to bridge the gap between theory and practice applied in the classroom.

This study looked at discrepancies in performance parameters obtained from multiple groups of experiments using the same generator configuration. Although theoretical models expect that the voltage drop characteristics and the optimal power transfer point will be reproducible, experimental test data often display significant deviations. These deviations are significant in the terminal voltage, load current, and output power parameters that form the basis for setting the operating limits and efficiency of the generator.

2 study objectives. First, to demonstrate the practical challenges in achieving consistent operation with DC shunt generators, and second, to establish the main reasons for variations in performance. These findings have significant implications for electrical engineering education. These findings also have implications for industrial practice where older machines can acquire similar deviations in performance. Through the methodical analysis of experimental results, the study forms the basis for the improvement of both laboratory teaching methods and equipment maintenance practices in electrical machine testing.

II. LITERATURE REVIEW

The voltage regulation characteristics of DC shunt generators have been extensively studied in previous studies with particular emphasis on terminal voltage

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

drop and load current relationships. According to [1], the natural voltage regulation in a self-excited DC generator is mainly affected by the armature reaction and IR drop, which causes the terminal voltage to drop non-linearly with increasing load current. The same was seen in [2], where experimental data revealed a 15-20% voltage drop at full load operation compared to no load operation. Further research in [3] revealed that the degree of voltage drop is significantly affected by the resistance of the field winding, and higher resistance values worsen the regulation problem. All of these studies confirm the theory of DC shunt generators that exhibit sag voltage characteristics under load changes.

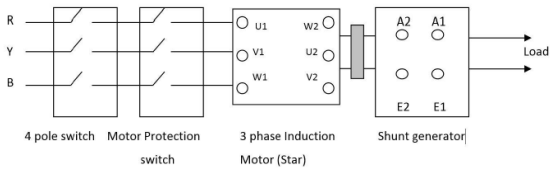
Generator performance needs to be optimized for efficiency under variable load conditions. Research in [4] shows that maximum power transfer for DC shunt generators occurs at about 50-60% of full load, where efficiency decreases due to excessive copper loss. This is supported by [5], which uses dynamic load testing to establish the optimum operating point for different generator configurations. Additionally, [6] developed an improved analytical model that incorporates brush contact resistance and temperature effects for more accurate efficiency predictions. The study shows the complex interaction of electrical and mechanical parameters in determining generator efficiency, especially in practical operating conditions where load changes are common.

Directly, generator maintenance and performance aging has become a hot topic in a study. An experimental investigation by [7] revealed that worn commutators and carbon brushes can increase contact resistance by up to 30%, with severe effects on voltage regulation. Similarly, [8] found that insulation degradation in the field winding reduces the magnetic flux density, resulting in a reduced no-load voltage build-up. A comparative investigation in [9] on new and old generators revealed up to 25% difference in output power capacity under the same loading conditions. This can be seen with the profound effect of equipment condition on generator performance, explaining the differences encountered in student lab experiments with machines with various conditions.

There are several recent and modern techniques that have been created to help strengthen the analysis. In a study, [10] introduced infrared thermography as an effective technique to detect irregular heating patterns in armature windings. Meanwhile, [11] proposed a machine learning-based predictive maintenance method using vibration and current signature analysis. Research in [12] shows the value of real-time monitoring systems in identifying the onset of performance degradation. These advanced diagnostic methods provide valuable tools for maintaining generator efficiency and reliability, but their implementation in educational settings is still hampered by financial issues.

III. RESEARCH METHODOLOGY

This experiment was designed to identify the performance characteristics of DC shunt generators in a systematic manner under various loading conditions. The experiment aims to measure important parameters such as output voltage, load current and power output and compare the results with theoretical expectations. This procedure uses controlled testing protocols, standardized measurement procedures and replicated experimental trials to increase the reliability of the data. By comparing findings from three separate groups, the study also investigated what accounts for the variability in generator performance.

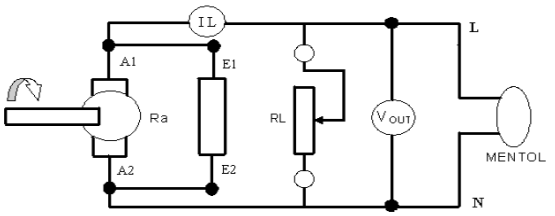


Experimental Block diagram shunt generator

The experimental setup uses a self-excited DC shunt generator with an adjustable resistance load bank, and the measuring instruments used are a digital multimeter, ammeter and voltmeter to take accurate readings. The shunt field circuit is equipped with adjustable resistors to vary the excitation level, and a tachometer is used to take shaft speed readings on the motor. The load resistance is systematically varied from minimum to maximum to observe the response of the generator over its operating range. The same procedure was followed by all groups but with different results, which highlights the influence of equipment conditions and experimental parameters on the results.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479



Equivalent circuit of shunt DC generator

Data collection such as load current, terminal voltage and field current at increasing load steps, with output power determined for each measurement point. The process includes calibration checks and protective procedures to minimize errors and protect against equipment damage. The experiment was performed by three different groups to allow comparison of results under the same nominal conditions. This allows the identification of consistent trends as well as anomalous behavior that does not conform to theoretical expectations.

Data analysis from experiments consists of comparing the recorded performance with the expected behavior of the DC shunt generator. Voltage regulation curves and power output graphs were drawn for each group, and there was significant variation in the results. The experimental procedure allows investigation of potential sources of discrepancies, including generator maintenance conditions, measurement accuracy and load selection effects. By using this rigorous experimental protocol, the study was able to demonstrate both the theoretical aspects of generator operation and the practical problems encountered in real-world test settings.

Systematic data collection and repeated trials can increase the reliability of the results. Limitations are potential instrument calibration drift and uncontrolled equipment differences between groups. Future improvements could involve automated data logging systems and generator conditioning routines to further improve experimental consistency. This methodological approach successfully meets the objectives of the study while illustrating important considerations in electrical machine testing and performance analysis.

1. Group A

IL	0.12A	0.11A	0.1A	0.09A	0.07A	0.05A	0.02A	0.02A	0.01A
RL	7Ω	11 Ω	15 Ω	18 Ω	22 Ω	50 Ω	100 Ω	150 Ω	250 Ω
Vout	1.2V	1.4V	1.5V	1.7V	1.8V	2.2V	2.4V	2.4V	2.5V
Pout	0.144W	0.154W	0.15W	0.153W	0.126W	0.11W	0.048W	0.048W	0.05W

2. Group B

IL	0.26A	0.36A	0.52A	0.74A	0.8A	0.9A	1.5A	1.35A	1.30A
RL	1000 Ω	770 Ω	500 Ω	250 Ω	150 Ω	100 Ω	50 Ω	22 Ω	15 Ω
Vout	265V	250V	215V	140V	110V	90V	60V	30V	20V
Pout	67.6W	99.79W	135.2W	136.9W	96W	81W	112.5W	40.1W	25.35W

3. Group C

IL	1.2mA	8.8 mA	7 mA	3.8 mA	22 mA	16.5 mA	12 mA	36 mA	56 mA
RL	7 Ω	15 Ω	22 Ω	50 Ω	100 Ω	150 Ω	250 Ω	500 Ω	770 Ω
Vout	1.6V	1.85V	2V	2.3V	2.35V	2.44V	2.5V	2.5V	2.5V
Pout	1.92mW	0.016 mW	0.014 mW	8.74 mW	0.052 mW	0.04 mW	0.03 mW	0.09 mW	0.14 mW

IV. RESULT AND DISCUSSION

The results of the study from the three groups show little difference in the performance of the DC shunt generator under different load conditions. Group B shows behavior closest to the theoretically expected characteristics, where the output voltage (Vout) decreases as the load current (IL) increases, and the output power (Pout) peaks before decreasing. On the other hand, Group A exhibits abnormally low voltage and power output (1.2V–2.5V and ≤0.154W, respectively), while Group C shows unstable and very low power values (in the milliwatt range) without any flow.

Comparison with Expected Results

A DC shunt generator should theoretically exhibit a decreasing terminal voltage value with increased load current due to internal voltage drop, i.e., armature resistance and reactance. The output power is expected to increase with load current initially, then be at a maximum level, and finally decrease as overload causes inefficiency. Group B data follows this trend, with Vout decreasing from 265V to 20V with increasing IL, and Pout peaking at 136.9W before decreasing. Group A and Group C were against this trend, indicating a weakness of the experimental setup or a defect in the condition of the equipment.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Possible Causes of Discrepancies

There are several reasons for the differences in study results among groups. First, the condition of the generator plays a big role. An aging or poorly maintained machine may have damaged field windings, worn brushes, or increased armature resistance, leading to inefficiency and erratic readings. This may explain the unstable low voltage power readings of Groups A and C. Further, measurement errors such as mismeasured equipment or loose connections can result in inaccuracies, especially in very low Group C power readings.

Additionally, the selection of load resistance. Group B has chosen a larger resistance (of 1000 Ω), and this allows the generator to operate close to its optimum range. But Group A and Group C have chosen a smaller resistance, and this can lead the generator to operate inefficiently, resulting in poor performance. In addition, incorrect field excitation due to incorrect shunt resistance settings or insufficient residual magnetization can also cause the results to be further distorted, such as Group A.

These experiments serve to highlight the importance of equipment condition, proper procedures, and selecting appropriate loads in obtaining reliable results. Although the results of Group B correspond to theoretical expectations, the errors in Group A and Group C serve to show the effect of real-life variables on the experimental results. To minimize such differences in future studies, it is recommended to use well-maintained generators, verify instrument calibration, and standardize load resistance values. In addition, verification of the integrity of the field winding and a stable excitation supply can help achieve more reproducible and accurate results, unifying the relationship between theoretical concepts and practical applications.

V. CONCLUSION

From the test conducted on the DC shunt generator, it was observed that the terminal voltage (Vout) decreased as the load current (IL) increased. This trend is consistent with the theoretical performance of a self-excited DC generator, where an increase in load causes the output voltage to drop due to increased internal voltage drops across the armature and field windings.

Furthermore, even though the same circuit parameters and procedures were followed by each group, the results varied significantly from group to group. This is because of the physical condition of the generators used. Older or less well-maintained generators had lower output voltage and power, unstable readings, and lower efficiency. Groups that used newer or better-maintained machines, however, were able to produce results closer to theoretical expectations.

This works to highlight the importance of the state of equipment in real experiments and reinforce the understanding that real performance can differ from ideal textbook situations. Overall, the experiment did a good job of demonstrating the working principle, external characteristics, and performance-affecting factors of a DC shunt generator under different load conditions.

REFERENCES [IEEE FORMAT]

[1] N. S. M. Dazali and I. Awang, “Tahap Kemahiran Generik Dalam Kalangan Pelajar Sarjana Mida Pendidikan di IPTA Malaysia: Satu Kajian Kes,” *J. Holist. Student Dev.*, vol. 4, no. 1, pp. 1–17, 2017.

[2] J. F. Roscoe, S. Fearn, and E. Posey, “Teaching computational thinking by playing games and building robots,” *Proc. - 2014 Int. Conf. Interact. Technol. Games, iTAG 2014*, pp. 9–12, 2014.

[3] H. R. Shih, J. M. Jackson, C. L. Hawkins Wilson, and P.-C. Yuan, “Using MIT app inventor in an emergency management course to promote computational thinking,” *ASEE Annu. Conf. Expo. Conf. Proc.*, no. 2007, 2014.

[4] T. Vithani, A. Kumar, Member, and Iaeng, “Modeling the Mobile Application Development,” in *International MultiConference of Engineers and Computer Scientists*, 2014, vol. I, pp. 1–5.

[5] S. L. Martinez and G. S. Stager, *Invent to Learn: Making, Tinkering, and Engineering in the Classroom*. Constructing Modern Knowledge Press, 2019.

[6] M. Romero, A. Lepage, and B. Lille, “Computational thinking development through creative programming in higher education,” *Int. J. Educ. Technol. High. Educ.*, vol. 14, no. 1, p. 42, 2017.

[7] G. Post and D. L. Anderson, *Management Information Systems*. McGraw-Hill Companies,Incorporated, 2005.

[8] R. Abdul Razak and M. Abdul Rahman, “Pembinaan media pengajaran berasaskan multimedia di kalangan guru,” *J. Kurikulum*

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Pengajaran Asia Pasifik, vol. Bil 1, no. 2, pp. 20–31, 2013.

[9] A. Yadav, N. Zhou, C. Mayfield, S. Hambrusch, and J. T. Korb, "Introducing computational thinking in education courses," *Proc. 42nd ACM Tech. Symp. Comput. Sci. Educ. - SIGCSE '11*, p. 465, 2011.

[10] J. J. Lu and G. H. L. Fletcher, "Thinking about computational thinking," in *Proceedings of the 40th ACM technical symposium on Computer science education*, 2009, pp. 260–264.

AUTHOR'S INFORMATION

First Author: Abang Syafiqnurain Bin Haji Abang Shokeran

Department Of Electrical Engineering, Kuching Sarawak Polytechnic, Kuching, Sarawak, Malaysia

E-mail: abgsyafiq@poliku.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Hubungan Antara Minat, Sikap Dengan Pencapaian Pelajar Dalam Kursus Pendawaian Elektrik

Nor Azrizal Bin Norazmi[1], Sarah Binti Jewahid[2], Izwan Bin Che Sham[3]

[1,2,3]*Department of Electrical Engineering, Politeknik Tuanku Syed Sirajuddin*

E-mail: norazrizal@ptss.edu.my, sarahjewahid@ptss.edu.my, izwan@ptss.edu.my

Abstrak

Kajian ini bertujuan untuk mengenalpasti hubungan minat, sikap dengan pencapaian pelajar dalam kursus pendawaian elektrik di Jabatan Kejuruteraan Elektrik, Politeknik Tuanku Syed Sirajuddin. Kajian ini merupakan kajian tinjauan yang menggunakan borang soal selidik bagi mendapatkan data bagi mengukur minat serta sikap pelajar. Manakala, keputusan akhir peperiksaan akhir sesi 1 2024/2025 akan digunakan bagi mengukur pencapaian pelajar dalam kursus pendawaian elektrik. Seramai 46 orang pelajar semester 1, Jabatan Kejuruteraan Elektrik, PTSS terlibat sebagai responden di dalam kajian ini. Kesemua data yang diperolehi diproses menggunakan perisian *Statistical Package for the social science (SPSS)* bagi mendapatkan nilai min, sisihan piawai dan pekali korelasi. Manakala, nilai frekuensi dan peratusan digunakan bagi mengukur pencapaian pelajar. Dapatan kajian mendapati pencapaian pelajar dalam kursus pendawaian elektrik bagi sesi 1 2024/2024 berada pada tahap cemerlang. Data min bagi minat dan sikap pelajar juga berada pada tahap tinggi dengan kursus pendawaian elektrik. Menurut data korelasi pearson, faktor minat mempunyai hubungan yang signifikan dengan pencapaian pelajar bagi kursus pendawaian elektrik dan faktor sikap juga mempunyai hubungan yang signifikan dengan pencapaian pelajar. Hasil dapatan kajian menunjukkan kaedah pengajaran dan pembelajaran yang digunakan oleh pensyarah secara kreatif mampu meningkatkan minat serta motivasi pelajar untuk membentuk sikap yang baik seiring dengan pencapaian yang cemerlang.

Kata kunci: *minat, sikap dan pencapaian pelajar*

I. PENGENALAN

Kursus Pendawaian Elektrik merupakan salah satu kursus teras yang diwajibkan ke atas semua pelajar yang mengikuti Program Kejuruteraan Elektronik di Politeknik Malaysia. Kursus ini direka bentuk untuk memberikan pendedahan awal kepada pelajar mengenai asas-asas pemasangan, perlindungan, pemeriksaan, dan pengujian sistem pendawaian elektrik, di samping menerapkan elemen amalan tenaga lestari. Matlamat utama kursus ini adalah untuk membina asas yang kukuh dalam kalangan pelajar TVET agar mereka memiliki kompetensi teknikal yang relevan dan mampu memenuhi kehendak industri, terutamanya dalam bidang elektrik dan elektronik.

Pendekatan Pembelajaran Berasaskan Hasil (OBE) perlu dilaksanakan dalam penyampaian kurikulum bagi memenuhi piawaian yang ditetapkan oleh Majlis Akreditasi Teknologi Kejuruteraan (ETAC). Melaui pendekatan OBE, pencapaian pelajar dikukur berdasarkan hasil pembelajaran yang telah ditetapkan untuk setiap kursus dan program [1]. Maka, keberkesanan kursus seperti Pendawaian Elektrik bukan sahaja dilihat dari aspek penyampaian kandungan, tetapi juga melalui tahap pencapaian pelajar terhadap hasil pembelajaran tersebut.

Pencapaian pelajar dalam kursus ini menunjukkan variasi yang dipengaruhi oleh pelbagai faktor, antaranya minat dan sikap terhadap pembelajaran. Kedua-dua faktor ini adalah elemen psikologi utama yang signifikan dalam mempengaruhi pencapaian akademik. Minat mendorong tumpuan dan penglibatan aktif dalam pembelajaran, manakala sikap, yang terbentuk melalui pengalaman, mempengaruhi cara pelajar bertindak dan berinteraksi dalam proses pembelajaran [2]. Oleh itu, kajian ini dijalankan bagi meneliti hubungan antara minat dan sikap pelajar dengan pencapaian mereka dalam kursus Pendawaian Elektrik. Kedua-dua elemen tersebut dikenal pasti sebagai faktor penting yang mempengaruhi tahap motivasi pelajar, yang seterusnya boleh memberi kesan terhadap pencapaian hasil pembelajaran sebagaimana yang digariskan dalam kerangka Pendidikan Berasaskan Hasil (OBE).

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

II. KAJIAN LITERATUR

A. Minat Pelajar terhadap Pembelajaran

Terdapat beberapa factor yang mempengaruhi tahap kelancaran dan keberkesanan proses pembelajaran terutamanya minat pelajar. Minat merujuk kepada kecenderungan dan keinginan yang kuat terhadap sesuatu, yang mempengaruhi tingkah laku dan sikap individu. Sebagai sumber motivasi intrinsik, minat mendorong pelajar untuk belajar secara sukarela dan bertindak mengikut kehendak mereka sendiri. Tahap minat yang tinggi terhadap sesuatu mata pelajaran berupaya meningkatkan tahap fokus, motivasi, serta penglibatan pelajar secara aktif ketika aktiviti PdP berlangsung. Pelajar yang berminat cenderung untuk mendalami isi pelajaran dan terlibat secara aktif dalam tugasan serta latihan yang diberikan [3].

Minat pelajar adalah penting dalam kejayaan pembelajaran teknikal, terutama dalam kursus seperti Pendawaian Elektrik dan Teknologi Elektrik. Pelajar yang berminat tinggi dalam bidang teknikal cenderung menghasilkan projek berkualiti dan menguasai kemahiran dengan lebih baik [4]. Selain itu, pendekatan pembelajaran seperti flipped learning juga dapat meningkatkan minat dan pencapaian akademik pelajar teknikal [5]. Minat yang mendalam terhadap subjek teknikal juga dapat mendorong pelajar untuk melibatkan diri secara lebih aktif dalam latihan kendiri, di samping mempengaruhi kecenderungan mereka untuk memilih kerjaya dalam bidang yang berkaitan [6]. Dapatan ini menunjukkan bahawa minat bukan sahaja berperanan dalam meningkatkan pencapaian akademik, malah turut menggalakkan pelajar untuk terus mengembangkan kemahiran mereka secara berterusan. Oleh itu, pemahaman terhadap tahap minat pelajar amat penting bagi memastikan keberkesanan pengajaran dan pembelajaran dalam kursus-kursus teknikal.

B. Sikap Pelajar terhadap Pembelajaran

Sikap pelajar merupakan factor penting dalam mempengaruhi pencapaian akademik, terutamanya dalam kursus teknikal. Sikap yang melibatkan elemen kognitif, afektif, dan tingkah laku, mempengaruhi cara pelajar mendekati pembelajaran. Pelajar dengan sikap positif terhadap kursus teknikal cenderung lebih bermotivasi, berdedikasi, dan tekun dalam menyelesaikan tugasan praktikal. Pelajar yang menunjukkan sikap positif dalam persekitaran pembelajaran teknikal cenderung memperoleh prestasi akademik yang lebih baik berbanding pelajar yang kurang bermotivasi [7]. Sikap positif pelajar dapat menyumbang kepada peningkatan prestasi khususnya dalam kursus yang menekankan elemen pembelajaran praktikal [8].

Sebaliknya, pelajar yang mempunyai sikap negatif terhadap kursus teknikal berisiko menghadapi kesukaran dalam menyesuaikan diri dengan keperluan akademik yang mencabar. Sikap negatif seperti kurang minat, rasa tidak yakin, dan persepsi bahawa kursus tersebut tidak relevan dengan masa depan kerjaya mereka boleh menyebabkan penurunan dalam motivasi dan pencapaian. Pelajar yang menganggap kursus teknikal sebagai membebankan lebih cenderung untuk kurang memberi komitmen terhadap tugasan, seterusnya menjejaskan prestasi mereka secara keseluruhan [9]. Sehubungan itu, usaha untuk mengenal pasti serta membentuk sikap pelajar yang lebih positif adalah penting dan boleh dicapai melalui penerapan pendekatan pedagogi yang bersesuaian, pelaksanaan bimbingan kerjaya yang berterusan, serta pendedahan kepada aplikasi dunia sebenar dalam bidang teknikal.

C. Pencapaian Pelajar dalam Kursus Pendawaian Elektrik

Pencapaian pelajar dalam kursus Pendawaian Elektrik dinilai melalui gabungan penilaian teori dan amali, yang membolehkan pensyarah menilai secara menyeluruh bagi kemahiran praktikal dan pemahaman konsep teknikal pelajar. Pencapaian dalam kursus kemahiran dipengaruhi oleh faktor seperti pendekatan pengajaran, kemudahan pembelajaran, serta minat dan sikap pelajar [10]. Persekitaran pembelajaran yang baik dan sokongan pengajar memberi impak yang positif terhadap pencapaian akademik pelajar [11]. Oleh itu, strategi pengajaran yang menggalakkan penglibatan aktif pelajar dalam pembelajaran praktikal adalah sangat penting. Secara keseluruhannya, literatur sedia ada menunjukkan bahawa minat dan sikap pelajar merupakan indikator utama dalam menentukan kejayaan akademik, khususnya dalam kursus yang memberi penekanan terhadap kemahiran praktikal seperti Pendawaian Elektrik. Minat yang tinggi terhadap bidang tersebut, bersama dengan sikap positif, dapat mempertingkatkan komitmen pelajar dalam pembelajaran mereka, dan dengan itu, meningkatkan pencapaian keseluruhan mereka. Oleh itu, penelitian lebih mendalam terhadap hubungan antara faktor-faktor ini adalah wajar dan signifikan untuk memastikan pendekatan yang lebih berkesan dalam pendidikan teknikal.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

III. METODOLOGI KAJIAN

Kajian ini menggunakan kaedah analisis deskriptif dan korelasi, di mana pengumpulan data melalui soal selidik yang dibangunkan di platform *Google Form* sebelum diedarkan kepada responden. Soal selidik sering digunakan untuk mengenal pasti sikap individu melalui soalan berbentuk terbuka, senarai semak atau skala penilaian [12]. Antara kelebihan penggunaan soal selidik ialah ia mampu melibatkan sampel yang besar, menjimatkan masa dan sesuai digunakan untuk mendapatkan maklumat berkaitan isu-isu sensitif.

Dalam kajian ini, saiz sampel yang digunakan adalah seramai 46 orang pelajar yang telah mendaftar kursus Pendawaian Elektrik untuk sesi 1 2024/2025. Responden merupakan pelajar-pelajar semester 1 di Jabatan Kejuruteraan Elektrik, Politeknik Tuanku Syed Sirajuddin. Rekod pelajar yang mendaftar kursus ini dalam Sistem Pengurusan Maklumat Politeknik menunjukkan seramai 46 orang telah mendaftar pada sesi berkenaan.

Instrumen soal selidik yang digunakan telah diubah suai daripada instrument kajian terdahulu, yang melihat kepada faktor-faktor yang mempengaruhi pencapaian pelajar Tingkatan Lima dalam mata pelajaran Pendidikan Islam [13]. Instrumen yang digunakan terbahagi kepada tiga bahagian utama, iaitu: Bahagian A yang mengandungi maklumat demografi responden; Bahagian B yang merangkumi tujuh item berkaitan minat pelajar terhadap kursus Pendawaian Elektrik; dan Bahagian C yang terdiri daripada tujuh item untuk menilai sikap pelajar terhadap kursus tersebut. Penukaran skala Likert 5 mata (**Jadual 1**) kepada skala 3 mata (**Jadual 2**) dapat meringkaskan proses interpretasi dan pemprosesan maklumat, sekali gus menjadikan analisis data lebih mudah dijalankan [14].

Jadual 1: Pengkelasan Skala *Likert*

Sangat tidak setuju (1)	Tidak setuju (2)	Hampir setuju (3)	Setuju (4)	Sangat setuju (5)
Tidak setuju		Setuju		

Jadual 2: Skala *Likert* yang diubahsuai kepada 3 tahap bagi skor min

Skala kajian	Maksud skala
< 2.33	Tahap rendah
2.33 – 3.67	Tahap sederhana
>3.67	Tahap tinggi

Data Korelasi Pearson digunakan dalam kajian ini bagi menilai kekuatan dan arah hubungan di antara dua pembolehubah yang dikaji. Kekuatan kolerasi diklasifikasikan seperti di dalam **Jadual 3** [15].

Jadual 3: Penetuan Kekuatan Kolerasi antara Pembolehubah

Nilai Kolerasi, r	Kekuatan Hubungan
± 0.90 – 1.00	Sangat tinggi
± 0.70 – 0.90	Tinggi
± 0.50 – 0.70	Sederhana
± 0.30 – 0.50	Rendah
± 0.01 – 0.30	Lemah
0	Tiada hubungan

IV. DAPATAN DAN PERBINCANGAN

A. Pencapaian Pelajar bagi Kursus Pendawaian Elektrik

Data pencapaian pelajar dianalisis berdasarkan Keputusan peperiksaan akhir pelajar pada sesi 1 2024/2025. Dapatan kajian merujuk **Jadual 4** menunjukkan bahawa pencapaian pelajar berada pada tahap tinggi iaitu 32 orang (69.6%) mendapat gred A manakala seramai 13 orang (28.3%) mendapat gred A- dan seorang sahaja (2.2%) mendapat gred B+. Daripada analisis juga mendapati tiada pelajar yang gagal bagi kursus ini. Hasil analisis mendapati tahap pencapaian keseluruhan pelajar yang mengambil kursus Pendawaian Elektrik pada Sesi 1 2024/2025 adalah berada pada tahap cemerlang.

Jadual 4: Pencapaian peperiksaan akhir pelajar dalam kursus pendawaian elektrik

Mata Gred	Gred	Frekuensi	Peratus	Tahap
4.00	A	32	69.6	Cemerlang
3.67	A-	13	28.3	Kepujian
3.33	B+	1	2.2	Kepujian
Jumlah		**46**	**100.0**	

(Sumber: Unit Peperiksaan, Politeknik Tuanku Syed Sirajuddin)

B. Tahap Minat Pelajar Dalam Kursus Pendawaian Elektrik

Kajian dilakukan adalah untuk tahap minat pelajar dalam kursus Pendawaian Elektrik. Hasil analisis data dalam **Jadual 5** memaparkan purata keseluruhan skor min untuk minat pelajar ialah tinggi iaitu min ialah 4.38 dan sisihan piawai ialah 0.61. Selain itu, purata min bagi setiap item yang

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

digunakan untuk mengukur aspek minat pelajar turut berada pada tahap tinggi. Ini menggambarkan bahawa pelajar mempunyai minat yang mendalam terhadap kursus Pendawaian Elektrik serta menganggap kursus tersebut penting dalam membina kerjaya mereka pada masa hadapan.

Jadual 5: Nilai Min dan Sisihan Piawai Aspek Minat

No	Item	Min	Sisihan piawai	Tahap
1	Saya amat berminat mempelajari kursus Pendawaian Elektrik	4.33	0.73	Tinggi
2	Saya amat gembira berpeluang mempelajari kursus Pendawaian Elektrik	4.39	0.71	Tinggi
3	Saya suka belajar kursus Pendawaian Elektrik	4.33	0.73	Tinggi
4	Kursus Pendawaian Elektrik memberi kesan dalam kehidupan saya	4.37	0.68	Tinggi
5	Kursus Pendawaian Elektrik penting dalam kerjaya saya pd masa depan	4.52	0.68	Tinggi
6	Kursus Pendawaian Elektrik adalah tidak membosankan.	4.41	0.68	Tinggi
7	Aktiviti pembelajaran berpusatkan pelajar bagi kursus Pendawaian Elektrik memberi kepuasan kepada saya.	4.37	0.74	Tinggi
	Purata Skor	4.38	0.61	

C. Tahap Sikap Pelajar Dalam Kursus Pendawaian Elektrik

Jadual 6 memaparkan nilai min dan sisihan piawai bagi pembolehubah sikap pelajar terhadap kursus Pendawaian Elektrik. Dapatan menunjukkan nilai min keseluruhan yang tinggi, iaitu 4.35, dengan sisihan piawai sebanyak 0.53. Setiap item yang dinilai dalam aspek sikap turut mencatatkan nilai min yang tinggi, mencerminkan sikap pelajar yang positif, komitmen tinggi terhadap pembelajaran, serta keinginan untuk mencapai kejayaan dalam kursus ini.

Jadual 6: Nilai Min dan Sisihan Piawai Aspek Sikap

No	Item	Min	Sisihan piawai	Tahap
1	Kursus Pendawaian Elektrik menarik minat saya	4.33	0.76	Tinggi
2	Saya berazam untuk skor A dalam kursus Pendawaian Elektrik	4.54	0.62	Tinggi
3	Saya aktif semasa sesi pembelajaran kursus Pendawaian Elektrik	4.37	0.61	Tinggi
4	Saya ingin mempelajari kursus Pendawaian Elektrik dengan lebih mendalam	4.35	0.67	Tinggi
5	Saya selalu melengkapkan nota	4.00	0.94	Tinggi
6	Kursus Pendawaian Elektrik adalah sama pentingnya seperti kursus atau modul lain	4.48	0.65	Tinggi
7	Saya kesal jika tidak menghadiri kelas Pendawaian Elektrik	4.39	0.74	Tinggi
	Purata Skor	4.35	0.53	

D. Hubungan Antara Minat dengan Pencapaian Pelajar dalam Kursus Pendawaian Elektrik

Jadual 7 memaparkan keputusan analisis korelasi antara minat pelajar dan pencapaian pelajar dalam kursus Pendawaian Elektrik, dengan nilai korelasi r = 0.58. Hasil analisis ini menunjukkan terdapat hubungan yang signifikan dan sederhana antara minat pelajar dengan pencapaian mereka dalam kursus berkenaan. Pelajar lebih bermotivasi untuk menjalankan latihan Matematik apabila mereka memiliki minat terhadap mata pelajaran tersebut [16]. Minat pelajar terhadap sesuatu kursus mempengaruhi pencapaian akademik dan proses pembelajaran mereka [17].

Jadual 7: Kolerasi minat dengan pencapaian pelajar

Hubungan	Korelasi (r)	Kekuatan Hubungan
Minat dengan pencapaian pelajar	0.58	Sederhana

Signifikan pada aras $p<0.01$

E. Hubungan Antara Sikap dengan Pencapaian Pelajar dalam Kursus Pendawaian Elektrik

Pembolehubah sikap dianalisis bagi mengenal pasti tahap hubungan antara sikap pelajar dan pencapaian mereka dalam kursus Pendawaian Elektrik. Merujuk kepada **Jadual 8**, hasil analisis menunjukkan wujudnya hubungan yang signifikan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

dan sederhana antara kedua-dua pembolehubah, dengan nilai pekali korelasi r = 0.68. Ini menggambarkan bahawa semakin positif sikap pelajar terhadap kursus tersebut, semakin tinggi kemungkinan mereka mencapai prestasi yang baik.

Jadual 8: Kolerasi sikap dengan pencapaian pelajar

Hubungan	Korelasi (r)	Kekuatan Hubungan
Minat dengan pencapaian pelajar	0.58	Sederhana

Signifikan pada aras p<0.01

Terdapat hubungan yang signifikan antara sikap pelajar dan pencapaian mereka dalam mata pelajaran Matematik Tambahan [18]. Pelajar yang memiliki sikap positif terhadap pembelajaran berkemungkinan besar mencapai prestasi akademik yang lebih cemerlang [19]. Sikap pelajar merupakan faktor penting yang mempengaruhi tahap pencapaian akademik mereka [20].

V. KESIMPULAN

Hasil kajian ini membuktikan bahawa terdapat hubungan yang signifikan antara minat dan sikap pelajar dengan pencapaian mereka dalam kursus Pendawaian Elektrik yang diikuti oleh pelajar Semester 1, sesi 1 2024/2025. Walaubagaimanapun, pembolehubah sikap mempunyai hubungan yang lebih tinggi berbanding pembolehubah minat. Dapat dilihat juga dalam kajian, hasil hubungan yang baik bagi minat dan sikap telah meningkat motivasi pelajar, justeru membantu pelajar memperolehi pencapaian yang cemerlang dalam kursus yang diikuti. Ini menunjukkan bahawa kedua-dua faktor tersebut merupakan elemen penting yang menyumbang kepada kejayaan pelajar.

REFERENCES

[1] Bong, S. W., Nuwairani, A. S., & Zainudin, M. T. (2024). Assesment of Outcome-Based Education Implementation : A Case Study of Diploma Program in Electronic Engineering (Communication) at Politeknik Mukakh. *Proceeding Of International Conference on Engineering, Technology & Social Science*, (pp. 162-169).

[2] Nurhayati, Lias, H., & Kemas, I. R. (2021). Determinasi Minat Belajar dan Sikap Terhadap Prestasi Belajar Melalui Kreativitas Mahasiswa. *Syntax Idea*. doi:https://doi.org/10.36418/syntaxidea.

[3] Shreenia, B., & Nurul, A. (2024). Sikap, Motivasi, dan Minat Pelajar Bukan Melayu Di Kolej. *International Journal of Advanced Research in Education an, 6*, 782-795. doi:https://doi.org/10.55057/ijares.2024.6.1.72

[4] Maizun, J., & Nurul Najwa, M. Y. (2024). Tahap Minat, Kefahaman dan Kemahiran Yang Mempengarahi Pencapaian Pelajar Dalam Pembelajaran Berasaskan Mini Projek (PBmP). *Technical and Vocaional Education International Journal (TAVEIJ), 4*(1). doi:https://doi.org/10.55642/taveij.v4i1.620.

[5] Jalil, A. (2023). Keberkesanan pembelajaran melalui kaedah flipped dalam kalangan pelajar teknikal di Politeknik Malaysia. *Journal of Innovation in Learning and Management Initiative, 3*(1),10-20.

[6] Mohamad Zhurad, H., & Mohd Nasrun, S. (2024). Halatuju Pelajar TVET: Pengaruh Minat Terhadap Niat Kerjaya Pelajar Teknologi Automotif Di Kolej Vokasional Daerah Johor Bahru. *Journal of Research, Innovation and Strategies for Education, 1*(1),58-71. doi:https://doi.org/10.70148/rise.5

[7] Ma, C., & Chen, B.-C. (2022). The Impact of Competitive and Collaborative Environments on Vocational Students' Competitive Attitudes, Task Motivation, and Adaptability: A Multilevel Structural Equation Modeling Analysis. *Frotiers in Psychology*, The impact of competitive and collaborative environments on vocational students' motivation and academic performance.

[8] Norfardilawati, M., Tuan Fatma, T. S., Raziana, C. A., Rosnida, A. B., & Nor Aisyah, F. (2022). Comparative Study of Student Performance in Traditional and Online Assessments . *ASEAN Journal of Open and Distance Learning*, 67-78.

[9] Norsaliza, A. B., Haslenda, Y., Norlina, M. A., & Nor Fauziah, A. B. (2022). Determinants of students' academic performance in higher learning institutions in Malaysia. *International Journal of Academic Research in Business and Social*

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Sciences, 1-15.

[10] Kim, W. L., & Aminuddin, H. (2020). Factors Influencing Instruction Competencies as Perceived by Technical and Vocational Education and Training Students in Malaysia. *International Journal of Academic Research in Business and Social Sciences, 10*(1).

[11] Ainon Ramli, R. Z., Mohd Zaimmudin, M. Z., & Anis Amira, A. R. (2021). Environmental Factors and Academic Performance: The Mediating Effect of Quality of Life. *The importance of new technologies and entrepreneurship in business development: In the context of economic diversity in developing countries*, 2082-2105.

[12] Mohamad Najib Abdul Ghafar (1999). *Penyelidikan Pendidikan.* Johor Bahru: Penerbit Universiti Teknologi Malaysia.

[13] Noraini Omar (2008). Faktor-faktor yang Mempengaruhi Pencapaian Pelajar Dalam Mata Pelajaran Pendidikan Islam Tingkatan Lima. Jurnal Pendidikan, Institut Perguruan Tun Abdul Razak, Sarawak.

[14] Rahimah Shahar (2006). *Pembangunan Laman Web Sebagai Media Pengajaran Di Politeknik Port Dickson: Topik Garis Imbas.* Tesis Sarjana, Universiti Kebangsaan Malaysia.

[15] Hinkle, D.E.,Wiersma, W., & Jurs, S.G. (1998). Applied Statistics For Tha Behavioral Sciences. Boston: Houghton Mioffin Company.

[16] Su Swariat, A.O. (2012). Activity Matters: Understanding Student Interest in School Science. Journal of Research in Science Teaching Vol. 49, Issue 4, pp 515-537.

[17] Lastri, Sri Kartikowati & Sumarno. (2020). Factors that Influence Student Learning Achievement. Journal of Educational Sciences, 4(3).

[18] Noor Erma Binti Abu dan Leong Kwan Eu (2014). Hubungan Antara Sikap, Minat, Pengajaran Guru Dan Pengaruh rakan Sebaya Terhadap Pencapaian Matematik Tambahan Tingkatan 4. JuKu: Jurnal Kurikulum & Pengajaran Asia Pasifik (Januari 2014, Bil. 2 Isu 1).

[19] Muhamad Shafiq & Noraini. (2018). Mengenalpasti Faktor-Faktor Yang Mempengaruhi Pencapaian Akademik Pelajar Sarjana Muda Psikologi, Kolej Universiti Islam Melaka (KUIM). Jurnal Sains Sosial, 7, 77-87.

[20] Hanifah Mahat, Paulin Chang Poh Ling, Nasir Nayan, Mohmad isa Hashim &Yazid Saleh. (2017). Pencapaian Pelajar dalam Mata Pelajaran Geografi Sekolah Menengah di Sabah.Jurnal Sains Humanika, 9(2), 1-7.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: Nor Azrizal Bin Norazmi 	Department of Electrical Engineering, Politeknik Tuanku Syed Sirajuddin, 02600 Arau, Perlis, Malaysia E-mail: norazrizal@ptss.edu.my
Second Author: Sarah Binti Jewahid 	Department of Electrical Engineering, Politeknik Tuanku Syed Sirajuddin, 02600 Arau, Perlis, Malaysia E-mail: sarahjewahid@ptss.edu.my
Third Author: Izwan Bin Che Sham 	Department of Electrical Engineering, Politeknik Tuanku Syed Sirajuddin, 02600 Arau, Perlis, Malaysia E-mail: izwan@ptss.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

The Effectiveness of Continuous Quality Improvement Implementation on the Achievement of Learning Outcomes for the DCC30093 Geotechnical Engineering

Mohd Firdaus Bin Che Soh[1], Mazlina Bt Harun[2]

[1] *Jabatan Kejuruteraan Awam, Politeknik Sultan Mizan Zainal Abidin*
E-mail: mohd.firdaus@psmza.edu.my

[2] *Jabatan Kejuruteraan Awam, Politeknik Sultan Mizan Zainal Abidin*
E-mail: mazlinaharun@psmza.edu.my

Abstract

Continuous Quality Improvement (CQI) is an approach that is gaining increasing attention in efforts to improve learning outcomes in higher education, particularly for Geotechnical Engineering courses. Geotechnical Engineering courses are one of the main courses in Civil Engineering that leads to an understanding and knowledge relates to the engineering properties of soils in civil engineering works. Based on the achievement of the Course Learning Outcome for the DCC30093 Geotechnical Engineering course, this study was conducted to evaluate the effectiveness of Continuous Quality Improvement implementation in achieving the desired learning outcomes for the Geotechnical Engineering course especially for CLO1: Apply fundamental of engineering properties of soils in civil engineering works. The objective of this study is to examine the difference in the achievement of CLO for the DCC30093 Geotechnical Engineering course for different sessions in terms of the achievement of CLO1 item. The research method used is a quantitative data analysis referred from Polytechnic Information Management System, SPMP (i-exam), Sultan Mizan Zainal Abidin Polytechnic. Data was obtained from the Course Outline Review Report issued at the end of each semester for the DCC30093 Geotechnical Engineering course. The findings of the study show that the percentage of CLO1 achievement is the lowest compared to the other three CLOs that were also assessed. The findings of CLO1 in Session I:2022/2023, showed the lowest percentage of 42.2% compared to other CLOs and recorded achievement below the target set by the department, which is to achieve at least 50.0%. The same thing happened in Session II:2022/2023 which also recorded the lowest percentage of CLO1 achievement and was still below the target of 49.0%. For Session I:2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO1 achievement is increasing and has exceeded the outlined target of more than 50%. With the increase in the percentage of CLO1 achievement, this shows that Continuous Quality Improvement (CQI) must always be implemented to ensure that the percentage of achievement for CLO1 always increases or at least exceeds the percentage target set by the department, which is 50.0% and above.

Keywords **:** *Geotechnical Engineering, Continuous Quality Improvement, Course Learning Outcome (CLO)*

I. INTRODUCTION

In the rapidly evolving field of geotechnical engineering, equipping students with a robust understanding of theoretical principles and practical applications is paramount. The DCC30093 Geotechnical Engineering course is specifically designed to provide foundational knowledge and skill development in this specialized branch of civil engineering. However, the dynamic and interdisciplinary nature of geotechnical engineering presents challenges in ensuring that students achieve optimal learning outcomes. To address these challenges, the implementation of Continuous Quality Improvement (CQI) methodologies has gained prominence as a systematic approach to enhancing the quality of education.

Continuous Quality Improvement, which originated in industrial and organizational contexts, emphasizes an iterative process of planning, execution, assessment, and enhancement. When applied to education, CQI fosters a culture of continuous evaluation and refinement, enabling educators to identify gaps in learning and to implement targeted strategies for improvement. By integrating CQI principles into the DCC30093

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Geotechnical Engineering course, this study seeks to address key issues such as bridging the gap between theoretical knowledge and real-world application, increasing student engagement, and meeting industry standards.

Moreover, as industries and professional practices evolve, higher education institutions are under increasing pressure to align their curricula with emerging trends and requirements. By incorporating CQI practices, educators can develop adaptive strategies that not only elevate the quality of instruction but also better prepare students for the complexities of modern geotechnical engineering. This is particularly relevant in the context of Malaysia's education landscape, where fostering technical competence and innovation is critical to national development goals.

This paper explores the effectiveness of CQI implementation within the DCC30093 Geotechnical Engineering course. The findings from this research will provide valuable insights for educators, curriculum designers, and policymakers seeking to improve teaching and learning practices in technical education.

Table 1: Course Learning Outcomes for DCC30093-Geotechnical Engineering

No	CLO	
1	CLO1C	Apply fundamental of engineering properties of soils in civil engineering works
2	CLO2C	Analyze geotechnical engineering problem using appropriate method in determination of safety, stable earthworks and geotechnical structures
3	CLO3C	Analyze data to reach conclusion on assigned topic of case study
4	CLO4A	Explain verbally in formal presentation based on assign topic

II. PROBLEM STATEMENT

The achievement of optimal learning outcomes in technical courses such as DCC30093 Geotechnical Engineering is critical for preparing students to meet the complex demands of the geotechnical engineering profession. However, various challenges hinder the effectiveness of traditional teaching and learning approaches in such courses. These challenges include a disconnect between theoretical concepts and practical applications, insufficient alignment of course content with industry expectations, and a lack of systematic evaluation processes to identify and address gaps in student learning. As a result, students often struggle to fully grasp critical geotechnical engineering principles, leading to suboptimal academic performance and inadequate professional preparedness.

Continuous Quality Improvement (CQI) has been proposed as a transformative approach to address these issues by fostering a culture of continuous assessment and enhancement within educational settings. While CQI has demonstrated success in industrial and organizational contexts, its implementation in technical education remains underexplored. The DCC30093 Geotechnical Engineering course offers a unique opportunity to evaluate the impact of CQI practices on bridging the gap between academic instruction and industry needs.

This research aims to address the problem by investigating the effectiveness of CQI implementation in enhancing learning outcomes for the DCC30093 Geotechnical Engineering course. By identifying barriers to effective learning and exploring CQI-driven interventions, this study seeks to provide actionable insights for optimizing teaching and learning practices in technical education.

III. RESEARCH OBJECTIVE

To evaluate the effectiveness of Continuous Quality Improvement Implementation for DCC30093 Geotechnical Engineering by focusing on CLO1: Apply fundamental of engineering properties of soils in civil engineering works. CLO1 is an assessment that test the cognitive aspects of students and is assessed through tests. The assessment involves CLO1, which contributes a total percentage of 35%, of which 10% is assessed through test, while another 25% is assessed through final examination.

IV. LITERATURE REVIEW

Continuous Quality Improvement (CQI) is a structured, data-driven process focused on enhancing organizational performance by systematically improving policies, practices, and outcomes. Originally developed in the healthcare and manufacturing sectors, CQI has increasingly been applied in educational settings to improve teaching and learning outcomes [1][2].

The Engineering Accreditation Council Malaysia (EAC) Programme Accreditation Standards [10] has included the assessment and evaluation of POs in the Engineering Curriculum to ensure that Continuous Quality Improvement (CQI) is carried out on a regular basis.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

CQI represents a valuable tool for enhancing student achievement in geotechnical engineering education. By promoting continuous evaluation and refinement of teaching practices, CQI helps align course delivery with learning outcomes and industry expectations.

Continuous Quality Improvement (CQI) has proven to be a significant tool in enhancing educational practices, especially in the field of engineering education. According [3], CQI efforts in civil engineering courses during and after the Covid-19 pandemic showcased how systematic adjustments could maintain academic quality despite challenges brought about by unexpected disruptions. This highlights the adaptability of CQI in ensuring that learning objectives are consistently met, even in volatile environments.

Similarly, [9] underscore the importance of quality assurance frameworks in civil engineering education. Their study delves into how CQI aligns with Program Educational Objectives (PEOs), promoting an effective balance between theoretical knowledge and practical application. The integration of CQI practices not only strengthens the curriculum but also ensures students are well-prepared for the demands of the engineering industry.

The integration of student-centered learning strategies with CQI has been shown to create more effective and engaging educational environments. [11] present evidence that adapting teaching approaches based on student needs leads to improved academic and personal growth. Their findings emphasize how CQI complements these strategies by fostering continuous improvement in both teaching practices and learning outcomes.

Explored how CQI utilizes assessments to gather information on the effectiveness of educational program design and delivery. Their study highlighted that this feedback-driven approach leads to improvements, enhancing teaching and learning through systematic evaluation [12]. CQI supports evidence-based decision-making, enabling institutions to adapt to changing student needs and societal demands [5].

Similarly, [13] highlighted a case study on implementing outcomes-based education and CQI, showcasing how these practices improve teaching methodologies. Additionally, [14] proposed a comprehensive framework for outcome-based engineering education, emphasizing how analytical tools and evaluations drive ongoing educational enhancements.

In the context of geotechnical engineering education, [1] reveal that integrating real-world scenarios and problem-solving activities through CQI can significantly improve student engagement and understanding. Furthermore,[6] points out the role of CQI in aligning course objectives with industry standards, thus preparing students for professional challenges.

Geotechnical engineering is a core component of civil engineering programs, encompassing soil mechanics, foundation design, slope stability, and site investigation. Courses in this domain often aim to develop both theoretical understanding and practical skills, including critical thinking, problem-solving, and proficiency in lab techniques.

Additionally [4] emphasize the need for more rigorous and longitudinal studies to evaluate how CQI-driven changes impact graduate preparedness and long-term competency in geotechnical engineering.

Increasing the frequency of formative assessments and feedback loops plays a critical role in guiding students throughout their learning journey and ensuring alignment with learning outcomes. Conducted a meta-analytical review of formative assessment strategies and found that these practices significantly enhance students' understanding and performance across diverse educational contexts [7]. Furthermore, [8] emphasized the importance of embedding feedback mechanisms within curriculum design to create continuous opportunities for reflection and improvement, thereby fostering deeper engagement with learning objectives.

Additionally, [15] discussed the importance of designing formative assessments that improve both teaching and learning, underscoring lessons learned from experienced educators.

V. RESEARCH METHODOLOGY

The research method used in this study is quantitative data analysis, where the raw data is obtained from the Polytechnic Information Management System -SPMP (i-exam). This data is specifically obtained from the Course Outcome Review Report (CORR) display, which can be accesses at the end of each semester immediately after the official results are released for the DCC30093-Geotechnical Engineering course.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

VI. RESEARCH FINDINGS AND DISCUSSION

Based on the Course Outcome Review Report obtained from the SPMP (i-exam) system of Sultan Mizan Zainal Abidin Polytechnic, Group Attainment data as shown in the Table 2 below was successfully obtained based on five different academic sessions. The data displayed in Table 2 includes all CLOs that are assessed for this course.

Table 2: Group Attainment Achievement for DCC30093 Geotechnical Engineering Course

SESSION	GROUP ATTAINMENT (%)			
	CLO1C	CLO2C	CLO3C	CLO4A
I: 2022/2023	42.2	52.5	68.2	79.0
II: 2022/2023	49.0	63.6	78.6	76.7
I: 2023/2024	52.3	72.0	82.3	88.6
II: 2023/2024	52.6	70.8	73.1	85.6
I: 2024/2025	56.4	76.2	87.8	81.3

Based on the distribution of data generated from the SPMP (i-exam) system, it can be concluded that in all academic sessions studied, the percentage of achievement for CLO1 showed the lowest percentage value compared to the other three CLOs that were also evaluated. The findings of CLO1 in Session I:2022/2023, showed the lowest percentage of 42.2% compared to other CLOs and recorded achievement below the target set by the department, which is to achieve at least 50.0%. The same thing happened in Session II:2022/2023 where CLO1 also recorded the lowest percentage of CLO achievement and was still below the target of 49.0%.

For Session I:2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO1's achievement is increasing and has exceeded the outlined target of more than 50%. With this increase in the CLO1 percentage achievement, it shows that Continuous Quality Improvement (CQI) must always be implemented to ensure that the percentage achievement for CLO1 always increases or at least exceeds the percentage target set by the department, which is 50.0% and above.

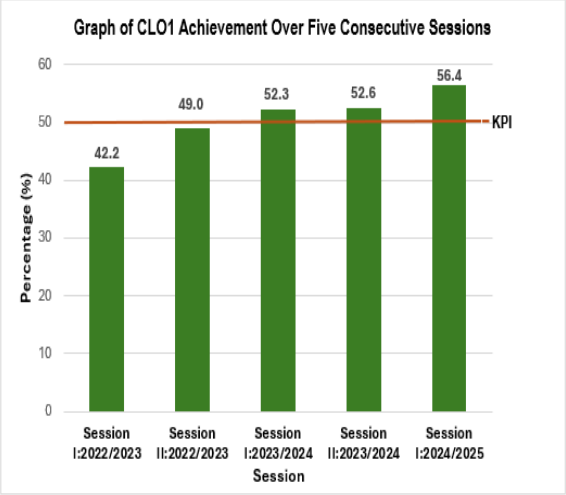


Figure 1: Graph of CLO1 Achievement Over Five Consecutive Sessions

Figure 1 above is a graph of CLO1 achievement for five consecutive. CLO1 achievement in Session I:2022/2023, was at the lowest level compared to other sessions and recorded achievement below the set target of 42.2%. The average percentage of CLO achievement for Group Achievement for a course must exceed the average percentage of learning outcome achievement set by Key Performance Indicators. However, there was an increase of 6.8% in Session II:2022/2023, with CLO1 achievement of 49.0% although still below the set target of 50%. For the next three sessions, namely Session I: 2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO 1 achievement has shown positive improvement, which is increasing and exceeding the set KPI achievement target of 50%.

The percentage of CLO1 achievement for each academic session is also influenced by the number of students who fail the course and subsequently register in the following semester as repeaters. The achievement of these students will have a significant impact on Group Achievement as the students will be classified according to different sections even though there is only one student. Based on Tables 3,4,5,6 and 7, it can be observed that the CLO1 achievement for the class of repeaters is lower than the current class.

Table 3: Group Attainment Achievement for Session I:2022/2023

SECTION	CLO1C (%)	GROUP ATTAINMENT (%)
DKA3A	38.0	42.0
DKA3B	42.0	
DKA3C	38.0	
DKA3D	45.0	
DKA3E	53.0	

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

DKA4A	37.0	

Table 4: Group Attainment Achievement for Session II:2022/2023

SECTION	CLO1C (%)	GROUP ATTAINMENT (%)
DKA3A	57.0	49.0
DKA3B	59.0	
DKA4A	53.0	
DKA4B	49.0	
DKA4C	35.0	
DKA4E	49.0	
DKA5A	41.0	

Table 5: Group Attainment Achievement for Session I:2023/2024

SECTION	CLO1C (%)	GROUP ATTAINMENT (%)
DKA2A	40.0	52.3
DKA3A	60.0	
DKA3B	57.0	
DKA3C	48.0	
DKA3D	52.0	
DKA4A	50.0	
DKA4B	59.0	

Table 6: Group Attainment Achievement for Session II:2023/2024

SECTION	CLO1C (%)	GROUP ATTAINMENT (%)
DKA3A	57.3	52.6
DKA4A	38.0	
DKA4B	38.0	
DKA4D	49.0	

Table 7: Group Attainment Achievement for Session I:2024/2025

SECTION	CLO1C (%)	GROUP ATTAINMENT (%)
DKA3A	55.6	56.4
DKA3B	54.6	
DKA3C	61.3	
DKA5A	40.0	
DKA5B	56.0	
DKA5C	35.0	

VII. CONCLUSION

The implementation of Continuous Quality Improvement (CQI) has proven to be an effective strategy in improving the achievement of learning outcomes. Through systematic assessment, repeated feedback, and data-driven decision-making, CQI fosters a culture of accountability and continuous improvement in educational settings. Research findings show that institutions that adopt CQI practices show significant improvements in student performance, curriculum relevance, and teaching quality.

Furthermore, CQI encourages active stakeholder participation, enabling a more responsive and student-centered approach. While challenges such as resource constraints and resistance to change may arise, the long-term benefits of continuous CQI efforts clearly support its integration into educational quality management systems. Therefore, CQI stands out as a valuable framework for driving educational excellence and ensuring that learning outcomes are aligned with evolving academic and professional demands. Other than that, the implementation of continuous quality improvement (CQI) also has the potential to positively impact course learning outcomes, provide a better educational experience for students, and create a more effective overall learning environment.

REFERENCES

[1] Roziah, K., Md Nor, N., & Mat Saliah, S. N. (2025). Continuous Quality Improvement for Civil Engineering Course During and After the Covid-19 Pandemic. *Jurnal Kejuruteraan*, 37(1), 507-526.

[2] American Institutes for Research. (2021). Using Continuous Quality Improvement in Competency-Based Education Programs: A Quick Guide for Practitioners and Program Leaders.

[3] Keria, R., Md Nor, N., & Mat Saliah, S. N. (2025). Continuous Quality Improvement for Civil Engineering Course During and After the Covid-19 Pandemic. *Jurnal Kejuruteraan*, *37*(1), 507–526.

[4] Idris, M., Shafie, M. A., & Liaw, S. C. (2023). Online OBE-CQI Tool for Engineering Programmes. *Esteem Academic Journal*, 9(1), 37-47.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[5] Koh, Y. Y., & Chong, P. L. (2019). Incorporating Student Feedback into Curriculum Review According to Outcome-Based Education Philosophy. Journal of Engineering Science and Technology, 14(2), 541-556.

[6] Che Maznah, M. I., Oh, C. L., & Liew, C. P. (2021). Effective Implementation of Complex Engineering Problems and Activities in Malaysian Engineering Curricula. *Asian Journal of University Education*, 17(4), 162-178.

[7] Foster, H. (2022). *The Impact of Formative Assessment on Student Learning Outcomes: A Meta-Analytical Review*. Kingston University.

[8] Irons, A., & Elkington, S. (2021). *Enhancing Learning through Formative Assessment and Feedback (2nd ed.)*.

[9] Ahmad Kamal, N., & Che Ibrahim, C. K. I. (2025). Quality assurance in civil engineering education: insights into program educational objectives (PEOs) in Malaysia. *Quality Assurance in Education*.

[10] EAC (2020). Engineering Programme Accreditation Standards. Petaling Jaya: Engineering Accreditation Council Malaysia.

[11] Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education*, *10*, Article 1518602.

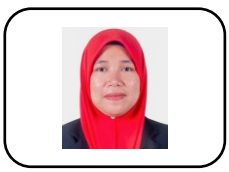
[12] Ismail, N. F., & Zulkifle, F. A. (2024). CQI: Improving Teaching and Learning Through Assessment and Evaluation. *Bulletin Universiti Teknologi MARA, Negeri Sembilan*.

[13] Koh, Y. Y., & Chong, P. L. (2021). From Outcome-Based Education (OBE) to Continual Quality Improvement (CQI): A Case Study of Teaching Mechanical Engineering at University of Newcastle, Singapore. International Journal of Emerging Technologies in Learning (iJET), 16(6), 45-56.

[14] Chuah, H. T. (2021). Outcome-Based Engineering Education and Continual Quality Improvement: A Framework for Enhancing Educational Quality. *Federation of Engineering Institutions of Asia and the Pacific*.

[15] Van der Steen, J., van Schilt-Mol, T., van der Vleuten, C., & Joosten-ten Brinke, D. (2023). Designing Formative Assessment That Improves Teaching and Learning: Lessons from Experienced Teachers. *Journal of Formative Design in Learning, 7*, 182–194.

AUTHOR'S INFORMATION

First Author: Mohd Firdaus Bin Che Soh 	Civil Engineering Department, Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu, Malaysia E-mail: mohd.firdaus@psmza.edu.my
Second Author: Mazlina Bt Harun 	Civil Engineering Department, Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu, Malaysia E-mail: mazlinaharun@psmza.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Understanding Financial Well-Being Through Social and Psychological Lenses: Evidence from Muslim Working Adults in Malaysia

Putri Aliah Mohd Hidzir[1], Shafinar Ismail[2], Aqilah Nadiah Md Sahiq[3], Juliana Juliana[4], Ririn Tri Ratnasari[5]

[1] *Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia*
E-mail: aliahidzrir@gmail.com

[2] *Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia*
E-mail: shafinar@uitm.edu.my

[3] *Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia*
E-mail: aqilahnadiah@uitm.edu.my

[4] *Faculty of Economics and Business Education, Univesitas Pendidikan Indonesia, Indonesia*
E-mail: julian@upi.edu

[5] *Faculty of Economics and Business Education, Univesitas Airlangga Indonesia, Indonesia*
E-mail: ririnsari@feb.unair.ac.id

Abstract

Financial well-being has gained increasing scholarly attention due to its relevance in economic resilience. Its significance lies in the stability of individuals' finances to navigate uncertainties in living expenses. Malaysia, with Islam as its most widely practiced religion, boasts approximately 22 million Muslims as of 2023, constituting a crucial demographic contributing to the country's economic growth. However, studies indicate that low financial well-being among Muslim working adults contributes to high bankruptcy rates in Malaysia. Thus, the objective of this study is to investigate the determinants of financial well-being among Muslim working adults in Malaysia. This study employed a quantitative method, collecting data through a survey utilizing purposive sampling. A total of 153 Muslim working adults in Malaysia were surveyed, and data were analysed using Structural Equation Modelling through SmartPLS software. The findings confirmed the pivotal roles of social trust and financial self-efficacy in shaping financial well-being, while social networks exhibited an insignificant relationship. This finding suggests that while social networks may provide emotional or informational support, they might not directly impact financial outcomes without accompanying factors such as financial literacy, or trust in the source of information. This study makes a significant contribution to the existing literature by enhancing our understanding of the relationship between social trust, social networks, financial self-efficacy, and financial well-being within a unified framework. By exploring the importance of financial well-being and investigating its determinants, the research adds depth to the existing literature in the context of Malaysian Muslim working adults. From a practical standpoint, this study highlights the necessity of nurturing individuals' confidence in managing finances, prompting educators and practitioners to focus on enhancing financial self-efficacy among Muslim working adults to improve their financial well-being.

Keywords **:** *Financial self-efficacy; Financial well-being; Malaysia; Muslim working adults; Social trust*

I. INTRODUCTION

Financial well-being is an emerging focus within the research field, drawing increasing interest in recent years. This term is employed to characterize an individual's financial condition, encompassing their ability to manage financial shocks and exercise discretion in spending [1]. Additionally, it denotes the capacity to meet current lifestyle demands, while concurrently planning for future needs and responsibilities [2]. Furthermore, financial well-being extends to an entity's or individual's

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

comprehensive financial health, embracing aspects such as stability, security, and satisfaction with their financial circumstances [3].

While these general concepts apply broadly, the financial well-being of Muslim working adults is shaped by distinct religious and cultural values.. For instance, a lot of Muslims follow the principles of Islamic banking, which forbid charging or paying interest (riba) and being overly doubtful (gharar) [4]. Alternatively, individuals could choose to use Sharia-compliant Islamic banking products including Islamic investment funds, Islamic mortgages, and Islamic savings accounts. Moreover, earning a lawful (*halal*) income is central to their financial practices, as income must be derived through Islamically permissible means to align with religious expectations.

Despite the availability of Shariah-compliant financial instruments, Muslim working adults face considerable financial challenges, as reflected in rising bankruptcy rates. Muslim working adults are individuals who identify as Muslim and are actively employed in the workforce. Like all working adults, they encounter various challenges and opportunities related to their employment, career advancement, financial well-being, and work-life balance.

Recent data reveals that 31,387 bankruptcy cases were recorded between 2020 and December 2024, out of a total of 133,884 cases being administered up to that point [5]. Notably, nearly 66% of bankruptcies during that five-year period involved individuals aged 25 to 44 years, with the 35–44 age group alone accounting for the highest share at 39.20%, followed by the 45–54 group (27.59%) and the 25–34 group (16.35%). These figures reflect the significant burden of financial stress among working-age adults.

The causes of bankruptcy further underscore the challenges faced by these working adults. The top contributing factor was personal loans, making up 49.11% of cases, followed by business loans (18.69%), vehicle hire-purchase loans (9.25%), and housing loans (7.76%). These debt categories are closely tied to household obligations and lifestyle needs, which can strain finances, especially for those with dependents and limited savings.

These trends paint a concerning picture of poor financial resilience, even among those with access to Shariah-compliant financial systems. Therefore, this study aims to investigate the underlying factors influencing the financial well-being of Muslim working adults in Malaysia. The following sections present the theoretical and empirical review of financial well-being, followed by the methodology employed in this study. Subsequently, the article discusses and interprets the research findings, and finally, a conclusion will be drawn to shed light on the issues surrounding financial well-being

II. LITERATURE REVIEW

In this chapter the researcher discusses the highlights of the study relating to the factors contributing to financial well-being of Muslim working adults such as problem-solving skills, creative and critical thinking skills, and analytical skills to students[1].

A. Theory of Social Capital

Based on social capital theory [6], this study posits that social trust, and networks underpin financial well-being in working adults. Social ties help human capital expand over time, according to the theory [7]. This definition of "social capital" refers to social relationships. It helps organisations share resources and bring forth fresh ideas [8]. This study also examines financial self-efficacy and financial well-being. The relationship between working people' psychological beliefs, such as financial self-efficacy, social capital (social trust and social networks), and financial well-being in Malaysia and its mechanisms has been understudied.

According to social capital theory, social networks, relationships, and norms can foster cooperation, trust, and mutual assistance in communities. These networks can affect many things, including financial security. A community-based savings group or family loan can increase financial well-being [9]. Social networks simplify professional and financial information sharing. Social media users can share investing, financial planning, and problem-solving tips. Information sharing through social capital can promote financial literacy and help people make better financial decisions, improving their financial well-being.

Community social capital is built on trust and cooperation. Trust makes people more likely to collaborate on economic projects, do financial commerce, and help one other when they need money [10]. Reliable relationships can lower transaction costs, remove barriers to financial transactions, and increase investment in enterprises and projects that benefit society, promoting financial well-being.

B. Financial Well-being

Financial well-being is defined as a state in which individuals have control over daily and monthly expenses, can withstand financial shocks, are progressing towards their financial goals, and possess the financial freedom to make choices that enhance their quality of life [11]. Previous studies on financial well-being can be categorized into three approaches: objective measurement (e.g., income and wealth), subjective measurement (e.g., personality, attitudes, and knowledge), and a combination of objective and subjective measurements [2]. However, given the personal

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

nature of financial experience, this study emphasizes subjective assessment, aligning with [2].

Government policies, cultural norms, economic situations, and religious opinions affect Malaysian Muslims' financial well-being [12]. Malaysia leads Islamic finance with Shariah-compliant financial services and products. Malaysian Muslims favour Shariah-compliant banking, which bans interest (riba) and promotes profit-sharing and asset-backed transactions. Islamic banking products including savings accounts, loans, and Takaful promote financial stability and religious observance. It also involves saving and budgeting. Budgeting and saving are crucial for financial stability. Malaysian Muslims can save (sadaqah) and spend properly. Leaving a percentage of income for zakat and sadaqah fulfils religious responsibilities and fosters financial discipline and social responsibility.

Financial well-being encompasses several facets of an individual's financial and psychological well-being. A systematic literature study by [13] examined financial well-being factors and measures. The authors stressed the necessity of evaluating financial well-being using financial literacy, behaviour, socialisation, and inclusion [13]. Financial well-being and other factors impacting behaviour are understudied, according to [14]. Social trust, social networks, and financial self-efficacy affect financial well-being. Hence this study seeks to fill this gap.

C. Social Trust

Social trust can be defined as having faith in strangers or society, exemplifying a reliance on the goodwill of humankind [15]. Various studies conducted in different areas have demonstrated that social trust can mitigate social crimes [16], stimulate angel investment [17], encourage the use of open B2B e-commerce [18], and enhance subjective financial well-being in China [15]. It has also been linked to improved psychological resilience, perceived social support during adversity [19], and greater engagement in long-term financial planning, including retirement savings and financial literacy, especially when trust in financial institutions is present [20, 21, 22, 23]. These further highlights how social trust is strongly correlated with subjective well-being through various channels [24].

In the context of Malaysia, where Islam significantly shapes societal values and financial behavior, social trust is particularly impactful for the Muslim community [25]. The operation of Islamic financial institutions depends on trust. Muslims in Malaysia depend on banking and financial services that adhere to Shariah, and the stability and expansion of Islamic finance depend heavily on their trust in these organizations. Within the Muslim community, high levels of social trust might encourage increased participation by fostering faith in Islamic banks, Takaful corporations, and other Shariah-compliant financial enterprises [12].

Furthermore, initiatives for community development and empowerment that improve Muslims' economic well-being are supported by social trust [26]. Financial well-being is influenced by one's level of faith in governmental institutions, regulatory agencies, and legal frameworks. In Malaysia, Muslims rely on laws and rules from the government to protect their financial rights and interests. Participation in formal financial markets and institutions is encouraged and confidence in the financial system is bolstered by trust in the efficacy and fairness of legal and regulatory frameworks. Therefore, the following hypothesis is proposed:

H1: There is a significant relationship between social trust and the financial well-being of Muslim working adults in Malaysia.

D. Social Network

Social networks encompass social ties or relationships with friends, co-workers, and the community, all viewed as forms of social capital by economists [27]. [28] explores the concept of social capital and its role in creating human capital, discussing how social networks and relationships provide individuals with resources, opportunities, and support contributing to overall well-being, including financial well-being. Social networks also grant access to valuable information and resources related to personal finance, empowering individuals to make informed financial decisions and improve their financial well-being [29]. Interactions with friends, family, and online communities enable individuals to learn about financial strategies, investment opportunities, and money-saving tips. Thomas and Gupta (2021) emphasize how employees' financial well-being may be influenced by their social networks. A lack of supportive social networks critically impacts health management and one's mental and physical well-being [30].

In the context of Malaysia, social networks are vital to the financial security of Muslims. Within the Muslim community, social media platforms and interpersonal relationships often act as support systems [31]. These networks provide not only emotional encouragement but also practical assistance, such as job referrals, business collaborations, or temporary financial aid to those facing hardship. Additionally, they facilitate the sharing of financial knowledge which enable individuals to exchange insights on entrepreneurship, budgeting, saving, and investment strategies within trusted circles.

Furthermore, social networks frequently serve as the catalyst for neighbourhood-based financial projects that support financial empowerment and inclusion. Within their social networks, Muslims in Malaysia might form

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

cooperative ventures, investment clubs, or savings organizations to share risks, pool money, and promote community-beneficial economic development projects [32]. Strong social ties within the Muslim community can promote prosperity, empowerment, and resilience, which in turn can improve the financial stability and standard of living for individuals and their families. Given the significant role played by social networks in well-being, this study hypothesizes the following:

H2: There is a significant relationship between social networks and the financial well-being of Muslim working adults in Malaysia.

E. Financial Self-efficacy

Financial self-efficacy is the level of assurance a person has in their ability to acquire and use financial goods and services, make complex financial decisions, and manage challenging financial situations [33]. [34] investigated the influence of money attitude, financial practices, self-efficacy, and emotional coping on employees' financial well-being, finding that financial self-efficacy positively impacts financial well-being. [35] also contributed to the literature by demonstrating that financial self-efficacy is positively associated with financial satisfaction and financial independence, while negatively associated with financial distress. These findings highlight the importance of individuals' confidence in their financial abilities in achieving positive financial outcomes and overall financial well-being [35].
Moreover, [36] conducted a study on women's personal finance behaviour and found that higher levels of financial self-efficacy are associated with more positive financial behaviours, such as budgeting, saving, and investing. These studies collectively demonstrate the importance of financial self-efficacy in determining financial well-being.

According to [37], financial self-efficacy is the belief in one's own competence to manage one's finances. It includes assurance in one's capacity to make sound financial decisions, establish and meet financial objectives, and deal with financial difficulties. Conversely, a person's total financial health and contentment with their financial circumstances are referred to as their financial well-being. Both cultural and religious variables affect Muslims' financial well-being and financial self-efficacy.

Trusting in Allah's guidance and believing in His provision can have a big impact on one's financial self-efficacy. When Muslims believe that their efforts to earn, save, and invest are in line with Islamic teachings and have faith in Allah's decree, they may feel more empowered to manage their finances [38]. In many Muslim communities, cooperation and mutual assistance are highly valued. This can take many different forms, like interest-free loans (qard al-hasan), and giving to the poor. These kinds of support systems can improve overall financial well-being and strengthen financial resilience. This study, therefore, proposes the following hypothesis:

H3: There is a significant relationship between financial self-efficacy and the financial well-being of Muslim working adults in Malaysia

F. The Framework of Financial Well-being

The literature review forms the basis for developing a conceptual framework in this study, aligned with the theory of Social Capital. A framework was developed specifically to study the relationship between financial well-being and social trust, social networks, and self-efficacy. Figure 1 illustrates the framework of the hypothesized relationships investigated in this study.

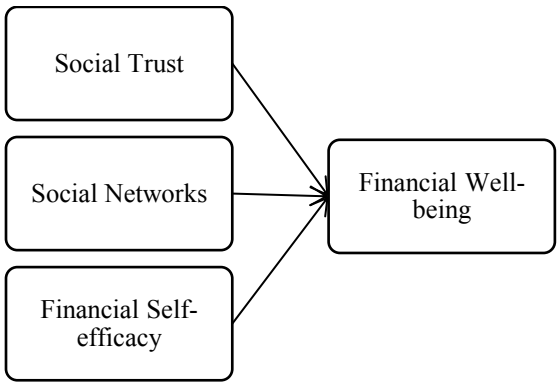


Figure 1 The Financial Well-being Framework

III. RESEARCH METHODOLOGY

A. Quantitative Analysis

A quantitative research approach was used to collect demographic data and validate qualitative findings on Malaysian Muslim working adults. Statista (2023) reported 15.39 million Malaysian employment. This population was chosen because of their importance in the Malaysian workforce. Participants were Muslim and employed. The research was cross-sectional, and questionnaire based. Using purposive sampling, Malaysian working individuals received the online self-administered questionnaire. The online survey link and study objectives were provided face-to-face and over WhatsApp. Participants had to be Malaysian, employed, and willing. Demographic characteristics (gender, age, employment, and years of working) and assessments of social trust, social networks, financial self-efficacy, and financial well-being were collected in the questionnaire. Based on 3 latent variables, a significance level of 0.05, a power level of 0.95, and an effect size of 0.15, GPower determined the minimal sample size as 119

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

respondents [39]. The study obtained 153 samples.

Screening was done following this to include people who met the criteria. Further, validity and reliability tests ensured data robustness, followed by descriptive analysis to summarise data. To assess model fitness and path coefficient significance between variables, PLS-SEM was used. The Malaysian Muslim working adult financial well-being framework was examined by these approaches.

1) Measures

Social trust: The five-item social trust scale was adapted from [40] and [41] to assess respondents' trust towards others.

Social networks: To measure participants' social connections, the five-item scale from [40]) and [42] was adapted.

Financial self-efficacy: The five-item scale to measure participants' assurance in their financial capacity was adopted from [43] and [44]

Financial well-being: To measure respondents' financial stability and security, the five-item scale by [45] was adapted.

All responses were scored on a five-point Likert scale ranging from 1=strongly disagree to 5=strongly agree

2) Data Analysis

This study used SmartPLS 4.0 for variance-based PLS-SEM. As [46] advised, the measurement model was analysed first, followed by the structural model. A Cronbach's alpha cut-off of more than 0.7 assessed the measurement model's internal consistency. Composite reliability (CR) was used to assess construct dependability, with a +0.7 threshold. Convergent validity requires CR of 0.7 or greater, AVE of 0.5, and AVE smaller than CR [47]. As per the Fornell–Larcker criterion, the square root of the AVE for each construct should be larger than its association with other constructs to determine discriminant validity. To evaluate discriminant validity, the Heterotrait-Monotrait ratio of correlations (HTMT) matrix was utilised, with all values over 0.85 [48]. With 5,000 bootstraps, the structural model and hypotheses were tested.

IV. RESULT AND DISCUSSION

A. Respondents' Profile

The current research conducted a comprehensive assessment of various demographics and attributes within the surveyed population. The sample comprised 65 males and 88 females, with 36.6% of total respondents falling in the age group of 25-34 years. Moreover, 93% of the total respondents were government servants, 42% had been working for 11-15 years, and 51% came from the Southern region. These detailed demographic insights, presented in Table 1, highlight the extensive scope and diversity within the surveyed population, enriching the understanding of the research.

Table 1 Demographic Profile of Respondents

Characteristics		Frequency (*n*)	Percentage (%)
Employment	Entrepreneurs	40	26.1
	Government servant	93	60.8
	Private sector	20	13.1
Age	18-24 years old	21	13.7
	25-34 years old	56	36.6
	35-44 years old	55	35.9
	45-54 years old	15	9.8
	55-60 years old	5	3.3
	61 years old and above	1	0.7
Gender	Male	65	42.5
	Female	88	57.5
Number of workers	1-2	23	15
	3-4	23	15
	More than 4 workers	107	69.9
Duration of working/ operation year	Less than a year	15	9.8
	1-5 years	37	24.2
	6-10 years	13	8.5
	11-15 years	42	27.5
	16-20 years	8	5.2
	More than 20 years	38	24.8

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Sector	Wholesale and retail trade	5	3.3
	Food and beverages	38	24.8
	Accommodation	8	5.2
	Information and communication	6	3.9
	Transportation and storage	3	2.0
	Health	7	4.6
	Education and art	10	6.5
	Entertainment and recreation	3	2.0
	Professional	14	9.2
	Real estate	1	0.7
	Others	58	37.9
Location	Northern region	47	30.7
	East coast region	4	2.6
	Central region	50	32.7
	Southern region	51	33.3
	East Malaysia	1	0.7

B. Descriptive Analysis

Using the statistical software IBM for SPSS 26, the mean and standard deviation for the items in the questionnaire were calculated and presented in Table 2. Mean and standard deviation are statistical measures describing the distribution or characteristics of a dataset. The mean represents the average value, while standard deviation measures the amount of variation or dispersion.

Table 2 Results of Descriptive Analysis

Constructs	Items	Mean	Standard Deviation
Social Trust	I know my co-workers will try and help me out if I get into difficulties.	3.88	0.873
	I can always trust my co-workers to lend me a hand if I need it.	3.97	0.760
	I can always rely on my co-workers to make my job easier.	3.69	0.927
	I believe most people in the society are honest.	3.51	0.889
	I believe most people will respond kindly when they are trusted by others	3.92	0.716
Social Networks	In general, I have a very good relationship with my co-workers	4.15	0.741
	In general, I am very close to my co-workers	3.98	0.815
	I am able to hold a discussion with my co-workers	3.99	0.835
	I am able to seek advice from others on mundane problems.	4.10	0.709
	I am able to seek advice from others on job related issues	4.10	0.686
Financial Self-efficacy	I am fully capable of making personal financial decision	3.67	0.811
	I am confident in my ability to make personal financial decision	3.73	0.778
	I am able to utilize the available financial information	3.75	0.799
	My past experiences increase my confidence in making sound financial decisions	3.87	0.758

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

	I stick to my spending plan even when unexpected expense arises	3.82	0.753
Financial Well-being	I could handle a major unexpected expense.	3.54	0.725
	I am securing my financial future	3.75	0.737
	I have control of my financial situation	3.71	0.760
	I have money left at the end of every month	3.68	0.694
	I am financially stable and secure	3.75	0.730

Social trust elements provided fascinating insights. *"I can always trust my co-workers to lend me a hand if I need it"* had the highest mean score of 3.97, showing that respondents trust and expect support from coworkers. *"I believe most people in society are honest"* had the lowest mean score of 3.51, indicating that respondents in this dataset had less faith in society. In the social networks construct, *"In general, I have a very good relationship with my co-workers"* had a mean score of 4.15, showing significant positive workplace relationship perceptions. However, *"I am very close to my co-workers"* had a slightly lower mean score of 3.98, indicating a less intense sense of connection.

In financial self-efficacy, *"I stick to my spending plan even when unexpected expenses arise"* received a mean score of 3.87, showing high financial plan adherence. However, *"I am fully capable of making personal financial decisions"* had a slightly lower mean score of 3.67, indicating less consensus among respondents about absolute financial decision-making abilities. Financial well-being perceptions varied across respondents. The mean scores for "I have control of my financial situation" and *"I am financially stable and secure"* were 3.75, showing a good perspective. However, *"I could handle a major unexpected expense"* had a lower mean score of 3.54, indicating that respondents were less confidence in their capacity to handle such charges.

C. Measurement Model Assessment

Table 3 Results of Measurement Model

Latent Variable	Indicators	Loadings	Composite Reliability	AVE	Cronbach's Alpha
Social Trust	ST1	0.751	0.895	0.662	0.873
	ST2	0.904			
	ST3	0.800			
	ST4	0.778			
	ST5	0.828			
Social Networks	SN1	0.861	0.931	0.774	0.927
	SN2	0.891			
	SN3	0.868			
	SN4	0.885			
	SN5	0.893			
Financial Self-efficacy	SE1	0.907	0.939	0.790	0.932
	SE2	0.928			
	SE3	0.923			
	SE4	0.906			
	SE5	0.770			
Financial Well-being	WB1	0.824	0.925	0.760	0.921
	WB2	0.877			
	WB3	0.918			
	WB4	0.835			
	WB5	0.902			

The strength of the indicator-latent variable link is represented by loadings. Greater loadings suggest a stronger link. Composite reliability measures internal consistency dependability, while Average Variance Extracted (AVE) measures convergent validity by measuring the latent variable's variance from its indicators. Another internal consistency reliability measure is Cronbach's Alpha. Social trust

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

has substantial loadings from 0.751 to 0.904, demonstrating a connection between the latent variable and its indicators. AVE of 0.662 and Cronbach's Alpha of 0.873 indicate strong indicator reliability, while composite reliability of 0.895 indicates that the indicators correctly assess the latent construct.

Social networks have loadings from 0.861 to 0.893, demonstrating a strong association between the variable and its indicators. AVE of 0.774 and Cronbach's Alpha of 0.927 confirm these indicators' reliability, while composite reliability of 0.931 indicates great internal consistency. Financial self-efficacy indicators had substantial loadings from 0.770 to 0.928, indicating a strong connection with the hidden variable. Composite Reliability of 0.939 indicates great internal consistency reliability. Good reliability is shown by the AVE of 0.790 and Cronbach's Alpha of 0.932. Financial well-being indicators had substantial loadings from 0.824 to 0.918, indicating a strong link with the latent variable. The high Composite Reliability score of 0.925 suggests strong internal consistency reliability, while AVE of 0.760 and Cronbach's Alpha of 0.921 imply solid indication reliability. These results show that the selected indicators are substantially correlated with their latent variables, which are credible assessments of their underlying components.

1) Discriminant Validity

The Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio of Correlations were used to measure discriminant validity. The results are portrayed in Table 4 and Table 5, respectively.

Table 4 Fornell-Larcker Criterion

	Financial self-efficacy	**Financial well-being**	**Social networks**	**Social trust**
Financial self-efficacy	**0.889**			
Financial well-being	0.497	**0.872**		
Social networks	0.569	0.465	**0.880**	
Social trust	0.294	0.384	0.489	**0.814**

The diagonal elements represent the square root of the AVE for each latent variable, while the off-diagonal elements represent the correlations between latent variables. The square root of the AVE for each latent variable is shown to be greater than the correlation between that latent variable and other latent variables. Therefore, the Fornell-Larcker Criterion is satisfied, indicating adequate discriminant validity between most of the constructs.

Table 5 Heterotrait-Monotrait Ratio of Correlations

	Financial self-efficacy	**Financial well-being**	**Social networks**	**Social trust**
Financial self-efficacy				
Financial well-being	0.533			
Social network	0.609	0.500		
Social trust	0.314	0.410	0.538	

The Heterotrait-Monotrait Ratio (HTMT) is another method used in Structural Equation Modelling (SEM) to evaluate discriminant validity. All the calculated HTMT ratios are below the commonly used threshold of 0.85. This suggests that the correlations between different constructs are significantly smaller than the correlations within constructs, indicating adequate discriminant validity between the latent variables in the model. Hence, based on the HTMT analysis, the results support the idea that each construct (financial self-efficacy, financial well-being, social networks, and social trust) is distinct from the others, reinforcing the discriminant validity of the measurement model.

2) Collinearity Statistics

Collinearity statistics were carried out, and the results are shown in Table 6 below. These Variance Inflation Factor (VIF) values, all below 5, indicate that multicollinearity among the predictors (financial self-efficacy, social networks, social trust) regarding their influence on financial well-being is

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

relatively low. Low VIF values are favourable as they suggest that the predictors provide unique information and are not redundant due to high intercorrelations. Hence, the interpretation of the relationships between these predictors and their impact on financial well-being in the SEM model can be considered reliable and not unduly influenced by multicollinearity concerns.

Table 6 Collinearity Statistics

	VIF
Financial self-efficacy → Financial well-being	1.479
Social networks → Financial well-being	1.775
Social trust → Financial well-being	1.314

D. Structural Model Assessment

1) Coefficient of Determination (R2)

Table 7 Coefficient of Determination (R2)

Construct	R-square
Financial Well-being	0.326

The R^2 value measures the proportion of variance in the endogenous latent variable (financial well-being) explained by its exogenous latent variables (financial self-efficacy, social networks, social trust). The provided R-squared value for financial well-being is 0.326, which means that the exogenous variables collectively explain 32.6% of the variance in financial well-being.

2) Effect Size (F2)

Table 8 Effect Size

	F-square
Financial self-efficacy → Financial well-being	0.115
Social network → Financial well-being	0.026
Social trust → Financial well-being	0.045

The Effect Size (F-square) further explores the proportion of variance explained by individual predictors (exogenous variables) in the model. Even though financial self-efficacy appears to have a larger individual impact compared to the other predictors, the combined effect of all predictors is significant in explaining the variance in financial well-being, as indicated by the r-squared value of 0.326. This collective impact suggests that these variables jointly contribute to understanding financial well-being, with financial self-efficacy being relatively more influential among them.

3) Path Coefficient

Table 9 Path Coefficient

	Path Coefficient	p-value
Financial self-efficacy → Financial well-being	0.339	0.000
Social network → Financial well-being	0.176	0.076
Social trust → Financial well-being	0.199	0.016

Financial self-efficacy has a significant relationship with a path coefficient of 0.339 and a p-value of 0.000. For every unit of financial self-efficacy, financial well-being rises by 0.339 units. Given its statistical significance, this relationship is accepted. However, social networks had a insignificant relationship with a path coefficient of 0.176 and p-value of 0.076. A p-value above 0.05 indicates that this association is not significant. Thus, social networks do not directly improve financial well-being. With a path coefficient of 0.199 and p-value of 0.016, social trust is positively correlated. Social trust increases financial well-being by 0.199 units per unit. This correlation is statistically significant. Financial self-efficacy and social trust directly affect financial well-being, but social networks do not in this model.

4) Predictive Power (Q^2)

Another means to assess the model's predictive accuracy is the Q^2 value [49]. The smaller the difference between the predicted and original values, the greater the Q2 criterion, and therefore, the predictive accuracy and relevance. If the value of Q^2 is below zero, it means that the model is poor where all independent variables cannot explain the dependent variable, and there is no predictive relevance. Q^2 value should be above than 0 and values above than 0.02, 0.15, and 0.35 indicates

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

small, medium, and large predictive relevance respectively [50]. The findings revealed Q^2 value of 0.275 which is medium predictive relevance for the financial well-being model.

V. CONCLUSION

The objective of this study is to investigate the determinants of financial well-being among Muslim working adults in Malaysia. According to quantitative data, social trust and financial self-efficacy significantly affected financial well-being, although social networks did not. [51] and [23] found that social trust improves financial well-being. This study found a positive association between subjective well-being, social trust, trust in people, self-compassion, and social empathy. The relationship between social networks and financial well-being was insignificant. Unlike [52], who found that informal and formal social networks help households recover financially from financial or physical calamities by buffering them. These findings show that social networks affect financial well-being differently, highlighting the need to better understand these interactions.

Financial well-being is notably linked to financial self-efficacy, supporting the results of [44] and [53]. [44] observed that individuals with elevated financial self-efficacy tend to engage in responsible financial behavior, ultimately predicting a positive financial well-being outcome. Additionally, [53] study not only reaffirms this positive correlation but also reveals an interconnected relationship between financial literacy, financial self-efficacy, and financial well-being.

This study adds to the literature by providing a complete framework for understanding social trust, social networks, financial self-efficacy, and financial well-being. The study expands the literature on Malaysian Muslim working adults' financial well-being and its causes. Refining the financial well-being paradigm and understanding how trust, networks, and financial capacities affect financial decisions and well-being advances the literature. This study has practical consequences for working adults, politicians, and financial practitioners beyond its theoretical contributions. Social trust is important for financial and general well-being, especially for Muslim working people. Government initiatives to boost social trust may improve Muslim working adults' well-being. The positive relationship between financial self-efficacy and financial well-being emphasises the need to build confidence in managing finances, urging educators and practitioners should focus on improving Muslim working adults' financial self-efficacy.

By managing their finances well, Muslims can become more self-sufficient and grow. Having enough money allows Muslims to support fair trade, ethical investing, and socioeconomic equality programmes in and outside their communities. Finally, Muslims can improve by pursuing financial stability and following Islamic financial rules.

Despite its benefits, this study has several drawbacks. Findings may be limited by focusing on Muslim working adults in Malaysia. The current research also explores social trust, social networks, and financial self-efficacy for financial well-being. Adding varied demographic groups to the research region may help future researchers overcome this issue. Future studies may include other races and other financial well-being aspects including financial innovation and psychology. Researchers can better comprehend financial well-being by overcoming these limitations.

ACKNOWLEDGMENT

This work was supported by Universiti Teknologi MARA, grant number 600-RMC/GSS 5/3 (072/2022).

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

REFERENCES

[1] M. F. Sabri, M. Anthony, S. H. Law, H. A. Rahim, N. A. S. Burhan and M. Ithnin, "Impact of financial behaviour on financial well-being: evidence among young adults in Malaysia," *Journal of Financial Services Marketing,* pp. 1-20, 2023.

[2] E. C. Brüggen, J. Hogreve, M. Holmlund, S. Kabadayi and M. Löfgren, "Financial well-being: A conceptualization and research agenda," *Journal of Business Research,* vol. 79, pp. 228-237, 2017.

[3] L. Riitsalu, R. Sulg, H. Lindal, M. Remmik and K. Vain, "From Security to Freedom— The Meaning of Financial Well-being Changes with Age," *Journal of Family and Economic Issues,* 2023.

[4] Demirguc-Kunt, L. Klapper and D. Randall, "Islamic Finance and Financial Inclusion: Measuring Use of and Demand for Formal Financial Services among Muslim Adults," *Review of Middle East Economics and Finance,* vol. 10, no. 2, 2014.

[5] Malaysian Department of Insolvency, "Statistik Kebankrapan," 2025. [Online]. Available: https://www.mdi.gov.my/statistik/.

[6] R. D. Putnam, "The Prosperous Community: Social Capital and Public Life," *The American Prospect,* vol. 4, no. 13, pp. 1-11, 1993.

[7] R. Machalek and M. W. Martin, Handbook on Evolution and Society, Routledge, 2015.

[8] A. Thomas and V. Gupta, "Social Capital Theory, Social Exchange Theory, Social Cognitive Theory, Financial Literacy, and the Role of Knowledge Sharing as a Moderator in Enhancing Financial Well-Being: From Bibliometric Analysis to a Conceptual Framework Model," *Frontiers in Psychology,* vol. 12, pp. 1-33, 2021.

[9] R. Machalek and M. W. Martin, "Sociobiology and Sociology: A New Synthesis," in *International Encyclopedia of the Social & Behavioral Sciences (Second Edition),*, J. D. Wright, Ed., Florida, Elsevier, 2015, pp. 892-898.

[10] R. D. Putnam, "Social Capital and Public Affairs," *Bulletin of the American Academy of Arts and Sciences,* vol. 47, no. 8, pp. 5-19, 1994.

[11] Consumer Financial Protection Bureau, "Financial well-being: The goal of financial education," Consumer Financial Protection Bureau, 2015.

[12] Z. M. Yusoff, E. R. Adawiah and H. Zakariyah, "Islamic Financial Planning: Towards Sustaining the Financial Wellbeing of Muslim Families in Malaysia Post Covid-19," *Turkish Journal of Islamic Economics,* vol. 8, pp. 355-376, 2021.

[13] M. F. Sabri, H. A. Rahim and A. S. Magli, "Review of The Factor Influencing and Measurements of Financial Well-Being," *International Journal of Academic Research in Business and Social Sciences,* vol. 11, no. 9, 2021.

[14] F. L. Carton, H. Xiong and J. Mccarthy, "Drivers of financial well-being in socio-economic deprived populations," *Journal of Behavioral and Experimental Finance,* vol. 34, 2022.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[15] C. Bai, Y. Gong and C. Feng, "Social Trust, Pattern of Difference, and Subjective Well-Being," *Sage Journal,* vol. 9, no. 3, 2019.

[16] D. Lederman, N. Loayza and A. M. Menéndez, "Violent crime: Does social capital matter?," *Economic Development and Cultural Change,* vol. 50, no. 3, pp. 509-539, 2002.

[17] Z. Ding, K. Au and F. Chiang, "Social trust and angel investors' decisions: a multilevel analysis across nations," *Journal of Business Venturing,* pp. 307-321, 2015.

[18] W. G. Qu, A. Pinsonneault, D. Tomiuk, S. Wang and Y. Liu, "The impacts of social trust on open and closed B2B e-commerce: A Europe-based study," *Information & Management,* vol. 52, pp. 151-159, 2015.

[19] V. Jovanović, F. Sarracino, M. Lazić and V. Gavrilov-Jerković, "Well-Being and the Pandemic: Trust in People Matters More Than Trust in Institutions," *Psychological Reports,* vol. 126, no. 2, pp. 674-687, 2021.

[20] L. Guiso, P. Sapienza and L. Zingales, "The Role Of Social Capital In Financial Development," *SSRN Journal,* 2000.

[21] W. Yin, B. Kirkulak-Uludag and K. Matthews, "Financialization, religion, and social trust in rural China," *PLoS ONE,* 2020.

[22] J. E. Fisch and J. S. Seligman, "Trust, financial literacy, and financial market participation," *Journal of Pension Economics and Finance,* vol. 21, no. 4, pp. 634-664, 2021.

[23] K. Barrafrem, G. Tinghög and D. Västfjäll, "Trust in the government increases financial well-being and general well-being during COVID-19," *Journal of Behavioral and Experimental Finance,* 2021.

[24] J. F. Helliwell and R. D. Putnam, "The social context of well-being," in *The Science of Well-Being*, Oxford, Oxford Academic, 2005, pp. 434-459.

[25] N. Jaffar, S. M. Faizal, Z. Selamat and N. Alias, "Muslim young adults' financial strain and financial stress during the COVID-19 pandemic: The moderating role of religiosity," *Heliyon,* vol. 9, no. 10, October 2023.

[26] A. B. A. Razak and M. Asutay, "Financial Inclusion and Economic Well-Being: Evidence from Islamic Pawnbroking (Ar-Rahn) in Malaysia," *Research in International Business and Finance,* pp. 1-27, 2021.

[27] J. Yeo and Y. G. Lee, "Understanding the Association Between Perceived Financial Well-Being and Life Satisfaction Among Older Adults: Does Social Capital Play a Role?," *Journal of Family and Economic Issues,* vol. 40, no. 4, pp. 592-608, 2019.

[28] J. S. Coleman, "Social Capital in the Creation of Human Capital," *The American Journal of Sociology,* vol. 94, pp. S95-S120, 1988.

[29] Y. Benkler, "The Wealth of Networks: How Social Production Transforms Markets and Freedom," *The Yale Law Journal,* vol. 116, no. 7, p. 1472, 2007.

[30] L. M. Boucher, E. S. Shoemaker, C. E. Liddy, L. Leonard, P. A. MacPherson, J. Presseau, A. Martin, D. Pineau, C. Lalonde, N. Diliso, T. Lafleche, M. Fitzgerald and C. E. Kendall, "“They’re all struggling as well”: social and economic barriers and facilitators to self-," *International Journal of Qualitative*

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Studies on Health and Well-being, vol. 17, 2022.

[31] S. H. Hassan, T. S. Zhen, I. Mahmud and A. Omar, "Muslim youths' e-lifestyle and its impacts on well-being," *International Journal of Islamic Marketing and Branding,* vol. 5, no. 1, pp. 58-75, 2020.

[32] N. S. Mahdzan, R. Zainudin, M. E. A. Sukor, F. Zainir and W. M. W. Ahmad, "An exploratory study of financial well-being among Malaysian households," *Journal of Asian Business and Economic Studies,* vol. 27, no. 3, 2020.

[33] N. Noor, I. Batool and H. M. Arshad, "Financial literacy, financial self-efficacy and financial account ownership behavior in Pakistan," *Cogent Economics & Finance,* pp. 1-17, 2020.

[34] M. F. Sabri, R. Wijekoon and H. A. Rahim, "The influence of money attitude, financial practices, self-efficacy and emotion coping on employees' financial well-being," *Management Science Letters,* vol. 10, pp. 889-900, 2020.

[35] A. B. LeBaron-Black, M. A. Curran, E. J. Hill, R. Toomey, K. Speirs and M. Freeh, "Talk is cheap: Parent financial socialization and emerging adult financial well-being," *Family Relations,* pp. 1201-1219. , 2022.

[36] L. Farrell, T. R. L. Fry and L. Risse, "The significance of financial self-efficacy in explaining women's personal finance behaviour," *Journal of Economic Psychology,* vol. 54, pp. 58-99, 2016.

[37] K. F. Chong, M. F. Sabri, A. S. Magli, H. A. Rahim, N. Mokhtar and M. A. Othman, "The Effects of Financial Literacy, Self-Efficacy and Self-Coping on Financial Behavior of Emerging Adults," *Journal of Asian Finance, Economics and Business,* vol. 8, no. 3, p. 0905–0915, 2021.

[38] M. S. Ghazali, S. F. S. Alwi, N. N. A. Aziz and S. F. Hazudin, "Pathway to Financial Well-being:A review on the role of psychological factors," in *8th AMER International Conference on Quality of Life*, Melaka, Malaysia, 2020.

[39] J. Cohen, Statistical Power Analysis for the Behavioral Sciences, New York: Routledge, 1988.

[40] W. S. Chow and L. S. Chan, "Social network, social trust and shared goals in organizational knowledge sharing," *Information & Management,* vol. 45, p. 458–465, 2008.

[41] T. Yamagishi and M. Yamagishi, "Trust and Commitment in the United States," *Motivation and Emotion,* vol. 18, no. 2, pp. 129-166, 1994.

[42] K. Gayen, R. Raeside and R. McQuaid, "Social networks, accessed and mobilised social capital and the employment status of older workers A case study," *International Journal of Sociology and Social Policy,* vol. 39, no. 5/6, pp. 356-375, 2019.

[43] S. E. Dare, W. W. v. Dijk, E. v. Dijk, L. F. v. Dillen, M. Gallucci and O. Simonse, "How Executive Functioning and Financial Self-efficacy Predict Subjective Financial Well-Being via Positive Financial Behaviors," *Journal of Family and Economic Issues,* vol. 44, pp. 232-248, 2023.

[44] M. Oquaye, G. M. Y. Owusu and G. A. Bokpin, "The antecedents and consequence of financial well-being: a survey of parliamentarians in Ghana," *Review of Behavioral Finance,* vol. 14, pp. 68-90, 2022.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[45] M. Nițoi, D. Clichici, C. Zeldea, M. Pochea and C. Ciocîrlan, "Financial well-being and financial literacy in Romania: A survey dataset," *Data in Brief,* vol. 43, 2022.

[46] J. Henseler, C. M. Ringle and R. R. Sinkovics, "The use of partial least squares path modeling in international marketing," in *New Challenges to International Marketing (Advances in International Marketing, Vol. 20)*, R. R. Sinkovics and P. N. Ghauri, Eds., Leeds, Emerald Group Publishing Limited, 2009, pp. 277-319.

[47] C. Fornell and D. F. Larcker, "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research,* vol. 18, no. 1, pp. 39-50, 1981.

[48] J. Henseler, C. M. Ringle and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *Journal of the Academy of Marketing Science,* vol. 43, pp. 115-135, 2014.

[49] S. Geisser, "A predictive approach to the random effect model," *Biometrika,* vol. 61, no. 1, pp. 101-107, 1974.

[50] W. W. Chin, "How to Write Up and Report PLS Analyses," in *Handbook of Partial Least Squares*, Berlin, Springer, 2009, p. 655–690.

[51] Q. Wang, K. Zhi, B. Yu and J. Cheng, "Social trust and subjective well-being of first-generation college students in China: the multiple mediation effects of self-compassion and social empathy," *Frontiers Psychology,* vol. 14, 2023.

[52] L. Palmer and V. Bhargava, "Forms of Wealth Associated with Attaining Peer Group Net Worth Following Bankruptcy," *Social Science Quarterly,* vol. 99, no. 1, pp. 97-117, 2018.

[53] U. M. Lone and S. A. Bhat, "Impact of financial literacy on financial well-being: a mediational role of financial self-efficacy," *Journal of Financial Services Marketing,* vol. 29, pp. 122-137, 2022.

AUTHOR'S INFORMATION

First Author: Name 	Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia E-mail: aliahidzir@gmail.com
Second Author: Name	Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia E-mail: shafinar@uitm.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

	
Third Author: Name 	Faculty of Business and Management, 110 Off Jalan Hang Tuah, Universiti Teknologi MARA (UiTM) Kampus Bandaraya 75350 Melaka, Malaysia E-mail: aqilahnadiah@uitm.edu.my
Third Author: Name 	Faculty of Economics and Business Education, Univesitas Pendidikan Indonesia, Indonesia E-mail: julian@upi.edu
Third Author: Name 	Faculty of Economics and Business Education, Univesitas Airlangga Indonesia, Indonesia E-mail: ririnsari@feb.unair.ac.id

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Pemerkasaan Pendidikan TVET di Malaysia Melalui Pendekatan Pembelajaran Berasaskan Industri: Cabaran dan Strategi Pelaksanaan

Ruzaihan Jaffar[1], Muhammad Murshid Ramlan[2], Norsaadah Sapon[3]

[1,2] *Department of Information Technology & Communication, Polytechnic of Mersing, Johor, Malaysia*
E-mail: ruzaihan@tvet.pmj.edu.my , E-mail: murshid@tvet.pmj.edu.my

[3] *Department of Electrical Engineering, Polytechnic of Mersing, Johor, Malaysia*
E-mail: norsaadah@tvet.pmj.edu.my

Abstrak

Kertas konsep ini membincangkan pemerkasaan Pendidikan dan Latihan Teknikal dan Vokasional (TVET) di Malaysia melalui pendekatan pembelajaran berasaskan industri (*Industry-Based Learning*, IBL). Walaupun pelbagai usaha telah dilaksanakan untuk memperkukuh sistem TVET, cabaran seperti ketidaksesuaian kurikulum dengan kehendak industri, hubungan yang lemah antara institusi pendidikan dan industri, serta persepsi negatif masyarakat terhadap laluan TVET masih berterusan. Kajian ini bertujuan menghuraikan kepentingan pendekatan IBL, mengenal pasti cabaran pelaksanaannya, serta mencadangkan strategi pelaksanaan yang lebih holistik dan berkesan. Dapatan menunjukkan bahawa penjajaran kurikulum bersama industri, pelaksanaan program latihan dual dan *Work-Based Learning* (WBL), penggunaan teknologi digital dalam latihan, serta penjenamaan semula TVET adalah antara strategi utama yang boleh mengukuhkan sinergi pendidikan-industri. Implikasi jangka panjangnya termasuk peningkatan kebolehpasaran graduan, pengurangan pengangguran belia, serta penjanaan tenaga kerja mahir tempatan yang lebih kompetitif. Kajian ini mencadangkan pendekatan sistematik dan mampan untuk menjadikan TVET sebagai teras utama dalam pembangunan negara berasaskan kemahiran.

Katakunci : *TVET; IBL; WBL*

Abstract

This concept paper explores the strengthening of Technical and Vocational Education and Training (TVET) in Malaysia through the implementation of Industry-Based Learning (IBL). Despite various initiatives, challenges such as misalignment between institutional curricula and industry needs, limited practical training opportunities, and societal stigma toward TVET remain unresolved. The study aims to highlight the importance of the IBL approach, identify the key challenges in its implementation, and propose realistic, actionable strategies to enhance collaboration between education providers and industry stakeholders. The findings indicate that curriculum co-development, expansion of work-based learning (WBL) programs, integration of digital technologies in training, and large-scale rebranding of TVET are crucial to bridging the gap between education and employment. Long-term implications include improved graduate employability, reduced youth unemployment, and the development of a competitive, skilled local workforce. This study provides a systematic framework for positioning TVET as a key driver of Malaysia's skills-based national development.

Keywords **:** *TVET; IBL; WBL*

I. PENDAHULUAN

Pendidikan dan Latihan Teknikal dan Vokasional (TVET) memainkan peranan penting dalam pembangunan modal insan yang berkemahiran tinggi untuk memenuhi keperluan industri di Malaysia. Selaras dengan aspirasi negara menuju status negara maju dan berpendapatan tinggi, pemerkasaan TVET melalui pendekatan yang lebih berorientasikan industri menjadi satu keperluan mendesak.

TVET Kementerian Pengajian Tinggi di Malaysia terdiri daripada 4 universiti dalam

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

Rangkaian Universiti Teknikal Malaysia (MTUN), 36 Politeknik dan 104 Kolej Komuniti[1]. Pendekatan Pembelajaran Berasaskan Industri (Industry-Based Learning) telah dikenalpasti sebagai strategi efektif dalam menjamin kebolehpasaran graduan serta meningkatkan kualiti latihan kemahiran.

Dalam konteks IBL, perkongsian dan pemindahan ilmu adalah secara sukarela dan memerlukan kerjasama antara pihak institusi dan yang paling utama adalah dari pihak industri. Perkongsian dan pemindahan pengetahuan berlaku secara serentak dengan kerjasama pihak-pihak yang terlibat iaitu kepada pelajar, pensyarah, dan pihak majikan industri[2]. Perkongsian pengetahuan juga boleh meningkatkan pengetahuan dan kemahiran praktikal, sekali gus merapatkan jurang antara teori dan amalan IBL adalah satu pengalaman pembelajaran berstruktur di mana pelajar melakukan tugasan kerja sebenar dalam persekitaran industri, membolehkan mereka mengintegrasikan pengetahuan akademik dengan amalan profesional di bawah pemantauan[3].

Selain itu, IBL juga merujuk kepada pendekatan pendidikan yang mengintegrasikan pengalaman pembelajaran formal di institusi dengan pengalaman praktikal di tempat kerja sebenar. Dalam konteks ini, pelajar bukan sahaja mempelajari teori dalam bilik darjah, tetapi juga berpeluang untuk menerapkan pengetahuan tersebut dalam persekitaran industri yang sebenar, melalui projek, latihan amali, atau penempatan industri.

Pendekatan Pembelajaran Berasaskan Industri (IBL) diperkenalkan sebagai satu usaha untuk merapatkan jurang antara dunia pendidikan dan dunia pekerjaan. Pendekatan ini menekankan kepada pembelajaran autentik yang berlaku secara langsung dalam persekitaran industri sebenar. Namun, pelaksanaannya di Malaysia masih belum menyeluruh dan memerlukan kajian terperinci untuk mengenal pasti kekangan serta strategi pelaksanaannya secara berkesan.

A. Objektif Kajian

Kertas konsep ini bertujuan untuk:

1. Meneliti kepentingan pendekatan pembelajaran berasaskan industri dalam konteks pendidikan TVET.
2. Mengenal pasti cabaran utama dalam pelaksanaan pendekatan ini di institusi TVET Malaysia.
3. Mencadangkan strategi pelaksanaan yang praktikal dan berkesan bagi memperkukuh hubungan industri dan institusi.

II. KAJIAN LITERATUR

IBL telah dilaksanakan secara meluas di negara-negara maju seperti Jerman dan Australia di mana hubungan erat antara industri dan institusi pendidikan telah menunjukkan peningkatan terhadap kebolehpasaran graduan. Kajian-kajian terdahulu menunjukkan bahawa IBL mampu meningkatkan keberkesanan pengajaran dan pembelajaran dalam bidang Pendidikan dan Latihan Teknikal dan Vokasional (TVET). Pelaksanaan pembelajaran berasaskan industri dapat meningkatkan keyakinan pelajar dan membolehkan mereka memperoleh kemahiran yang relevan[4]. TVET berperanan sebagai platform untuk melahirkan individu yang bukan sahaja berpengetahuan teknikal tetapi juga mempunyai kemahiran praktikal yang sejajar dengan keperluan industri[5]. IBL pula berfungsi sebagai jambatan antara teori dan amalan, sekali gus meningkatkan kebolehpasaran graduan[4], [6]

Walaupun pelbagai inisiatif telah dilaksanakan, terdapat beberapa isu yang membataskan keberkesanan TVET di Malaysia. Antaranya ialah hubungan yang lemah antara institusi TVET dan pihak industri yang menyebabkan kesukaran dalam menyelaraskan keperluan semasa industri dengan kurikulum yang ditawarkan. Pelaksanaan IBL di Malaysia masih berdepan pelbagai cabaran termasuk dari aspek dasar, kerjasama industri, serta pemantauan dan penilaian yang berstruktur[7]. Penglibatan sektor industri dalam pembangunan kurikulum membolehkan institusi TVET menawarkan latihan yang lebih relevan dan terkini [8]. Ini sekaligus memberi impak positif kepada kebolehpasaran graduan. Kekurangan peluang latihan praktikal yang relevan juga membataskan pelajar daripada memperoleh pengalaman kerja sebenar, sekali gus menjejaskan tahap kebolehpasaran mereka [9].

Selain itu, terdapat persepsi negatif dalam kalangan masyarakat yang menganggap pendidikan TVET sebagai laluan kedua berbanding laluan akademik arus perdana, menyebabkan kurangnya penyertaan pelajar [10]. Tambahan pula, wujud jurang yang ketara antara kehendak industri dengan kandungan kurikulum semasa institusi TVET, yang memerlukan pendekatan pembelajaran yang lebih bersifat kolaboratif dan berasaskan industri. Kepentingan model kerjasama tiga hala yang tersusun sebagai kunci kejayaan dalam pendekatan IBL [7].

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Kajian juga menunjukkan bahawa pelajar yang mengikuti WBL menunjukkan prestasi yang lebih baik semasa penempatan kerja kerana mereka telah terdedah kepada suasana kerja sebenar. Latihan yang dilaksanakan di persekitaran industri dapat meningkatkan keyakinan kendiri, kemahiran komunikasi, dan penguasaan teknikal dalam kalangan pelajar. Penglibatan langsung dengan mentor industri turut mendedahkan pelajar kepada budaya kerja dan jangkaan sebenar majikan [11][12]. Dalam konteks Malaysia, kajian menunjukkan masih wujud ketidaksepadanan antara kehendak industri dan latihan yang diberikan oleh institusi TVET. Justeru, mereka mengesyorkan dasar bersepadu dan pelaksanaan program berasaskan industri secara menyeluruh bagi memastikan hasil latihan yang kompeten dan sejajar dengan keperluan pasaran kerja [13].

Dalam konteks global, pendekatan berasaskan industri telah lama diamalkan secara sistematik di negara-negara seperti Jerman dan Australia melalui sistem pendidikan dual dan latihan vokasional nasional yang menyeluruh[14].

Pelbagai usaha telah digerakkan bagi memperkasakan TVET di Malaysia, namun masih terdapat halangan yang menjejaskan keberkesanannya secara menyeluruh. Antaranya ialah:

i. Hubungan yang tidak konsisten dan kurang berstruktur antara institusi pendidikan dan industri menyebabkan kekurangan input industri dalam pembangunan kurikulum.
ii. Ketidaksepadanan antara latihan yang diterima oleh pelajar dengan keperluan sebenar pasaran kerja.
iii. Peluang latihan praktikal yang terhad serta kurangnya pendedahan kepada persekitaran kerja sebenar.
iv. Stigma masyarakat yang masih memandang rendah terhadap pendidikan vokasional sebagai laluan pendidikan "kelas kedua".
v. Ketidakseimbangan antara pembangunan infrastruktur TVET dengan keperluan teknologi semasa.

Isu-isu ini menunjukkan perlunya pendekatan yang lebih sistematik dan mampan seperti pembelajaran berasaskan industri bagi merapatkan jurang antara dunia pendidikan dan dunia pekerjaan. perlunya satu kerangka kerjasama sistematik antara industri dan institusi pendidikan. Mereka mendapati bahawa ketiadaan garis panduan yang jelas sering mengakibatkan ketidak seimbangan dalam penyampaian latihan [15].

Situasi ini menimbulkan persoalan tentang bagaimana pendekatan pembelajaran berasaskan industri dapat membantu menangani cabaran-cabaran ini dan memperkasakan sistem TVET negara.

A. Model-model Pelaksanaan IBL

Pelbagai model pelaksanaan IBL telah dibangunkan dan diamalkan di peringkat antarabangsa berdasarkan konteks ekonomi, sistem pendidikan dan keperluan tenaga kerja setempat. Antara model yang sering dirujuk ialah Model Pendidikan Dual Jerman, yang menekankan pembelajaran formal di institusi latihan teknikal serta latihan praktikal di syarikat secara serentak. Model ini melibatkan kerjasama strategik antara institusi pendidikan dan majikan, dengan pemantauan bersama oleh kerajaan [14].

Di Australia pula, pendekatan Work-Integrated Learning (WIL) dipraktikkan secara meluas dalam pendidikan vokasional dan pengajian tinggi. Model ini menggabungkan pelbagai bentuk pengalaman kerja termasuk latihan industri, pembelajaran berasaskan projek (project-based learning), dan simulasi tempat kerja. Ciri utama WIL ialah integrasi sistematik antara kurikulum akademik dan pengalaman kerja sebenar melalui kolaborasi formal dengan industri[4].

Sementara itu, UNESCO-UNEVOC mencadangkan Model Berasaskan Kompetensi (Competency-Based Model) bagi pelaksanaan IBL, yang menekankan pencapaian hasil pembelajaran berasaskan kompetensi industri sebenar[16]. Model ini digunakan secara fleksibel di beberapa negara membangun termasuk Filipina dan Indonesia, yang sedang memperkukuh sistem TVET mereka melalui penglibatan industri secara langsung dalam reka bentuk dan pelaksanaan kurikulum.

Kesemua model ini memberi panduan penting kepada Malaysia dalam membentuk struktur IBL yang lebih tersusun dan lestari, khususnya dari segi reka bentuk kurikulum, penilaian berasaskan kompetensi, dan insentif untuk pihak industri.

B. Perbandingan Amalan IBL: Malaysia dengan Negara Maju

Amalan pelaksanaan Pembelajaran Berasaskan Industri (IBL) menunjukkan perbezaan yang ketara antara Malaysia dan beberapa negara maju seperti Jerman dan Australia. Di Malaysia, pelaksanaan IBL masih berada pada tahap yang tidak seragam dengan pelbagai pendekatan modul bergantung kepada institusi dan industri yang terlibat. Ini berbeza

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

dengan negara seperti Jerman, yang mengamalkan sistem pendidikan dual yang mengintegrasikan modul latihan industri secara menyeluruh dalam kurikulum kebangsaan mereka[14].

Hubungan antara institusi TVET dan industri di Malaysia juga masih bersifat jangka pendek serta bergantung kepada Memorandum Persefahaman (MoU) yang tidak semestinya menghasilkan kerjasama berterusan. Sebaliknya, di Australia dan Jerman, hubungan ini dibentuk secara formal dan berstruktur melalui sistem kolaborasi industri yang berterusan dan dipantau oleh badan berkaitan kerajaan[4].

Dari segi pemantauan, Malaysia masih kekurangan mekanisme piawai bagi penilaian latihan industri. Sebaliknya, negara maju melaksanakan pemantauan sistematik melalui rubrik kompetensi yang dibangunkan bersama antara industri dan institusi[6]. Selain itu, Malaysia masih belum mempunyai sistem insentif yang konsisten kepada industri yang terlibat dalam IBL, manakala di negara-negara seperti Jerman, penyertaan industri disokong oleh insentif kewangan, cukai, dan pensijilan pengiktirafan kemahiran[16].

C. Teori Pembelajaran yang Menyokong IBL

Pelaksanaan Pembelajaran Berasaskan Industri (IBL) sangat berkait rapat dengan beberapa teori pembelajaran yang memberi asas kepada pendekatan ini. Antara teori utama yang relevan ialah:

i. Teori Konstruktivisme (Piaget & Vygotsky):
Teori ini menyatakan bahawa pelajar membina pengetahuan secara aktif melalui pengalaman dan interaksi sosial. Dalam konteks IBL, pelajar didedahkan kepada situasi kerja sebenar yang membolehkan mereka membina pemahaman secara kontekstual dan kolaboratif.

ii. Teori Pembelajaran Situal (Situated Learning – Lave & Wenger):
Teori ini menekankan bahawa pembelajaran adalah paling berkesan apabila ia berlaku dalam konteks sebenar. IBL memenuhi elemen ini kerana pelajar menyertai komuniti amalan di tempat kerja dan terlibat secara langsung dalam aktiviti industri.

iii. Teori Pembelajaran Experiential (Kolb, 1984):
Kolb memperkenalkan empat fasa pembelajaran berasaskan pengalaman: pengalaman konkrit, pemerhatian reflektif, pembentukan konsep abstrak, dan ujian aktif. IBL memberikan ruang kepada pelajar untuk melalui keempat-empat fasa ini melalui latihan industri dan tugasan berasaskan projek.

iv. Teori Humanistik (Maslow & Rogers):
Pendekatan humanistik menekankan potensi manusia, autonomi pelajar dan pembelajaran berpusatkan pelajar. Dalam IBL, pelajar bukan sahaja memperoleh kemahiran teknikal tetapi juga membina keyakinan diri, motivasi dan sikap profesional melalui pengalaman kerja sebenar.

D. Ciri-ciri utama IBL

Enam ciri utama WBL yang bersesuaian dengan konsep IBL, yang berasaskan perspektif industri:

1. Saluran komunikasi antara penyelia industri, pensyarah dan pelajar.
2. Peranan yang jelas antara pihak industri, pihak akademik mahupun dari pihak pelajar.
3. Tempoh penempatan pelajar untuk menjalani latihan praktikal di industri.
4. Tempoh masa bimbingan yang bersesuaian.
5. Sokongan pembelajaran kendiri.
6. Standard penilaian WBL yang sistematik

Ciri-ciri ini menjamin program IBL yang terstruktur, dapat memberi panduan dengan jelas sepanjang tempoh penempatan, disamping dapat meningkatkan kolaborasi yang berterusan antara sektor akademik dan pihak industri.

Ciri-ciri utama IBL yang konsisten seperti dalam literatur pula meliputi:

1. Struktur dan komitmen jangka masa – penempatan dan pembimbingan yang jelas dan lama mencukupi.
2. Kolaborasi aktif – penglibatan langsung industri melalui projek dan penilaian.
3. Komunikasi dan sokongan – dengan saluran antara pensyarah, pelajar dan syarikat.
4. Perhatian sama pada kemahiran teknikal dan insaniah – melalui aktiviti sebenar dan refleksi

Kesemua ciri ini adalah asas untuk memastikan IBL bukan sekadar “latihan industri”, tetapi ianya memberi pengalaman pembelajaran yang menyeluruh.

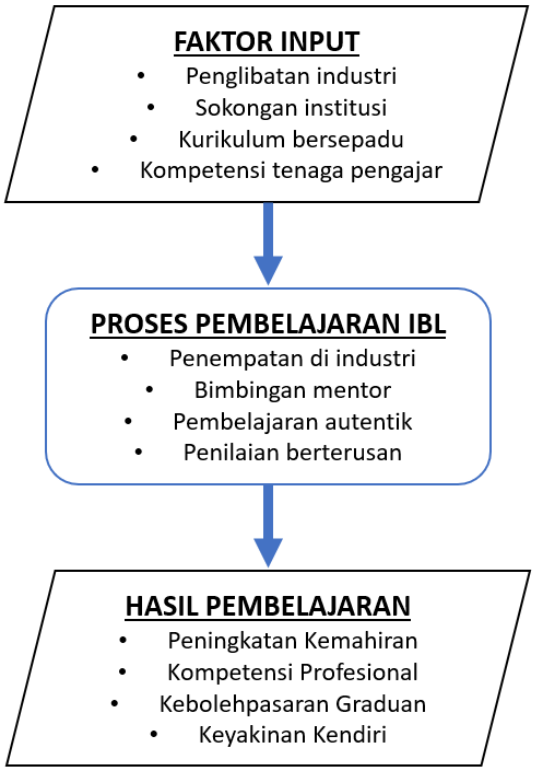
E. Rangka Program Industry-Based Learning (IBL)

IBL merupakan salah satu bentuk Work-Integrated Learning (WIL). Dalam pendekatan ini, apa yang

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

diutamakan adalah pendekatan yang menekankan kolaborasi antara institusi pendidikan dan juga pihak industri bagi menyediakan pengalaman pembelajaran yang lebih holistik, autentik dan relevan dengan keperluan pasaran kerja semasa.



Gambarajah 1 *Kerangka Konsep Program IBL*

III. METODOLOGI KAJIAN

Kajian ini merupakan sebuah kajian konsep yang berbentuk bukan empirikal dan dijalankan melalui pendekatan analisis kandungan. Dalam kajian ini, ia memfokuskan kepada pemerhatian kritikal terhadap konsep, model dan pelaksanaan Pembelajaran Berasaskan Industri (IBL) dalam konteks pendidikan TVET.

Data sekunder diperoleh daripada dokumen dasar pendidikan negara, laporan rasmi kerajaan, jurnal akademik terkini serta penerbitan berkaitan pelaksanaan TVET dan IBL dari dalam dan luar negara.

Sumber-sumber tersebut dianalisis secara deskriptif dan tematik untuk mengenal pasti cabaran, isu utama serta strategi pelaksanaan yang telah digariskan dalam pelbagai konteks. Kajian ini turut menggunakan pendekatan sintesis literatur untuk mengenal pasti kesepadanan pelaksanaan IBL di Malaysia berbanding amalan terbaik antarabangsa. Penulisan ini tidak melibatkan pengumpulan data lapangan secara langsung, namun memberi penekanan kepada pembangunan naratif ilmiah yang berasaskan bukti sokongan sekunder dan rujukan silang antara sumber.

Rangka program IBL biasanya dibentuk melalui kerjasama strategik antara institusi pendidikan tinggi dan organisasi industri. Program ini disesuaikan mengikut keperluan bidang pengajian tertentu, misalnya kejuruteraan, teknologi maklumat, reka bentuk grafik, perakaunan, atau pendidikan teknikal dan vokasional (TVET).

A. Rangka Program Model IBL

1) Swinburne Sarawak (Universiti Luar Negeri)

Pelaksanaan Industry-Based Learning (IBL) di Swinburne Sarawak sebenarnnya telah dipelopori sejak 1963 lagi melalui kampus induknya di Swinburne, Australia. Pelaksanaan di Sarawak pula bermula apabila kampus tersebut membuka cawangannya di Malaysia pada tahun 2000. Ini secara tidak langsung adalah untuk menyemarakkan tradisi IBL yang telah dipelopori oleh Swinburne Australia sejak sekian lama.

Melalui kerangka tersebut, kerjasama rasmi dilakukkan di antara pihak universiti dan organisasi industri. Program ini disesuaikan mengikut keperluan bidang pengajian tertentu, misalnya kejuruteraan, teknologi maklumat, reka bentuk grafik, perakaunan, atau pendidikan teknikal dan vokasional (TVET).

Pelajar, pensyarah dan pihak industri dalam memberikan penempatan pelajar secara berbayar antara 6 hingga 12 bulan. Pelajar akan memperolehi pengalaman sebenar dalam projek kejuruteraan yang disertai oleh mereka. Disamping itu juga, mereka juga akan dinilai oleh kedua-dua belah pihak sama ada dari pihak industri mahupun dari pihak pensyarah di universiti. Akhirnya pelajar akan dapt memperolehi sijil pengikhtirafan kerana telah berjaya menyertai kursus IBL.

2) Kajian Kes di Malaysia: Universiti Tun Hussein Onn Malaysia (UTHM)

Kajian yang telah dilaksanakan pada kampus tersebut, meneliti tiga program diploma termasuk Diploma Lanjutan Rangkaian dan Teknologi Kejuruteraan Komputer. Dalam kajian tersebut perkongsian teori antara universiti dan kemahiran industri berlaku melalui pengglibatan industry yang melibatkan *Work Based Learning* (WBL)[8].

Hasil daripada pelaksanaan WBL di kampus tersebut, di dapati pelajar lebih bersedia dan pada masa yang sama pihak industri mendapat kemahiran

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

teknikal sumber manusia daripada pelajar yang telah melalui WBL. Maka ianya telah mewujudkan peluang yang sama untuk kedua-dua pihak mencapai kejayaan melalui program ini.

3) Project-Oriented Problem-Based Learning (PoPbL) dalam Kejuruteraan Perisia ndi Universiti Teknologi Malaysia (UTM)

UTM telah memperluas pendekatan Problem-Based Learning (PBL) ke dalam format Project-Oriented PBL (PoPbL). Menurut pendekatan ini,pelajar akan didedahkan untuk menggubal dan menyelesaikan masalah sebenar yang disumbangkan oleh pihak industri [17].

Bermula tahun 2017 sehingga 2019, Program PoPbL telah dijalankan dalam dua kursus kejuruteraan perisian iaitu bidang *Requirement Engineering* dan *Software Modelling*. Selain dari itu juga melalui kerjasama dengan pelbagai agensi seperti IRDA, Pejabat Kesihatan Daerah Johor Bahru dan Infinite Logix Sdn. Bhd. turut dilakukan. Hasilnya telah memberi banyak maklum balas yang positif kepada pelajar. Di samping dapat meningkatkan keterlibatan pelajar, secara tidak langsung motivasi pembelajaran mereka juga turut meningkat [17]. Secara kesimpulannya, kerangka kerja bagi generic SE-PoPbL menunjukkan potensi untuk digunakan secara meluas merentas kursus disiplin di universiti.

Gambarajah 2 *Kerangka Generik SE-PoPbl*

Sejak tahun 2019, UTM juga telah menawarkan model 2u2i (Dua Tahun Kuliah + Dua Tahun Industri). Program yang menggabungkan dua tahun pembelajaran kampus diikuti dengan dua tahun penempatan industri. Mengikut struktur program ini, pelajar akan menghabiskan selama 3 tahun belajar di dalam kampus, manakala 1 tahun penuh dalam industry. Antara penglibatan aktif syarikat-syarikat yang terlibat adalah Petronas, TM One, Top Glove, IJM, DHL, PPG, dan DOSM [18].

Antara kebaikan yang diperolehi melalui pendekatan model tersebut ialah pelajar mendapat pengalaman kerja sebenar dan kemahiran profesional semasa berada dalam organisasi semasa tahun keempat mereka mengikuti pengajian.

Pendekatan IBL yang seterusnya dilaksanakan di UTM ialah melibatkan Latihan Industri di peringkat Antarabangsa pada tahun 2023. Dengan termetarainya di antara UTM dan Malaysia-Japan International Institute of Technology (MJIIT). Dengan pendekatan baharu iaitu Program Latihan Industri (LI) yang melibatkan 10 orang pelajar dari jabatan kejuruteraan mekanikal dan kimia untuk menjalani latihan selama satu bulan di syarikat Jepun seperti Oshikiri, Daido, NSK dan Azbil.

IV. KEPENTINGAN PENDEKATAN IBL DALAM KONTEKS TVET

1) Menyediakan Pelajar dengan Kemahiran Dunia Sebenar

IBL memberikan pelajar pengalaman langsung di tempat kerja sebenar, di mana ianya membolehkan mereka mengaplikasikan pengetahuan teori dalam situasi praktikal. Ini selari dengan keperluan TVET yang menekankan kemahiran amali dan keboleh kerjaan.

Pelajar TVET yang mengikuti latihan industri selama 6 bulan menunjukkan peningkatan kemahiran teknikal sebanyak 35% berbanding sebelum penempatan [19].

2) Menggalakkan Perkongsian Strategik antara Institusi dan Industri

Pendekatan IBL mengukuhkan kerjasama dua hala antara institusi TVET dan sektor industri. Syarikat memainkan peranan sebagai rakan latihan, sementara institusi bertanggungjawab membangunkan kurikulum yang relevan dan responsif terhadap perubahan industri.

Penyelarasan berterusan antara sektor pendidikan dan industri membantu memastikan keselarasan kemahiran pelajar dengan permintaan pasaran kerja [20].

3) Meningkatkan Kebolehpasaran Graduan

Graduan TVET dengan pengalaman IBL biasanya lebih mudah mendapat pekerjaan kerana mereka telah terdedah kepada persekitaran kerja sebenar dan mempunyai kefahaman tentang jangkaan majikan.

Kajian dari World Bank pada tahun 2021 di Malaysia menunjukkan bahawa, 68% pelajar TVET yang mengikuti latihan industri mendapat pekerjaan dalam tempoh 3 bulan selepas tamat pengajian, berbanding hanya 42% pelajar tanpa latihan sedemikian [21].

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

4) Meningkatkan Kebolehpasaran Graduan

IBL bukan sahaja membina kemahiran teknikal, tetapi juga membantu pelajar mengasah kemahiran komunikasi, kerja berpasukan, pemikiran kritikal, dan penyelesaian masalah. Ini penting untuk pelajar TVET yang akan bekerja dalam persekitaran pelbagai disiplin.

Mengikut peritus, sebanyak 75% majikan dalam sektor pembuatan menilai pelajar IBL dari institusi TVET mempunyai kemahiran interpersonal lebih baik berbanding graduan dari laluan akademik semata-mata. Pelajar TVET yang mengikuti IBL juga mempunyai tahap kemahiran insaniah (*soft skills*) yang baik dan tahap kesediaan sederhana menghadapi bagi menghadapi IR4.0. Terdapat korelasi sederhana kuat antara kemahiran insaniah dan kesediaan untuk revolusi industri[22].

5) Memperkasa Kurikulum yang Adaptif dan Dinamik

Melalui maklum balas yang berterusan daripada pihak industri, kurikulum TVET dapat dikemas kini secara lebih cepat dan relevan. IBL secara relevannya akan menjadikan proses pengajaran akan menjadi lebih dinamik dan berpandukan kepada kehendak pasaran sebenar.

Institusi yang melibatkan industri dalam pembangunan kurikulum menghasilkan program yang lebih relevan, praktikal, dan diterima industri[23].

V. CABARAN PELAKSANAAN PENDEKATAN IBL

Industry-Based Learning (IBL) merupakan pendekatan pedagogi yang berfokus kepada pembelajaran berasaskan pengalaman kerja sebenar, hasil kerjasama erat antara institusi pendidikan dan industri. Pendekatan ini dianggap selari dengan objektif utama Pendidikan dan Latihan Teknikal dan Vokasional (TVET) yang menekankan kebolehpasaran graduan, pemindahan kemahiran, dan kesediaan menghadapi dunia pekerjaan sebenar. Walaupun inisiatif seperti Work-Based Learning (WBL) dan pelaksanaan Dasar TVET Negara (2021–2030) telah mengiktiraf kepentingan IBL, pelaksanaannya masih menghadapi pelbagai kekangan yang menjejaskan keberkesanannya dalam kalangan institusi TVET di Malaysia[24].

1) Keterbatasan Kerjasama Strategik antara Industri dan Institusi

Salah satu cabaran paling ketara ialah kurangnya penyertaan aktif industri dalam merancang dan melaksanakan program IBL. Banyak syarikat enggan menawarkan tempat latihan kerana kekangan operasi, keperluan pematuhan keselamatan, atau kekurangan insentif daripada kerajaan. Kajian oleh Salleh & Sulaiman (2020) menunjukkan bahawa hanya 45% institusi TVET mempunyai kerjasama formal dengan industri tempatan, menyebabkan peluang penempatan pelajar terhad dan tidak menyeluruh[23].

2) Ketidak sepadanan antara Kurikulum dan Keperluan Industri

Terdapat jurang ketara antara silibus yang diajar di institusi TVET dengan kemahiran sebenar yang diperlukan oleh industri, terutama dalam bidang teknologi tinggi dan IR 4.0. Didapati bahawa 62% majikan menyatakan graduan TVET masih kurang kemahiran terkini seperti automasi, data analitik dan penyelenggaraan peralatan pintar, menandakan keperluan kurikulum yang lebih responsif terhadap perubahan industri [25].

3) Kekangan Logistik dan Infrastruktur

Tidak dinafikan keberadaan geografi Institusi TVET yang jauh dari arus pembangunan seringkali berdepan dengan segala macam masalah. Institusi yang berada di luar bandar sering berdepan dengan masalah kekurangan akses kepada syarikat industri yang sesuai untuk IBL. Selain itu, kos logistik, pengangkutan pelajar, dan kekurangan fasiliti latihan turut menyulitkan penempatan yang efektif. Menurut laporan oleh World Bank pada tahun 2021, isu logistik ini menjadi penghalang utama kepada 38% pelajar TVET yang layak untuk menjalani latihan industri[21].

4) Kualiti dan Persediaan Tenaga Pengajar

Banyak isu yang berkaitan dengan kualiti tenaga pengajar di institusi TVET. Tenaga pengajar TVET yang tidak mempunyai pengalaman industri terkini turut menyumbang kepada kesukaran dalam menyelaraskan pembelajaran di bilik kuliah mahupun makmal dengan keperluan dunia kerja sebenar. Banyak pengajar TVET di Malaysia diserap terus daripada institusi pengajian tinggi tanpa pernah mengalami pekerjaan praktikal dalam sektor industri. Kurang pendedahan mengenai standard operasi dan teknologi semasa di industri, tiada peluang untuk memperbaharui kemahiran teknikal mereka dan faktor lain seperti gaji kurang menarik menyukarkan individu berpengalaman untuk menjadi tenaga pengajar[26]. Permasalahan ini menyebabkan kecenderungan ruang antara teori yang diajar dengan apa yang diperlukan oleh industri semasa, menjadikan graduan kurang bersedia untuk bekerjasama di dunia kerja yang sebenar.

Mereka juga tidak selalu dilatih untuk mengurus pelaksanaan IBL secara berstruktur. Perlunya program peningkatan kemahiran tenaga

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

pengajar melalui industry attachment program sekurang-kurangnya sekali setiap 3 tahun[27].

VI. STRATEGI PELAKSANAAN DALAM MENCAPAI IBL DI INSTITUSI TVET

1) Penubuhan Jawatankuasa Bersama Industri-Institusi

Antara strategi mampan dalam mencapai objektif program IBL dalam institusi TVET negara ialah dengan mewujudkan jawatankuasa tetap yang terdiri daripada wakil institusi TVET dan syarikat industri terpilih. Ini adalah bagi memastikan penetapan hala tuju kurikulum, penilaian program latihan industri, dan penyemakan pencapaian IBL dapat dipantau secara berkala.

Dengan tertubuhnya penubuhan jawatankuasa bersama ini, secara tidak langsung pihak industri dapat memasukkan kandungan kurikulum yang berkaitan dalam kursus yang ditawarkan oleh pihak institusi selain dari mewujudkan akauntabiliti bersama[28].

2) MoU dan MoA Bersifat Jangka Panjang dengan Syarikat Strategik

Melalui strategi ini, pihak institusi hendaklah menandatangani Memorandum of Understanding (MoU) atau Memorandum of Agreement (MoA) dengan syarikat industri secara formal bagi tempoh di antara 3 hingga 5 tahun. Segala komitmen yang hendak diselaraskan perlulah diperincikan dengan mendalam tentang penempatan pelajar, sumbangan teknologi, pensyarah jemputan, dan melaksanakan kolaboratif projek secara bersama.

Perlu diperingatkan agar pihak institusi TVET agar mengelakkan pelaksanaan IBL secara ad-hoc. Ini kerana ianya bagi menjamin kestabilan dan kesinambungan kerjasama antara kedua belah pihak[29].

3) Penempatan Pensyarah di Industri (Industry Attachment for Lecturers)

Melaksanakan program ‘industrial attachment’ kepada pensyarah sekurang-kurangnya sekali setiap 3 tahun. Pensyarah mengikuti kerja industri selama 2–6 minggu untuk memahami teknologi terkini dan budaya kerja sebenar. Kesan dari pelaksanaan tersebut ianya memberi kesan terhadap pensyarah. Pensyarah akan lebih relevan dan kontekstual dalam pengajaran. Selain itu juga ia dapat meningkatkan kredibiliti dan hubungan dua hala antara pensyarah dan pihak industri[27].

4) Penglibatan Mentor Industri dalam Pembelajaran

Selain dari melibatkan pihak industri dalam kurikulum, pihak institusi juga boleh membuat lantikan dari kalangan pakar industri sebagai penyelia bersama (co-supervisor) atau mentor dalam projek akhir pelajar mengikut kepakaran mereka masing-masing. Penglibatan mereka dalam sesi kuliah jemputan atau forum industri bersama pelajar sedikit sebanyak menyuntik pandangan praktikal dalam pembelajaran[30].

5) Penubuhan Pusat Pembangunan Kolaborasi Industri (IPIC - Industry Partnership & Innovation Centre)

Penubuhan pusat kolaborasi mampan khusus di antara pihak industri bersama institusi TVET. Ia sekaligus antara lain adalah bagi memantau dan menguruskan di institusi TVET dalam aspek mengurus hubungan industri, latihan, penyelidikan bersama, dan inovasi berasaskan keperluan industri.

Dengan tertubuhnya IPIC, selain dapat meningkatkan imej institusi sebagai rakan industri yang proaktif secara tidak langsung dapat menstruktur kembali penjajaran yang dinamik dan responsif melalui pelbagai inisiatif kerjasama yang terjalin agar program IBL yang lebih segar dan sistematik dapat dicapai.

VII. KESIMPULAN

Secara keseluruhannya, pendekatan Industry-Based Learning (IBL) telah terbukti sebagai satu strategi yang efektif dalam merapatkan jurang antara teori dan amalan sebenar di tempat kerja, terutamanya dalam konteks pendidikan TVET. Melalui penglibatan langsung pelajar dalam persekitaran industri, IBL bukan sahaja meningkatkan kemahiran teknikal, tetapi turut memupuk kemahiran insaniah seperti komunikasi, kerja berpasukan, dan kepimpinan. Pendedahan kepada budaya kerja sebenar, bimbingan mentor industri serta tugasan yang berasaskan projek nyata dapat meningkatkan keyakinan diri dan kesiapsiagaan pelajar untuk menyertai dunia pekerjaan[31], [29].

Namun, pelaksanaan IBL juga tidak lari dari menghadapi beberapa cabaran, antaranya kekangan dari segi infrastruktur, kurangnya tenaga pengajar berpengalaman industri, serta kekangan kerjasama jangka panjang antara institusi dan industri[27]. Justeru, strategi pelaksanaan yang berstruktur dan sistematik perlu dirangka, termasuklah program peningkatan kemahiran tenaga pengajar melalui penempatan industri berkala dan pelaksanaan penilaian berteraskan kompetensi sebenar industri.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Secara tuntas, keberkesanan IBL banyak bergantung kepada tahap kolaborasi yang mantap antara pihak institusi dan industri. Dengan memperkukuh jaringan kerjasama ini dan menyesuaikan kurikulum mengikut keperluan pasaran kerja, pendekatan IBL berpotensi menjadi pemangkin utama dalam melahirkan graduan TVET yang berdaya saing dan relevan dengan kehendak industri masa kini.

Kajian ini menegaskan bahawa pelaksanaan IBL dalam TVET di Malaysia mempunyai potensi besar dalam melahirkan graduan yang kompeten dan bersedia untuk dunia pekerjaan. Namun, pelaksanaannya memerlukan penyelarasan dasar, pengukuhan kerjasama antara pihak berkepentingan dan pembangunan modul yang lebih sistematik. Diharapkan hasil kajian ini dapat dijadikan rujukan dalam penambahbaikan pelaksanaan IBL di institusi TVET seluruh negara.

PENGHARGAAN

Penghargaan yang tidak terhingga kepada ahli kumpulan penulisan untuk artikel ini sehingga ianya dapat diterbitkan. Juga kepada pihak Pengurusan dan UPIK, PMJ yang banyak membantu dalam mendapatkan info yang berkaitan, Semoga kertas kajian konsep ini dapat diterima umum khususnya dalam pengurusan TVET.

RUJUKAN

[1] Mazlan. M. A., Abdul Latif. M, Mohd Nawi. I, "Pemerkasaan TVET di Malysia: Satu Tinjauan" JPPKK, Kementerian Pengajian Tinggi, 2020.

[2] Jabatan Pendidikan Politeknik dan Kolej Komuniti, JPPKK. Buku Panduan Pelaksanaan Program Pengajian Pendekatan Work Based Learning (WBL). Politeknik Malaysia Kementerian Pendidikan Malaysia, 2019.

[3] Smith, Calvin, Sonia Ferns, & Leoni Russell. "Designing Work-Integrated Learning Placements that Improve Student Employability: Six Facets of the Curriculum that Matter." *Asia–Pacific Journal of Cooperative Education, 17(2), hlm. 197–211*, 2016.

[4] Chan, C. K. Y. "Work-integrated learning: Theory, practices and challenges." *Higher Education Research & Development, 40(6), 1205–1219*. 2021.

[5] Dasar Pendidikan TVET Negara (DPTVN), Kementerian Pendidikan Malaysia, 2018.

[6] Tay, L., & Lim, C. P. Realizing authentic learning in TVET through industry partnerships. International Journal of Training Research, 18(3), 265–282. 2020.

[7] Zolkafli, M. Y., & Musa, N. "Enhancing Work-Based Learning in Malaysian TVET: Strategies and Implementation Models." *Journal of Technical Education and Training, 14(2), 56–67*. 2022.

[8] Mustapha, R. "Industry Collaboration in TVET Curriculum Design." *Malaysian Journal of Technical Education*, 7(2), 45–52, 2020.

[9] Ismail S., Mohamad M.M. & Mohd Faiz N. S. "Work-Based Learning di Politeknik Sultan Salahuddin Abdul Aziz Shah." *Journal of Technical Education and Training, Vol. 3 No. 2*, 2018.

[10] WilayahKu. TVET Pembangunan Industri Masa Depan. https://www.wilayahku.com.my, 2023.

[11] Abdul Wahid, N. A., Zakaria, R., & Halim, L. TVET Graduates' Employability and the Role of Work-Based Learning. *International Journal of Educational Management and Development, 4(1), 33–41*, 2022.

[12] Arinaitwe, D. "Practices and strategies for enhancing learning through collaboration between vocational teacher training institutions and workplaces." *Empirical Research in Vocational Education and Training, Vol. 13 Article (13),* 2021.

[13] Norazah, M. N., Rahmat, N., & Zulkifli, M. "Persepsi Industri Terhadap Pelaksanaan Latihan Berasaskan Industri di Malaysia." *Jurnal Penyelidikan Pendidikan, 13(1), 77–88*. 2022.

[14] Gessler, M., & Moreno Herrera, L. "The role of stakeholders in workplace learning: A comparative view." *Journal of Vocational Education & Training, 74(1), 1–20*. 2022.

[15] Ooi, M. K., Lim, C. H., & Leong, S. Y., "Collaboration in TVET: Strengthening Work-Based Learning Implementation in Malaysia." *Journal of Education and Social Sciences, 18(2), 56–64*. 2021.

[16] Ra, S., Chin, B., & Lim, C. "Transforming TVET in Asia-Pacific: Innovations and partnerships for skills development." *UNESCO-UNEVOC*. 2021.

[17] Ibrahim, N. "Software Engineering (SE)-

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Project-oriented Problem-based Learning (PoPbL) approach © IP/CR/2016/0894. Malaysia," https://people.utm.my/noraini/se-popbl/?utm_source (2022).

[18] https://news.utm.my/2019/07/utm-2u2i-workshop-successfully-enhancing-university-industry-collaboration, 2019.

[19] Abdullah, S., Musa, M. & Talib, O. "TVET Graduates and Industrial Training: A Malaysian Case Study." *Journal of Technical Education and Training*, 12(1), 44–55. 2020.

[20] Nordin, N., Ismail, A., & Amin, N. M.. "Industry Collaboration in TVET Curriculum Design." *International Journal of Vocational Education and Training*, 2019.

[21] World Bank. "Education Policy Review: TVET Malaysia," 2021.

[22] Hashim, S. et. al. "Students' Soft Skills and Their Readiness Towards Industrial Revolution in Technical and Vocational Education and Training (TVET): A Malaysian Sight." *Online Journal for TVET Practitioners, Vol 9(1), hlm. 37–51*, 2022.

[23] Mohd Salleh, K. & Sulaiman. N. "Reforming Technical and Vocational Education and Training (TVET) on Workplace Learning and Skills Development." *International Journal of Recent Technology and Engineering, Vol. 8(5),* 2020.

[24] Kementerian Sumber Manusia. "Laporan Pelaksanaan Dasar TVET Negara 2021–2030." Putrajaya: Jabatan Pembangunan Kemahiran, 2022.

[25] Hashim, S., Rahman, M.Z. & Jamal, N. "Industrial Readiness among TVET Graduates in Malaysia." TVET Journal Malaysia, 11(1), 23–35, 2023.

[26] Ahmad, J., & Essien, E. O. "Training and Retraining: A Case of TVET Teachers in Malaysia." *Asia–Africa Journal of Academic Research and Review, 1, 110–118,* 2021.

[27] Nor Azlina, I., Mohamad Naim, R. & Khairul Anuar, M.N. "TVET Educators' Industrial Attachment and Its Impact on Teaching Relevance." *Journal of Technical Education and Training, 14(2), 56–66,* 2022.

[28] Alias, M., & Hassan, R. "Strategic Partnerships in TVET: The Malaysian Experience." *TVET@Asia, Issue 13*, 2019.

[29] Aziz, N. A., & Manaf, N. A. "Enhancing Industry-Institution Collaboration for Work-Based Learning." Journal of Technical Education and Training (JTET), 13(2), 94–101, 2021.

[30] Rahmat, N.H. & Awang, H. "Bridging TVET and Industry through Mentorship Collaboration." *Malaysian Journal of ELT Research.* 2023.

[31] Mohd Salleh, M. F., Ali, S. R. O., & Wahab, N. A. "The Role of Industry-Based Learning in Developing Graduate Employability Skills." *International Journal of Academic Research in Business and Social Sciences, 8(3), 659–672. https://doi.org/10.6007/IJARBSS/v8-i3/4014*, 2018.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: **Ruzaihan Bin Jaffar** 	Department of Information Technology & Communication, Polytechnic of Mersing, 86800 Mersing, Johor, Malaysia. E-mail: ruzaihan@tvet.pmj.edu.my
Second Author: **Muhammad Murshid Bin Ramlan** 	Department of Information Technology & Communication, Polytechnic of Mersing, 86800 Mersing, Johor, Malaysia. E-mail: murshid@tvet.pmj.edu.my
Third Author: **Norsaadah Binti Sapon** 	Department of Electrical Engineering, Polytechnic of Mersing, 86800 Mersing, Johor, Malaysia. E-mail: norsaadah@tvet.pmj.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Kajian Keberkesanan Penggunaan Uart Wireless Trainer Dikawal Melalui Aplikasi Sebagai Alat Bantu Mengajar Kursus Embedded System Application

Hashamiza binti Haruddin [1], Gauri a/p Birasamy [2]

[1] *Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar,Perak, Malaysia*
E-mail: hashamiza@puo.edu.my

[2] *Jabatan Kejuruteraan Elektrik, Politeknik Tuanku Sultanah Bahiyah,, Kulim, Malaysia*
E-mail: gauri@ptsb.edu.my

Abstrak

Di era teknologi dan pembelajaran kendiri, penguasaan pelajar terhadap konsep komunikasi mikropengawal seperti UART (Universal Asynchronous Receiver Transmitter) menjadi semakin penting, terutamanya dalam kursus berasaskan sistem terbenam. Kajian ini dijalankan bagi menilai tahap keberkesanan penggunaan UART Wireless Trainer yang dikawal melalui aplikasi mudah alih sebagai bahan bantu mengajar dalam kalangan pelajar politeknik. Trainer ini membolehkan pelajar mengawal peranti output (seperti LED, motor, dan mentol 240V) serta membaca data input (seperti suhu dan cahaya) secara *real-time* melalui sambungan tanpa wayar. Instrumen kajian terdiri daripada soal selidik 30 item yang merangkumi enam domain utama: kefahaman konsep, kemahiran rekabentuk dan pengujian, fungsi aplikasi, kecekapan masa dan kos, tahap keyakinan, serta penilaian keseluruhan. Jumlah responden yang terlibat dalam kajian ini ialah seramai 86 orang pelajar semester empat Jabatan Kejuruteraan Elektrik Politeknik Tuanku Sultanah Bahiyah yang terdiri daripada program DEE, DET dan DTK. Hasil analisis menunjukkan pelajar menunjukkan peningkatan ketara dari aspek kefahaman teori, kemahiran praktikal, dan keyakinan kendiri dalam melaksanakan projek mikropengawal. Selain itu, pelajar juga melaporkan pengurangan tekanan kerja dan peningkatan motivasi terhadap pembelajaran. **.** Nilai min yang tinggi bagi setiap aspek kajian membuktikan bahawa trainer ini mampu menjembatani jurang antara teori dan amali, sekaligus meningkatkan kualiti pengajaran dan pembelajaran secara menyeluruh Kajian ini mencadangkan bahawa penggunaan trainer seperti ini wajar diperluaskan dalam kursus berasaskan amali dan projek untuk menyokong pendekatan pembelajaran abad ke-21.

Kata Kunci **:** *Aplikasi Mudah Alih; Trainer; Uart*

Abstrak

In the era of technology and self-learning, students' mastery of microcontroller communication concepts such as UART (Universal Asynchronous Receiver Transmitter) is becoming increasingly important, especially in embedded systems-based courses. This study was conducted to evaluate the effectiveness of using UART Wireless Trainer controlled via mobile applications as a teaching aid among polytechnic students. This trainer allows students to control output devices (such as LEDs, motors, and 240V bulbs) and read input data (such as temperature and light) in real-time via a wireless connection. The study instrument consisted of a 30-item questionnaire covering six main domains: conceptual understanding, design and testing skills, application functions, time and cost efficiency, confidence level, and overall assessment. The total number of respondents involved in this study was 86 fourth-semester students of the Department of Electrical Engineering, Tuanku Sultanah Bahiyah Polytechnic, consisting of DEE, DET, and DTK programs. The results of the analysis showed that students showed significant improvements in terms of theoretical understanding, practical skills, and self-confidence in implementing microcontroller projects. In addition, students also reported reduced work pressure and increased motivation for learning. . The high mean value for each aspect of the study proves that this trainer is able to bridge the gap between theory and practice, thus improving the overall quality of teaching and learning. This study suggests that the use of trainers like this should be expanded in practice-based and project-based courses to support 21st century learning approaches.

Keywords *: Mobile Application; trainers; Uart*

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

I. PENDAHULUAN

Dalam era Revolusi Industri 4.0, kebolehan menguasai teknologi sistem terbenam dan komunikasi tanpa wayar merupakan kemahiran asas yang perlu dikuasai oleh pelajar dalam bidang kejuruteraan dan teknologi. Salah satu komponen penting dalam sistem terbenam ialah komunikasi bersiri jenis Universal Asynchronous Receiver Transmitter (UART) yang digunakan secara meluas untuk membolehkan pertukaran data antara mikropengawal dan peranti lain. Meskipun UART merupakan antara topik penting dalam kursus sistem terbenam, pengajaran secara teori semata-mata didapati tidak mencukupi untuk membantu pelajar memahami aplikasi sebenarnya dalam pembangunan projek elektronik [1].

Pengalaman di institusi politeknik menunjukkan bahawa pelajar sering menghadapi kesukaran apabila dikehendaki mereka bentuk dan membina sistem berasaskan UART dalam kursus seperti Embedded System Application, Projek 1 dan Projek 2. Kesukaran ini berpunca daripada kelemahan pelajar dalam memahami asas teori komunikasi UART serta kekangan masa dan sumber dalam menjalankan aktiviti praktikal. Situasi ini sering menyebabkan pembinaan litar tidak berjaya dalam masa yang ditetapkan, sekaligus memberi tekanan kepada pelajar dan menjejaskan kualiti projek akhir yang dihasilkan [2].

Bagi mengatasi isu ini, satu alat bantu pengajaran telah dibangunkan iaitu UART Wireless Trainer Dikawal Melalui Aplikasi. Trainer ini direka bentuk bagi membolehkan pelajar mengawal pelbagai komponen seperti LED, motor dan mentol 240V serta membaca data sensor suhu dan cahaya secara masa nyata melalui sambungan tanpa wayar seperti ZigBee, RF dan Bluetooth. Trainer ini juga membolehkan pengujian kod dan litar dilakukan secara terus sebelum pelajar melaksanakan pembinaan sebenar di atas papan prototaip (protoboard). Pendekatan ini dilihat dapat membantu pelajar mengaplikasikan teori yang dipelajari, mengurangkan kesilapan dalam pembinaan sistem dan meningkatkan keyakinan serta kefahaman mereka [3].

Justeru, kajian ini dijalankan di Politeknik Tuanku Sultanah Bahiyah yang melibatkan pelajar semester 4 dari program diploma yang mengikuti kursus Embedded System. Kajian ini bertujuan untuk menilai tahap keberkesanan penggunaan UART Wireless Trainer sebagai alat bantu mengajar dari aspek kefahaman teori, kemahiran praktikal, pengurusan masa, serta tahap keyakinan pelajar dalam pembelajaran berasaskan projek.

Objektif Kajian

1. Menilai keberkesanan penggunaan UART Wireless Trainer dikawal melalui aplikasi sebagai alat bantu mengajar dalam kursus Embedded System Application.
2. Mengkaji tahap kefahaman pelajar terhadap konsep komunikasi UART selepas menggunakan trainer.
3. Menganalisis keberkesanan trainer dalam meningkatkan kemahiran rekabentuk dan pengujian sistem mikropengawal.
4. Menilai impak penggunaan trainer terhadap tahap keyakinan pelajar, kecekapan masa dan kos dalam pembangunan projek.
5. Meneliti persepsi keseluruhan pelajar terhadap kesesuaian dan potensi penambahbaikan trainer dalam kursus berasaskan amali.

Pernyataan Masalah

Pengajaran topik komunikasi UART dalam kursus sistem terbenam di politeknik sering dilaksanakan secara teori semata-mata, tanpa latihan praktikal yang mencukupi. Ini menyebabkan pelajar menghadapi kesukaran untuk memahami aplikasi sebenar UART dalam pembangunan sistem elektronik. Kelemahan dalam pemahaman teori, kekangan masa, serta kekurangan sumber latihan praktikal menyebabkan pelajar gagal membina sistem yang berfungsi dengan baik, sekaligus memberi tekanan dan menjejaskan hasil projek akhir. Oleh itu, terdapat keperluan untuk memperkenalkan bahan bantu mengajar yang lebih interaktif dan efektif bagi mengatasi jurang antara teori dan amali.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

I. KAJIAN LITERATUR

Komunikasi UART (Universal Asynchronous Receiver Transmitter) adalah antara protokol bersiri yang paling asas dan penting dalam pembangunan sistem terbenam. Ia digunakan secara meluas dalam komunikasi antara mikropengawal dan peranti seperti sensor, modul wireless, dan paparan LCD. Namun, konsep ini sering sukar difahami oleh pelajar jika hanya diajar melalui pendekatan teori atau simulasi asas [1]. Oleh itu, pemahaman mendalam melalui amali adalah penting bagi memastikan pelajar dapat menguasai proses penghantaran dan penerimaan data bersiri secara praktikal.UART merupakan protokol komunikasi bersiri yang digunakan secara meluas dalam mikropengawal seperti Arduino, ESP32, dan PIC. Ia beroperasi berdasarkan prinsip penghantaran data bit demi bit tanpa isyarat jam luaran, menjadikannya lebih mudah diintegrasikan dalam aplikasi ringkas dan sistem terbenam berskala kecil [4]. Di dalam bilik darjah, pengajaran UART sering dilaksanakan melalui kaedah pensyarah-sentris, iaitu hanya melalui kuliah dan demonstrasi asas, tanpa latihan praktikal yang mencukupi.

Hal ini mengakibatkan pelajar menghadapi kesukaran untuk mengaplikasikan konsep UART dalam pembangunan litar dan pengaturcaraan sebenar. Kajian oleh Sulaiman dan Harun (2018) menunjukkan bahawa hampir 60% pelajar tahun akhir politeknik gagal membina sambungan UART berfungsi tanpa bantuan pensyarah. Ini menunjukkan keperluan mendesak untuk mengintegrasikan pembelajaran berasaskan pengalaman (experiential-based learning) dalam topik komunikasi digital, terutama untuk sistem terbenam. Trainer atau alat bantu praktikal yang menyokong simulasi dan pengujian real-time akan membantu pelajar lebih memahami konsep seperti baud rate, sinkronisasi, dan struktur data bersiri.Kajian oleh Abdullah dan Mohd Yusof [2] menunjukkan bahawa penggunaan modul interaktif dalam kursus mikropengawal memberi kesan positif terhadap pemahaman dan motivasi pelajar. Dalam konteks pendidikan teknikal, trainer memberi peluang pelajar memahami hubungan antara perisian dan perkakasan dengan lebih jelas [5].

Teknologi tanpa wayar seperti Bluetooth, ZigBee dan RF kini meluas digunakan dalam aplikasi *Internet of Things (IoT)*. Oleh itu, pelajar perlu didedahkan kepada teknologi ini supaya mereka dapat membina sistem yang realistik dan selari dengan industri semasa [6]. Aplikasi mudah alih yang diintegrasikan dengan kit latihan memudahkan pelajar untuk mengawal dan memantau peranti secara fleksibel, sekali gus menjadikan pembelajaran lebih interaktif dan menghadiahkan pembelajaran luar bilik darjah . Beberapa kajian turut menunjukkan bahawa penggunaan alat bantu seperti trainer memberi kesan positif bukan sahaja dari segi kognitif tetapi juga aspek afektif pelajar. Sebagai contoh, Latif dan Noraini mendapati pelajar lebih yakin dan kurang stres apabila mereka dapat menguji kod dan litar sebelum membina sistem sebenar [7]. Di samping itu, penggunaan kit latihan turut meningkatkan kecekapan masa dalam menyiapkan projek, mengurangkan kos dan kadar kegagalan prototaip [8].

Keberkesanan sesebuah bahan bantu mengajar boleh dinilai dari pelbagai aspek seperti peningkatan prestasi akademik, penguasaan kemahiran teknikal, dan persepsi pelajar terhadap penggunaannya [9]. Dalam kursus berbentuk amali seperti Embedded System, penekanan terhadap keupayaan pelajar mengaplikasi teori dalam pembangunan sistem sebenar adalah amat penting. Keberkesanan bahan bantu mengajar yang disusun sebagai kit latihan boleh diukur melalui prestasi akademik, penguasaan kemahiran teknikal, dan persepsi pelajar terhadap penggunaannya. Sebagai contoh, kajian oleh Nur Kholis *et al.* [10] membuktikan bahawa penerapan kit elektronik digital dalam pendidikan kejuruteraan elektrik meningkatkan prestasi pelajar berdasarkan penilaian dan analisis Cronbach Alpha.

II. METODOLOGI KAJIAN

Dalam kajian ini, seramai 86 orang pelajar semester 4 daripada Diploma Kejuruteraan Elektrik (DET), Diploma Kejuruteraan Elektrik dan Elektronik (DEE) , Diploma Kejuruteraan Elektronik (Komputer) Jabatan Kejuruteraan Elektrik Politeknik Tuanku Sultanah Bahiyah telah dipilih sebagai responden untuk menjawab soal selidik. Kesemua pelajar yang dipilih telah menggunakan Uart Wireless Trainer bagi kerja amali. Borang soal selik diedarkan bagi memperolehi data daripada pelajar dalam menentukan keberkesanan Uart Wireless Trainer sebagai alat bantu mengajar bagi kurus *Embedded System Application*. Kajian ini adalah kuantitatif dan instrument yang digunakan dalam kajian ini berbentuk soal selidik. Terdapat penambahbaikkan telah dibuat pada borang soal selidik mengikut kesesuaian. Borang soal selidik ini terdiri daripada 2 bahagian. Bahagian A merujuk kepada maklmat berkaitan demografi responden (Jantina dan Program). Bahagian B merujuk kepada Persepsi Pelajar terhadap Penggunaan UART Wireless Trainer. Aspek yang terdiri daripada soal

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

selidik 30 item yang merangkumi enam domain utama: kefahaman konsep, kemahiran rekabentuk dan pengujian, fungsi aplikasi, kecekapan masa dan kos, tahap keyakinan, serta penilaian keseluruhan. Hasil analisis awal menunjukkan pelajar menunjukkan peningkatan ketara dari aspek kefahaman teori, kemahiran praktikal, dan keyakinan kendiri dalam melaksanakan projek mikropengawal. (Rekabentuk, Minat dan Kefahaman). Jadual 2 merujuk kepada skala pengagihan maklumat responden. Jadual 1 menunjukan skala likert bagi soalan soal selidik bagi bahagian B.

Nilai kebolehpercayaan setiap item dalam instrumen soal selidik yang akan digunakan dalam kajian sebenar dinilai dengan menggunakan teknik ketekalan dalaman Alpha Cronbach. Kajian rintis dijalankan secara atas talian terhadap 10 orang pelajar menggunakan Google Forms untuk menentukan kebolehpercayaan item yang dibina. Setiap item dalam soal selidik dianalisis untuk menentukan pekali Alpha Cronbach dengan menggunakan Statistical Package for Social Science (SPSS) versi 26.0. Nilai pekali Alpha Cronbarch yang diperolehi ialah 0.920, Jika pekali alpha Cronbach lebih daripada 0.6, ia boleh dianggap boleh diterima dan boleh dipertimbangkan.

Jadual 1 : Skala Likert

Item	Skala
Sangat Setuju	5
Setuju	4
Tidak Pasti	3
Tidak Setuju	2
Sangat Tidak Setuju	1

Jadual 2 : Maklumat Responden

Item	Pilihan
Jantina	Lelaki,Perempuan
Program	DEE,DTK,DET
Tahap kemahiran dalam mikropengawal	Tiada pengalaman,Asas, Sederhana,Mahir
Pernah belajar tentang komunikasi UART	Ya,Tidak
Adakah anda pernah menggunakan sebarang modul komunikasi tanpa wayar contoh ESP8266	Ya,Tidak

III. KEPUTUSAN DAN PERBINCANGAN

Item soal selidik pada bahagian B adalah bertujuan untuk mendapatkan maklumat keberkesanan penggunaan *UART Wireless Trainer* di kalangan pelajar yang mengambil Kursus Embedded System Application. Jadual 6,7,dan 8 menunjukan skor min bagi setiap item soalan yang dinilai.

Jadual 3 : Skor Min bagi Aspek Kefahaman Konsep dan Teori

	N	Mean
Saya lebih memahami perbezaan konsep penghantaran dan penerimaan isyarat selepas menggunakan trainer.	86	4.33
Penggunaan trainer membantu saya memahami komunikasi tanpa wayar seperti ZigBee, RF, dan Bluetooth.	86	4.47
Saya lebih jelas tentang hubungan antara pengaturcaraan dan litar perkakasan selepas menggunakan trainer.	86	4.59
Saya lebih yakin menjelaskan semula konsep komunikasi wayarles kepada rakan.	86	4.33
Saya dapat mengaplikasikan teori kursus Embedded System dengan lebih baik selepas latihan dengan trainer.	86	4.40
Valid N (listwise)	86	

Jadual 4 : Skor Min bagi Aspek Kemahiran Rekabentuk dan Pengujian Projek

	N	Mean
Saya lebih mudah membina litar prototaip selepas menggunakan trainer.	86	4.49
Trainer ini membantu saya memahami hubungan antara sensor, output dan pengaturcaraan.	86	4.40
Saya dapat menguji rekabentuk litar saya secara real-time dengan lebih yakin.	86	4.40
Saya dapat menyelesaikan masalah litar sebelum projek sebenar dibangunkan.	86	4.49
Saya lebih yakin menjalankan eksperimen berkaitan projek 1 dan projek 2 selepas menggunakan trainer.	86	4.49

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Valid N (listwise)	86	

Jadual 5 : Skor Min bagi Aspek Fungsi Aplikasi dan Kawalan Jarak Jauh

	N	Mean
Aplikasi kawalan tanpa wayar berfungsi dengan stabil dan boleh dipercayai.	86	4.60
Saya dapat menghidupkan/mematikan komponen seperti LED dan motor melalui aplikasi dengan mudah.	86	4.40
Saya faham konsep kawalan output seperti motor dan mentol 240V melalui aplikasi.	86	4.47
Fungsi sensor cahaya dan suhu dalam trainer membantu saya memahami sistem maklum balas.	86	4.47
Paparan skrin suhu dan cahaya memberi maklumat berguna untuk ujian saya.	86	4.60
Valid N (listwise)	86	

Jadual 6 : Skor Min bagi Aspek Kecekapan Masa dan Kos

	N	Mean
Penggunaan trainer membantu saya merancang projek dengan lebih efisien.	86	4.40
Saya dapat menjimatkan masa pembinaan litar dengan adanya trainer.	86	4.49
Trainer ini mengurangkan kos uji litar sebelum membina sistem sebenar.	86	4.49
Saya tidak perlu ulang banyak kali pembinaan litar selepas menguji dengan trainer.	86	4.49
Trainer ini membantu saya menyelesaikan projek dalam tempoh masa yang ditetapkan.	86	4.27
Valid N (listwise)	86	

Jadual 7 : Skor Min bagi Aspek Tahap Keyakinan Pelajar

	N	Mean
Saya lebih yakin menyelesaikan projek selepas menggunakan trainer.	86	4.47
Saya kurang mengalami tekanan semasa membangunkan projek dengan adanya trainer.	86	4.40
Penggunaan trainer menjadikan saya lebih tenang dalam perancangan projek.	86	4.60
Saya tidak takut untuk mencuba pengaturcaraan baharu kerana boleh diuji dahulu dengan trainer.	86	4.27
Saya rasa lebih bersedia untuk menghadapi penilaian atau pembentangan projek selepas latihan dengan trainer.	86	4.47
Valid N (listwise)	86	

Jadual 8 : Penilaian Umum dan Cadangan Penambahbaikan

	N	Mean
Trainer ini sangat sesuai digunakan dalam kursus Embedded System Application.	86	4.33
Saya mencadangkan supaya trainer ini digunakan dalam kursus lain seperti Projek 1 & 2.	86	4.65
Penggunaan trainer ini menjadikan pembelajaran saya lebih menyeronokkan.	86	4.40
Saya berpuas hati dengan keberkesanan keseluruhan UART Wireless Trainer.	86	4.40
Saya ingin melihat lebih banyak fungsi ditambah dalam trainer pada masa akan datang.	86	4.65
Valid N (listwise)	86	

Aspek Kefahaman Konsep dan Teori

Bagi aspek kefahaman konsep dan teori skor min tertinggi ialah 4.59 (Tahap Tinggi) pada item 3 dan skor min paling rendah ialah 4.33 (Tahap Tinggi). Bagi min keseluruhan pula nilainya adalah 4.41 (Tahap Tinggi). Ini menunjukan pelajar memahami konsep komunikasi tanpa wayar serta perbezaan konsep penghantaran dan penerimaan isyarat.

Aspek Kemahiran Rekabentuk dan Pengujian Projek

Bagi aspek kemahiran rekabentuk dan pengujian projek pula, dapatan menunjukan skor min yang tertinggi adalah pada item soalan 1,4 dan 5 iaitu 4.49 (Tahap Tinggi) dan skor min paling rendah adalah pada item soalan 2 dan 3 iaitu 4.40 (Tahap Tinggi). Skor min keseluruhan bagi aspek minat adalah 4.44 (Tahap Tinggi). Ini menyatakan bahawa para pelajar dapat menguji litar projek secara real time dengan lebih yakin.

Aspek Fungsi Aplikasi dan Kawalan Jarak jauh

Bagi aspek fungsi aplikasi dan kawalan jarak jauh pula, nilai skor min yang tertinggi adalah pada item 1 dan 5, iaitu aplikasi kawalan tanpa wayar berfungsi dengan stabil dan boleh dipercayai. Nilai skor min adalah 4.60 (Tahap Tinggi), manakala skor min paling rendah adalah item 2 dengan nilai skor min 4.40 (Tahap Tinggi). Skor min keseluruhan bagi aspek fungsi aplikasi dan kawalan jarak jauh adalah 4.48 (Tahap Tinggi). Ini menunjukan trainer ini dapat membantu pelajar memahami konsep kawalan *output* seperti motor dan mentol 240V melalui aplikasi.

Aspek Kecekapan Masa dan Kos Projek

Bagi aspek kecekapan masa dan kos projek pula, dapatan menunjukan skor min yang tertinggi adalah pada item soalan 2,3 dan 4 iaitu 4.49 (Tahap Tinggi) dan skor min paling rendah adalah pada item soalan 5 iaitu 4.27 (Tahap Tinggi). Skor min keseluruhan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

bagi aspek minat adalah 4.41 (Tahap Tinggi). Ini menunjukkan trainer ini dapat mengurangkan kos uji litar sebelum pelajar membina sistem sebenar.

Aspek Tahap Keyakinan dan Tekanan Pelajar
Bagi aspek tahap keyakinan dan tekanan pelajar pula, dapatan menunjukan skor min yang tertinggi adalah pada item soalan 3 iaitu 4.60 (Tahap Tinggi) dan skor min paling rendah adalah pada item soalan 4 iaitu 4.27 (Tahap Tinggi). Skor min keseluruhan bagi aspek minat adalah 4.43 (Tahap Tinggi). Ini menunjukkan pelajar lebih berkeyakinan untuk menyelesaikan projek selepas menggunakan trainer.

Aspek Penilaian Umum dan Cadangan Penambahbaikan
Bagi aspek penilaian umum dan cadangan penambahbaikan, nilai skor min yang tertinggi adalah pada item 2 dan 5, iaitu pelajar mencadangkan trainer ini digunakan dalam Projek 1 dan 2, serta ingin melihat lebih banyak fungsi ditambah pada trainer, nilai skor min adalah 4.65 (Tahap Tinggi).

IV. KESIMPULAN

Secara keseluruhannya, dapatan kajian menunjukkan bahawa penggunaan UART Wireless Trainer yang dikawal melalui aplikasi sangat berkesan sebagai alat bantu mengajar dalam kursus Embedded System Application. Pelajar menunjukkan tahap pemahaman yang tinggi terhadap konsep komunikasi UART, kemahiran membina dan menguji litar, serta peningkatan dari aspek keyakinan dan pengurusan masa projek. Nilai min yang tinggi bagi setiap aspek kajian membuktikan bahawa trainer ini mampu menjembatani jurang antara teori dan amali, sekaligus meningkatkan kualiti pengajaran dan pembelajaran secara menyeluruh. Beberapa cadangan penambahbaikan telah dikenalpasti bagi meningkatkan lagi keberkesanan penggunaan trainer ini. Pertama, penambahan elemen kecerdasan buatan (AI) menggunakan ESP32-CAM bagi pengesanan imej atau warna sebagai input kawalan automatik boleh dimanfaatkan untuk aplikasi yang lebih realistik. Kedua, integrasi paparan antaramuka pengguna (GUI) dalam aplikasi kawalan boleh membantu meningkatkan kefahaman pelajar terhadap sistem secara visual. Ketiga, pensyarah boleh dibekalkan dengan modul latihan khusus agar pendekatan pengajaran lebih seragam dan efektif di seluruh jabatan. Kajian lanjutan juga dicadangkan untuk melibatkan bilangan sampel yang lebih besar dan pelbagai program bagi memperkukuh kesahan dapatan kajian ini.

RUJUKAN

[1] Cheah, S. Y., Lee, C. Y., & Tan, J. H. (2021). Enhancing microcontroller learning using interactive teaching kits. Journal of Technical Education and Training, 13(1), 21–30.

[2] Abdullah, M. F., & Mohd Yusof, N. A. (2020). Penggunaan modul interaktif dalam pembelajaran mikropengawal. Jurnal Pendidikan Teknikal Malaysia, 8(2), 45–52.

[3] Ismail, R., & Aziz, M. A. (2019). Pengajaran berasaskan simulasi dan keberkesanannya dalam kursus kejuruteraan elektrik. International Journal of TVET, 5(1), 17–25.

[4] Bharadwaj, A., Verma, R., & Gupta, M. (2020). Serial communication protocols in embedded systems: A comparative study. International Journal of Electronics and Communication Engineering, 7(2), 88–95.

[5] Yusof, N. A., & Khalid, M. (2019). Constructivist learning through microcontroller-based kits: A case in Malaysian polytechnic. International Journal of Learning, Teaching and Educational Research, 18(11), 225–239.

[6] R. A. S. Abdul Salam *et al.*, "An overview of recent wireless technologies for IoT-enabled smart grids," *J. Elec. Comput. Eng.*, vol. 2024, Article ID 2568751, 2024.

[7] H. Latif dan M. N. Noraini, "Impact of training kits on students' confidence and project success in electrical engineering education," *Malaysian J. Eng. Technol.*, vol. 4, no. 1, pp. 10–18, 2022.
(*Sekiranya rujukan lengkap tidak tersedia, ini adalah cadangan berdasarkan maklumat anda*)

[8] R. Rahman dan H. A. Mohd, "Improving project-based learning through interactive kits in embedded systems," *Asian J. Educ. Train.*, vol. 7, no. 3, pp. 140–147, 2021.

[9] Zakaria, M. R., Latif, H., & Johari, R. (2021). Effectiveness of using trainer kits in practical electronics courses among TVET students. Journal of TVET Research and Practice, 10(1), 43–57.

[10] N. Kholis, M. S. Zuhrie, dan D. H. Burhanuddin, "Development of Digital Electronics and Information Literacy Training Kit to Improve the Performance of Students Electrical Engineering Education," *International Journal of Recent Educational Research*, vol. 6, no. 2, pp. 347–361, Mar. 2025.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

AUTHOR INFORMATION

First Author: Hashamiza Binti Haruddin 	Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, Ipoh, 31400, Malaysia E-mail: hashamiza@puo.edu.my
Second Author: Gauri a/p Birasamy 	Jabatan Kejuruteraan Elektrik, Politeknik Tuanku Sultanah Bahiyah, Kulim Hi Tech Park, Kulim, 09000, Malaysia E-mail: gauri@ptsb.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Optimizing Food Business Operations Through Web-Based Systems: The Case of Bakso Bytes

Nurul Nisa Mohd Nasir[1], Herman Nordiadi Abd Wahab[2]

[1] *Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia*
E-mail: n_nisa@poliku.edu.my

[2] *Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia*
E-mail: herman@poliku.edu.my

Abstract

The food and beverage industry faces numerous operational challenges that require innovative solutions to ensure sustainability and growth in an increasingly competitive environment. In this context, web-based systems have emerged as a technological solution with the potential to optimize operations, improve customer satisfaction, and expand market reach. This study aims to develop a web-based system, Bakso Bytes, specifically designed to assist food businesses in managing order operations and enhancing user experience through efficient and innovative order processing. The research employs a system development approach, focusing on the phases of planning, design, development, testing, and feedback, guided by the Agile methodology. The study integrates user needs analysis, intuitive user interface (UI/UX) design, and order processing technologies to develop a system that meets the operational requirements of food and beverage businesses. The findings indicate that Bakso Bytes not only accelerates the order processing workflow but also provides customers with the convenience of making quick and efficient reservations. Furthermore, the research highlights that web-based systems like Bakso Bytes can minimize delays in order processing and help business owners manage inventory and customer feedback more effectively. However, challenges such as data security risks and the ability to accommodate increasing user demand were identified as critical aspects requiring attention in this solution. Overall, this study demonstrates the immense potential of web based systems in enhancing operational scalability and efficiency within the food and beverage industry. Through this research, Bakso Bytes is expected to serve as a model for other businesses in embracing digital transformation to ensure sustainability and competitiveness in a rapidly evolving market.

Keywords **:** *Web based system; Ordering system; inventory*

I. INTRODUCTION

The rapid advancement of technology has transformed the food and beverage industry, fostering the emergence of digital solutions to enhance operational efficiency and customer satisfaction. Bakso Bytes is a web based system designed to streamline the ordering process for bakso, a popular Indonesian meatball dish, while providing a seamless experience for both customers and vendors. This system aims to address common challenges in the traditional food ordering process, such as long waiting times, manual errors in order management, and limited accessibility to menus.

The Bakso Bytes web based system integrates core functionalities such as online ordering, real-time menu updates, and order tracking. Customers can place their orders remotely, customize their preferences, and track the preparation process, all through an intuitive user interface. For vendors, the system offers tools to

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

manage orders efficiently, monitor inventory, and generate sales reports. By leveraging web based technology, Bakso Bytes promotes operational convenience, enhances customer engagement, and reduces the reliance on manual processes.

This paper explores the development of Bakso Bytes, focusing on its design, implementation, and testing phases. The discussion also highlights the methodologies employed, challenges encountered, and the potential impact of this system on the food industry. By providing a case study of Bakso Bytes, this research contributes to the growing body of knowledge on web-based systems tailored for food service businesses.

II. LITERATURE REVIEW

This literature review examines recent advancements in web based systems development, particularly within the food and beverage industry, emphasizing their effectiveness in enhancing operational efficiency and customer satisfaction.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Web based systems have gained significant attention over the past few years due to their ability to streamline operations and improve service delivery. According to [1], online food ordering systems have positively impacted small and medium enterprises (SMEs), particularly by expanding market reach and simplifying order management. Similarly, [2] highlighted the effectiveness of real-time order processing systems in addressing common challenges in traditional food businesses, such as manual errors and delivery delays, resulting in faster service and higher customer satisfaction. Web-based systems also modernize food businesses by providing centralized platforms to manage orders, inventory, and customer feedback, as observed by [3]. These systems reduce dependency on manual operations, ensuring faster response times and consistent service, especially during peak hours.

[4] emphasized the importance of web-based systems in improving customer relationship management, as these platforms utilize data analytics to understand purchasing patterns and preferences, enabling businesses to deliver personalized experiences and foster customer loyalty. Moreover, [5] demonstrated that web-based systems support scalability, allowing businesses to handle growing customer demands without incurring significant operational costs. Automation provided by these systems reduces overhead expenses, making them cost-effective for small-scale enterprises. Additionally, [6] pointed out that web-based platforms enhance visibility, especially in competitive markets, through integration with social media and search engine optimization (SEO) strategies, enabling businesses to reach broader audiences. The flexibility of web-based systems has also proven essential in dynamic market environments. For instance, [7] noted that during the COVID-19 pandemic, businesses using web-based systems could quickly transition to delivery and takeout models, ensuring continuity despite dine-in restrictions.

The effectiveness of web-based systems is further supported by advancements in user interface (UI/UX) design, which significantly influence customer experiences. [8] emphasized that intuitive and user-friendly designs enhance technology adoption and foster trust among users, [9] highlighted that responsive interfaces improve task efficiency and accommodate customers with varying levels of digital literacy. However, the implementation of web-based systems is not without challenges. [10] noted the increasing prevalence of cyber threats, including hacking and data breaches, in applications that manage sensitive user

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

information. To address these risks, they recommended multi-layer authentication and data encryption. [11] added that regular security testing and real-time monitoring are essential for safeguarding systems from potential cyberattacks.

The digitalization of the food industry has accelerated significantly since 2020, driven by changing consumer behavior and the global COVID-19 pandemic. [12] observed a rapid increase in the adoption of digital platforms among small food businesses, particularly in Indonesia, as a response to growing demand for online ordering. These systems simplify operations while enabling vendors to adapt to evolving customer expectations. Similarly, [13) emphasized that web technologies provide valuable opportunities for food businesses to maintain competitiveness and expand market reach in the digital age. Overall, web-based systems are proving indispensable in transforming food businesses, offering cost-effective, scalable, and customer-focused solutions that address the needs of both vendors and consumers. The development of platforms like Bakso Bytes is therefore crucial to supporting businesses in navigating the increasingly competitive and technology-driven food industry.

III. RESEARCH METHODOLOGY

The development of Bakso Bytes will occur in multiple phases, utilizing the Agile methodology. This approach promotes continuous delivery and progress, offering flexibility and iterative improvements. The project will proceed through the following phases:

Figure 1 Agile Methodology

The development process will begin with stakeholder meetings, where discussions with the café staff and manager will be held to gather specific requirements and gain a clear understanding of their business needs. Following this, user stories will be created to represent the desired functionalities and features that stakeholders want included in the system. Finally, the items in the backlog will be prioritized based on their business value and

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

feasibility, ensuring that the most critical features are addressed first.

During the design phase, our team will start by creating wireframes and user interface mockups, with a strong emphasis on user experience and ease of navigation. The goal is to ensure the interface is intuitive and user-friendly. Following this, we will define the system architecture, specifying how the front-end, back-end, and database components interact. This will include outlining the data flow and interactions within the prototype design.

In the development and coding phase, we will begin by building the front-end interface using HTML and CSS, ensuring it is responsive and easy to use. PHP will be utilized for back-end development, focusing on data processing and applying business logic. The database will be set up and developed using Apache to ensure data integrity and efficient query handling. Throughout this process, we will take an iterative approach, making continuous modifications based on feedback to ensure the system meets all the requirements we have gathered.

The deployment phase will involve careful planning, including user training, data migration, and server configuration. Once these steps are completed, the system will be deployed in a production environment to ensure that it does not cause any significant disruptions to current operations. The system's stability and performance will be closely monitored, and any issues that arise will be addressed promptly to ensure a smooth user experience.

In the review phase, user feedback will be collected to assess the functionality and performance of the system. This feedback will be used to make continuous improvements by adding suggestions and areas for enhancement to the product backlog for future sprints. Bakso Bytes will undergo ongoing refinement to ensure it aligns with the changing needs of the stakeholders at Gerai Ina Bakso Singkawang.

A. FUNCTIONAL REQUIREMENT

The functional requirements for the system encompass several key areas to ensure efficient and user-friendly management. Figure 2, show a Use Case Diagram of Bakso Bytes. User Management is a foundational feature, enabling users to create accounts and log in, with role-based access controls distinguishing functionalities for customers, staff, and admins. Menu Management allows customers to view available menu items with details such as

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

names and prices, while admins and staff can add, edit, and remove items. Additionally, the system supports the creation and display of promotional offers alongside regular menu items for customers.

The Ordering System provides customers with the ability to place orders by selecting menu items, specifying quantities, and reviewing or modifying orders before final submission. On the other hand, Order Management ensures that staff can manage incoming orders and update their statuses, as well as track table availability in real-time.

The system also incorporates Inventory Management, where staff and admins can maintain inventory by adding, updating, or deleting items and tracking ingredient quantities. Ingredient stock levels automatically update based on menu orders, ensuring real-time inventory accuracy.

Finally, Reporting and Analytics are available to admins, offering insights into sales performance, order volumes, and revenue statistics. Together, these features create a robust, integrated system designed to enhance operational efficiency and customer satisfaction.

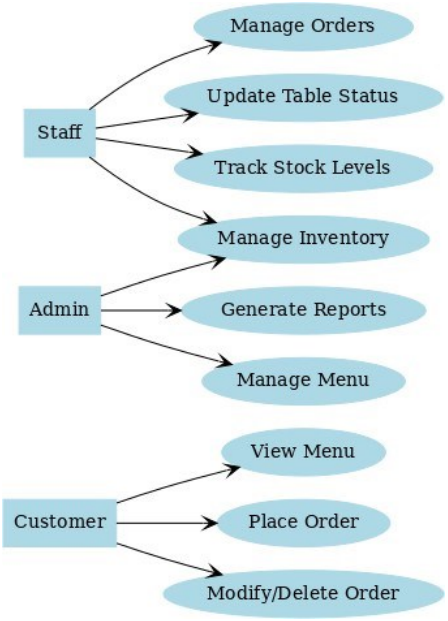


Figure 2 Use Case diagram

B. SYSTEM ARCHITECTURE

The system architecture for Bakso Bytes adopts a multi-tier structure, which includes the Client Layer, Web Server, Application Layer, and Database Layer. This architecture is designed to ensure flexibility, performance, and scalability,

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

particularly for small-scale food businesses that require efficient yet affordable digital solutions.

The Client Layer serves as the main access point for users including customers, staff, and administrators. These users interact with the system through standard web browsers on desktop computers or mobile devices. The system's responsive web interface ensures seamless usability across various screen sizes, enabling users to place orders, update inventory, and view reports with ease.

The Web Server Layer acts as a communication bridge between the client and the backend application. It processes HTTP requests, maintains session control, and forwards valid inputs to the application logic. Apache is utilized as the web server due to its high compatibility with PHP and MySQL, ensuring smooth integration across system layers.

The Application Layer contains the core business logic of the system, developed using PHP. It handles all critical processes such as order validation, inventory deduction, report generation, and user authentication. This layer also supports role-based access control, enabling different user experiences depending on the user's responsibilities. Its modular design allows future upgrades like payment gateway integration or delivery tracking to be implemented efficiently.

The Database Layer is powered by MySQL and stores all structured data, including customer profiles, menu details, ingredient stocks, and transaction history. The database schema is normalized to reduce redundancy and ensure data consistency. Foreign key constraints are applied to maintain referential integrity across multiple tables, and indexing is used to optimize query performance during high-traffic operations.

The system is deployed on a cloud-compatible server, enabling centralized access, remote management, and potential scalability as the user base expands. Figure 3 illustrates the flow of interaction and data exchange between each architectural layer. This architecture is strategically designed to align with the operational needs of traditional food vendors while enabling them to transition smoothly into digital management systems.

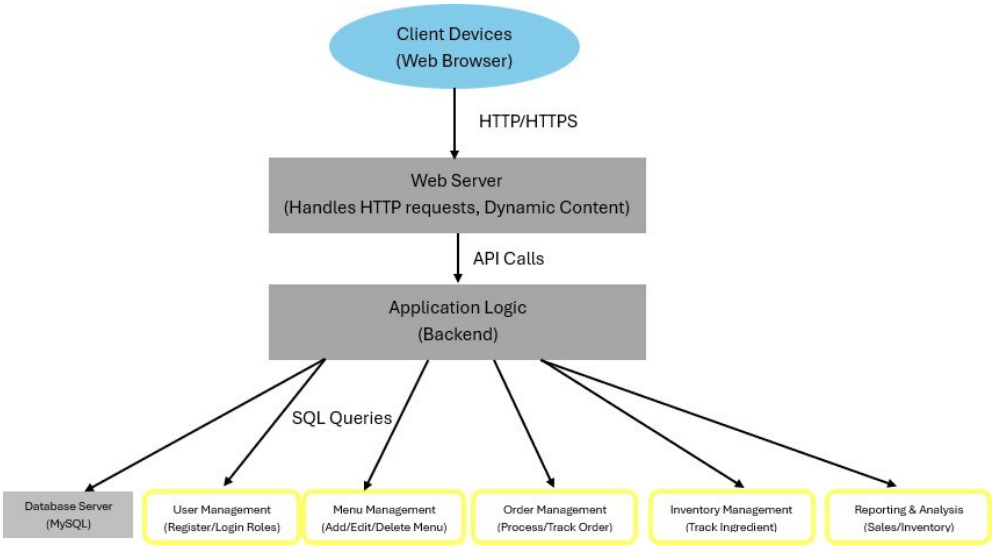


Figure 3 System Architectural Diagram

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

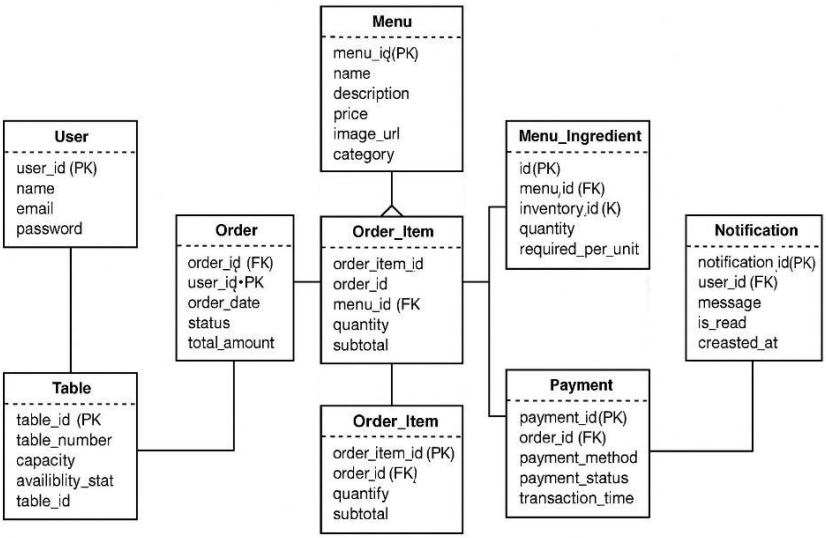


Figure 4 Entity Relationship Diagram

The Entity-Relationship Diagram (ERD) in Figure 4 illustrates the database design for the cafe management system, encompassing the key entities and their relationships to fulfill the system's functional requirements. The Customers entity captures user details, including their name, contact information, and login credentials, with a one-to-many relationship to the Orders entity, as each customer can place multiple orders. The Orders entity records essential order details, such as menu items, quantities, payment methods, and dining options, while also linking to the Tables entity for dine-in orders. The Menu entity maintains a comprehensive list of menu items, including their names, prices, images, and promotional details, with a many-to-many relationship to the Orders entity and a connection to the Grocery entity to track ingredients.

The Tables entity represents seating arrangements, capturing details like table capacity and availability, which integrates with the Orders entity for efficient table management. The Staff entity stores employee information, including roles, enabling role-based system access and management of various operations. The Grocery entity is crucial for inventory management, tracking ingredient quantities and automatically updating stock levels based on menu orders. This ERD ensures streamlined order management, real-time inventory tracking, and effective table assignments while supporting dynamic menu updates and promotional offers. It is designed for operational efficiency, scalability, and enhanced user satisfaction, aligning with both business and customer needs.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

C. HARDWARE AND SOFTWARE REQUIREMENT

To develop and run the Bakso Bytes web-based system, certain hardware and software requirements must be met to ensure optimal performance. Hardware requirements include a device capable of browsing the web, such as laptops, tablets, or mobile phones. The system should be operated on a device with at least a dual-core processor, such as an Intel Core i3 or an AMD equivalent, to ensure smooth operation, especially when browsing or interacting with the system. A minimum of 4 GB of RAM is recommended for handling basic operations, particularly if multiple browser tabs are open. For storage, a 128 GB SSD is ideal, offering speed and efficient performance for quick data retrieval and system responsiveness. A reliable internet connection with at least 50 Mbps is also essential for smooth data transactions and uninterrupted online activities.

In terms of software requirements, the system should be accessible via modern web browsers such as Google Chrome, Mozilla Firefox, Safari, or Microsoft Edge, with the latest versions for compatibility and security. It is designed to work on any operating system that supports these browsers, including Windows 10+, macOS for desktops, and Android or iOS for mobile devices. For development, tools like Visual Studio Code or Notepad, optimized for PHP and HTML development, are necessary. Database handling requires XAMPP, which includes Apache, PHP, and MySQL, to support local development and manage

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

the backend data. Finally, for hosting the web application, a shared hosting plan that supports PHP 8.0+ and MySQL with phpMyAdmin access is recommended for production, providing a reliable and scalable platform to run the system. These hardware and software specifications are crucial to ensure Bakso Bytes runs smoothly and efficiently, meeting both the business needs and user expectations.

IV. DATA ANALYSIS AND TESTING

During the system development phase, the integration and testing process plays a crucial role in ensuring that each system component functions smoothly and meets the specified requirements. The front-end, back-end, and database modules were fully integrated to enable seamless data flow and effective communication between all components.

A comprehensive testing approach was employed, including Unit Testing, Integration Testing, System Testing, and User Acceptance Testing (UAT). This iterative testing process helped to identify and resolve defects early, ensuring a stable and reliable system. The primary objective of the testing phase is to validate that the system operates as intended and fulfills all performance criteria.

The overall testing process, which includes Unit Testing and Integration & System Testing, confirms that the system components perform reliably and meet the expected functional requirements. All test cases were executed successfully, as summarized in Table 1.

Table 1 Unit Testing

Test Category	Test Area	Key Functionality Tested	Expected Outcome	Result
Unit Testing	User Login	Authentication using valid credentials and handling login errors	Redirects to homepage upon successful login	Pass
	Staff Page	Access to authorized staff tasks only	Staff can perform tasks based on access level	Pass
	Customer Page	Order placement, viewing, and editing based on menu	Customer can manage and place orders effectively	Pass
Integration & System	Application Access	Launch and navigation of the web-based system	Smooth access and transition between pages	Pass
	Order Processing	Order creation, processing, and display	Orders are accurately recorded and shown in the database	Pass
	Database Interaction	Retrieval and update of user data	Data matches input and updates are reflected in real-time	Pass
	Payment Gateway	Payment processing with third-party integration	Transactions complete successfully with confirmation	Pass
	API Connectivity	Front-end and back-end communication	API returns correct and expected responses	Pass
	User Notification	Delivery of real-time status updates	Notifications are sent to users accordingly	Pass

V. CONCLUSION

In conclusion, this research highlights the significant role of web-based systems in transforming the food and beverage industry by improving operational efficiency, customer satisfaction, and business

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

scalability. The findings underscore that web-based platforms, such as online food ordering and real-time order processing systems, effectively address traditional operational challenges like delivery delays, manual errors, and limited market reach. Furthermore, web-based systems enable SMEs to streamline inventory management, process customer feedback, and leverage data analytics for personalized customer experiences.

The review also demonstrates that user-friendly interface design (UI/UX) is crucial in encouraging technology adoption and enhancing customer interactions with these systems. Despite

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

the benefits, challenges such as data security risks and system scalability must be carefully managed through strategies like encryption, multi-layer authentication, and continuous system monitoring.

Digitalization has proven vital in ensuring business continuity, particularly in adapting to shifts in consumer behavior post-pandemic. By implementing web-based solutions, food businesses can maintain competitiveness, optimize operations, and expand their customer base. The development of systems like Bakso Bytes is a response to these needs, offering innovative, efficient, and customer-centric solutions in a dynamic market environment.

Ultimately, the study concludes that the adoption of web-based systems provides a strategic advantage for food businesses by streamlining operations, improving customer experience, and ensuring sustainability. Moving forward, continuous innovation, strategic investment in security, and attention to user design will be key to maximizing the potential of web-based systems in the food and beverage sector.

ACKNOWLEDGMENT

The authors would like to express their sincere appreciation to the staff and management of Gerai Ina Bakso Singkawang for their cooperation and valuable input during the system development process. Gratitude is also extended to all individuals who contributed directly or indirectly to the success of this project. Special thanks to family and friends for their continuous moral support and encouragement throughout the completion of this study.

REFERENCES

[1] M. Al-Bakri and M. Qasem, "Impact of Online Food Ordering Systems on SMEs," *International Journal of E-Business and E-Government Studies*, vol. 12, no. 2, pp. 45–56, 2020.

[2] R. Prabowo and B. Nugroho, "Real-Time Order Processing for Traditional Food Business Efficiency," *Journal of Foodservice Business Research*, vol. 24, no. 1, pp. 33–48, 2021.

[3] A. Kurniawan, M. Santoso, and T. Lestari, "Modernizing Food Business Operations Using Centralized Web Systems," *Journal of Web Technology and Application*, vol. 19, no. 3, pp. 112–121, 2021.

[4] V. Chandra and G. Priyadarshini, "Customer Relationship Management via Web-Based Systems," *International Journal of Business Information Systems*, vol. 15, no. 4, pp. 87–94, 2020.

[5] S. Kumar, R. Ismail, and A. Hamzah, "Scalability and Cost-Effectiveness of Web-Based Systems in SMEs," *Asia-Pacific Journal of Innovation in Hospitality and Tourism*, vol. 11, no. 1, pp. 58–67, 2022.

[6] H. Hadi, S. Sulaiman, and R. Johari, "Enhancing Market Reach Through Web-Based Platforms," *Journal of Digital Business*, vol. 14, no. 2, pp. 72–81, 2023.

[7] M. Asih, R. Yuliani, and S. Gunawan, "Digital Transition in Food Industry During COVID-19," *International Journal of Business Continuity and Risk Management*, vol. 6, no. 4, pp. 120–130, 2021.

[8] F. Alharbi and S. Drew, "Impact of UI/UX on User Adoption in Web Applications," *Journal of User Experience and Web Design*, vol. 10, no. 2, pp. 25–34, 2020.

[9] A. Ashraf, L. Rahim, and N. Jalil, "Responsive Interfaces and Customer Engagement," *Malaysian Journal of Computing*, vol. 6, no. 1, pp. 40–49, 2021.

[10] A. Al-Janabi, B. Hassan, and Y. Fadhil, "Cybersecurity Risks in Web-Based Systems," *International Journal of Cybersecurity Intelligence & Cybercrime*, vol. 4, no. 2, pp. 33–44, 2021.

[11] S. Wattanajantra, K. Nair, and A. Prasetyo, "Security Practices in Web Application Deployment," *International Journal of Information Security and Privacy*, vol. 17, no. 1, pp. 19–29, 2022.

[12] H. Purwanto, N. Widodo, and R. Fitria, "Adoption of Digital Platforms in Indonesian Food SMEs," *Asian Journal of Entrepreneurship*, vol. 9, no. 3, pp. 65–74, 2021.

[13] A. Rahman, M. Abdullah, and S. Karim, "Web Technology for Market Expansion in the F&B Sector," *Journal of Business and Technology*, vol. 17, no. 2, pp. 99–107, 2022.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

Second Author: Name 	Jabatan Teknologi Maklumat dan Komunikasi, Politeknik Kuching Sarawak, KM22, Jalan Matang, Kuching, 93050, Malaysia E-mail: n_nisa@poliku.edu.my
Second Author: Name 	Jabatan Kejuruteraan Mekanikal, Politeknik Kuching Sarawak, KM22, Jalan Matang, Kuching, 93050, Malaysia E-mail: herman@poliku.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Arduino-Powered Portable Motorized Car Lifter: An Intelligent Solution for Ergonomic Vehicle Lifting

Herman Nordiadi Abd Wahab[1], Nurul Nisa Mohd Nasir[2]

[1] *Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia*
E-mail: herman@poliku.edu.my

[2] *Politeknik Kuching Sarawak, Kuching, Sarawak, Malaysia*
E-mail: n_nisa@poliku.edu.my

Abstract

Vehicle maintenance tasks such as tire replacement often require car-lifting tools that are physically demanding and time-consuming. Traditional manual jacks, though affordable, pose ergonomic challenges and safety risks, especially for users with limited physical strength. On the other hand, advanced automated lifting systems remain financially inaccessible to many small-scale workshops and individual users. This research aims to design and develop a smart, portable electro-hydraulic car jack system controlled by Arduino, offering a safer, faster, and user-friendly alternative. The main objective of this project is to automate the vehicle-lifting process using a motorized hydraulic jack integrated with Arduino-based control, sensors, and DC motors. The system is powered by a 12V car battery, making it suitable for both workshop and roadside use. The development follows the Agile methodology, encompassing planning, design, prototyping, testing, and user feedback phases. An ultrasonic sensor and LED indicators were used to enhance safety and provide operational feedback. Testing results demonstrate that the proposed system requires only 45 Nm of torque to lift a vehicle, compared to 70 Nm for a manual scissor jack. It also achieves a lifting height of 50 cm within 1 minute and 48 seconds, significantly faster than conventional tools. The findings confirm improved efficiency, reduced physical strain, and greater user accessibility. In conclusion, this Arduino-powered electro-hydraulic jack offers a practical and cost-effective solution for safe vehicle lifting. It is particularly advantageous for users in emergency scenarios and for workshops seeking a low-cost automation upgrade.

Keywords **:** *Arduino; Mobile jack; Automotive*

I. INTRODUCTION

Hydraulic jacks play a crucial role in lifting heavy loads, particularly in automotive repair, by utilizing hydraulic pressure. However, traditional methods involving manual labour remain prevalent among many car repairers despite being labour-intensive and time-consuming [1]. While modern car-lifting equipment such as automated lifts and advanced hydraulic systems are effective, they are often associated with high acquisition and maintenance costs, making them inaccessible to small-scale repair shops or individual vehicle owners [3].

In developing regions, where affordability is a major concern, these high costs create a significant barrier to adoption [4]. Moreover, the operational complexity of such modern systems often requires specialized training, limiting usability among general consumers. On the other hand,

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

manual car jacks remain the most affordable option but demand significant physical effort to operate, posing challenges especially for elderly users or individuals with limited physical strength [2]. Prolonged usage can also cause musculoskeletal strain or injuries during frequent or heavy-duty applications [9].

Beyond cost and operational challenges, safety is another critical concern. The use of low-quality equipment or improper handling increases the risk of accidents, which can lead to vehicle damage or user injury [10]. Thus, there is a pressing need for a comprehensive solution that balances affordability, safety, and ease of use.

To address these challenges, this project proposes the development of a control motor hydraulic jack that automates the lifting process. Powered by a motor and using hydraulic principles, the proposed system aims to offer an affordable, efficient, and user-friendly solution [11].

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Automation significantly reduces manual effort, making the tool more accessible to all users, including women and the elderly. Additionally, the motorized control enhances ease of operation and eliminates the steep learning curve associated with conventional lifting systems.

This research emphasizes achieving an optimal balance between affordability and functionality, ensuring that the system remains high-quality and durable while being accessible to small repair shops and individual users. The design prioritizes safety by incorporating reliable materials and user-centric features. Furthermore, the use of the vehicle's own battery to power the system enhances portability and makes it suitable for roadside emergencies [4].

The following sections of this paper will elaborate on the conceptual design, technical development, and performance evaluation of the proposed system. Key aspects such as cost-effectiveness, safety features, and user benefits will be discussed to highlight how this innovation could redefine traditional vehicle-lifting practices.

II. LITERATURE REVIEW

Car-lifting equipment is an essential component in automotive maintenance, with a variety of designs developed to suit different user needs. Manual jacks, such as scissor and bottle jacks, are the most commonly used due to their affordability and portability. However, these jacks require considerable physical effort, making them less practical for users with limited strength, such as the elderly or women.

Hydraulic jacks, like trolley and floor jacks, offer better efficiency as they use fluid pressure to lift vehicles with minimal effort. These are widely used in workshops where their capacity to handle heavier loads proves beneficial. More advanced lifting systems such as two-post or four-post lifts provide even higher levels of performance and safety. However, their high purchase and maintenance costs often make them inaccessible to small-scale operators [3].

In addition to the cost factor, advanced systems generally require skilled operators. This training requirement increases operational complexity and reduces the systems' appeal for general consumers. Meanwhile, manual jacks, though cheaper, remain time-consuming and physically demanding to use. Regular or extended use can cause musculoskeletal discomfort, especially when applied in repeated or heavy-lifting tasks.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Safety issues are also central to the discourse on car-lifting tools. Manual jacks are often misused, or made from poor-quality materials, which can result in equipment failure or accidents during operation. In emergency roadside situations, where conditions may be uneven or unstable, the risks are heightened due to the absence of built-in safety mechanisms.

Although automated systems address some of these safety risks, they bring new challenges. Their size and reliance on external power make them unsuitable for portable or emergency use. On the other hand, while manual jacks are more mobile, they lack efficiency, which is crucial during time- sensitive repairs.

To overcome these limitations, modern innovations are incorporating motorized hydraulic mechanisms. These systems use electric motors to drive hydraulic pumps, eliminating the need for manual pumping. The motor supplies constant pressure, resulting in smooth, consistent lifting performance. In some designs, these systems draw power directly from the vehicle's battery [11], enhancing portability and making them ideal for roadside use.

Emerging designs now integrate smart control systems that include pressure monitoring and automated shut-off features. For example, pressure sensors can detect a sudden drop in hydraulic force and respond by adjusting the motor’s output or stopping it entirely to prevent instability [10].

One of the most significant advancements in this domain is the incorporation of Arduino-based microcontrollers. Arduino boards offer flexibility, low cost, and ease of integration with various sensors and actuators. These microcontrollers act as the “brain” of the system, managing motor speed, monitoring inputs, and executing safety protocols in real time [9].

Because Arduino is open-source and widely supported, it provides a practical platform for building intelligent systems at a relatively low cost. Its modularity allows for easy system upgrades, while wireless connectivity options enable future enhancements such as remote control or monitoring via mobile devices [13].

With the integration of sensors, automation, and programmable logic, modern car-lifting tools are evolving into smart systems. They not only improve lifting performance but also offer enhanced safety and user convenience. Such improvements are especially valuable for users who lack technical experience but still require reliable tools in emergency situations.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

In summary, the trend in car-lifting technology is shifting toward affordable, smart, and motorized systems that minimize physical effort while maximizing safety and usability. This transformation is driven by the use of motor-hydraulic combinations, microcontroller integration, and intelligent feedback systems. The development of such systems aligns with the goal of this project to provide an accessible and efficient car-lifting solution suitable for a wide range of users, including individuals and small-scale workshops.

III. RESEARCH METHODOLOGY

The development of the Portable Motorized Car Lifter utilized the Agile methodology. According to [7], [8], Agile is an ideal approach for product development as it enables more efficient and effective problem-solving. This methodology is divided into five key phases: planning, design, development, testing, and feedback, as shown in Figure 1. The iterative and flexible nature of this approach ensures that the development process can adapt to user needs and feedback at every stage.

Figure 1 Agile Methodology

The planning phase serves as the initial step in the Agile methodology, focusing on analyzing the requirements for developing the device. During this phase, key aspects such as the problem statement, proposed solutions, objectives, scope, and constraints of the device are identified. The design phase involves creating system designs, software, hardware, and prototypes to ensure the product meets its objectives. In the development phase, the Portable Motorized Car Lifter is constructed. This prototype then undergoes multiple evaluations in the testing phase, aimed at identifying and resolving errors in the Arduino circuit and the prototype itself. The final phase, feedback, gathers user input on the Portable Motorized Car Lifter. This feedback is instrumental in guiding future enhancements and improvements to the product.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

A. BLOCK DIAGRAM

The block diagram for the Portable Motorized Car Lifter outlines the system's functionality as shown in Figure 2. The ultrasonic sensor acts as the input, sending data to the Arduino circuit for processing. Once processed, the red, green, and blue LEDs serve as outputs, delivering visual feedback to the user. To ensure the accuracy of physical connections and coding, the Simulator 2021 software was utilized. This software enables testing of both coding and physical connections prior to the development of the product prototype. Figure 3 illustrates the simulator interface for this device. The use of Simulator 2021 helps to minimize the risk of damage to the hardware during prototype development.

Figure 2 Block diagram

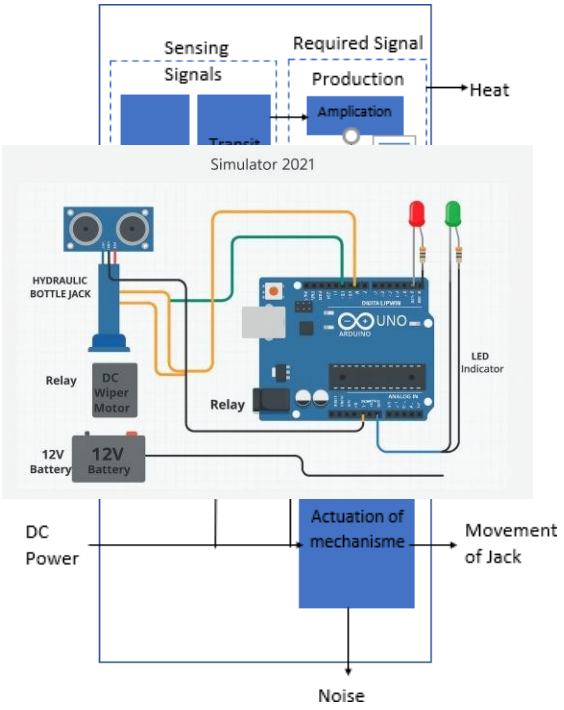


Figure 3 Simulator interface

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

B. HARDWARE AND SOFTWARE DESIGN

The core hardware components include a 12V DC gear motor, a hydraulic cylinder, relay module, pressure sensor, and an Arduino UNO microcontroller. The Arduino UNO was chosen due to its affordability, wide community support, and sufficient capabilities for basic control and monitoring tasks [5].

The system uses a DC motor to power the hydraulic pump, which provides the force required to lift a vehicle. The motor is controlled via a relay module interfaced with the Arduino. Arduino programming was carried out using the Arduino IDE, with sketches developed based on the system requirements. Programming followed structured pseudocode and modular functions for reliability and ease of debugging [6]. The hydraulic jack mechanism is mounted on a trolley frame for mobility. This design ensures that the system remains practical for both workshop and roadside environments.

Figure 4 show the final design of portable motorized car lifter. The components required for the development of the Portable Motorized Car Lifter include the Arduino UNO R4 Wi-Fi, DC Motor Wiper for pumping, Jumper Wires, and a DC Motor for the pressure valve. Additionally, 14 AWG Wire (6 meters) is used, costing, along with Iron Material and a Hydraulic Bottle Jack. The construction also involves Plain Wood and the L298N Motor Driver. Lastly, a Lever Arm is used, with no associated cost. These components collectively support the development and functionality of the system.

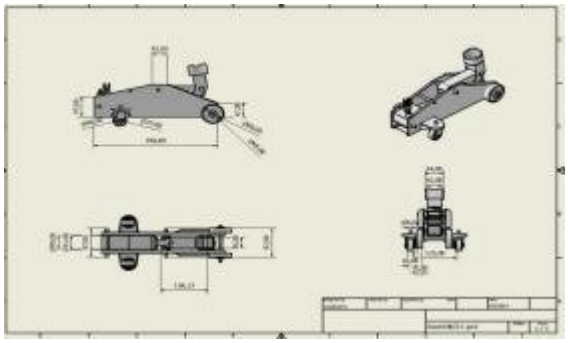


Figure 4 Final design of portable motorized car lifter

C. PRODUCT DESIGN

Figure 5 showcases the developed Portable Motorized Car Lifter, while Figure 6 illustrates the Arduino circuit integrated with an ultrasonic sensor and red, green, and blue LEDs. The circuit is securely placed inside a box to prevent direct exposure to water. The jack pumping valve is connected to an iron rod, which was crafted by grinding and welding, and is linked to a DC wiper motor to facilitate the pumping action. A second DC motor is welded to the pressure valve to automate its opening and closing every 3 seconds. Both DC motors are controlled by a control panel consisting of an Arduino UNO R4 Wi-Fi and an L298N motor driver. The control panel receives power from a 12V car battery to supply the necessary electrical current for operation.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Figure 5 Final product in testing

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

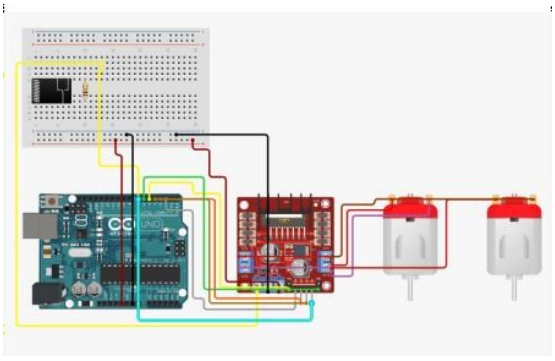


Figure 6 Integration of Arduino UNO and motor wiper

IV. DATA ANALYSIS AND TESTING

The findings indicate that the Portable Motorized Car Lifter offers superior performance compared to the scissor jack. Powered by a 12V car battery, it uses a direct current motor to operate the hydraulic pump, requiring only 45 Nm of energy significantly less than the 70 Nm required by the manually operated scissor jack. It also achieves a greater maximum height of 50 cm, compared to the scissor jack's 30 cm, and is more time-efficient, lifting the car in 1 minute and 48 seconds, which is 47 seconds faster. These results demonstrate that the Portable Motorized Car Lifter is a more efficient and user-friendly solution than the traditional scissor jack.

Table 1 summarizes the results of testing conducted in week 12 to compare the performance of a scissor jack with a Portable Motorized Car Lifter. The comparison highlights significant differences in energy consumption, maximum height, and operational efficiency between the two devices.

Table 1 Performance Comparison Between Scissor Jack and Portable Motorized Car Lifter

No.	Criteria	Scissor Jack	Portable Motorized Car Lifter
1	Energy Source	Human Strength	12V DC Power Window
2	Tire Distance from Ground	3 cm	3 cm
3	Maximum Jack Height	30 cm	50 cm
4	Energy Required to Lift	70 Nm	45 Nm
5	Time to Lift Car	2 min 35 sec	1 min 48 sec

The data findings indicate that the motorized car lifter is efficient, time-saving, and offers a safer, more ergonomic, and user friendly solution for both vehicle owners and service professionals. This system enhances convenience by reducing risks associated with physical exertion and improper handling. The findings confirm that the Portable Motorized Car Lifter is a practical, cost-effective, and innovative alternative to traditional scissor jacks. With its superior performance and advanced technology, it has the potential to transform the way vehicle maintenance and tire-changing tasks are performed.

V. CONCLUSION

In conclusion, the Portable Motorized Car Lifter is a battery-powered car jack designed to make tire changes simpler, safer, and more convenient. This innovative solution is particularly useful for

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

addressing unexpected car issues during long-distance travel, allowing users to lift their vehicles with ease while minimizing the risk of side injuries. Additionally, it promotes energy conservation by eliminating the need for the manual labour typically required with traditional hydraulic jacks.

The product's introduction has the potential to transform vehicle maintenance by improving accessibility for a broader range of users, including the elderly and individuals with limited physical strength. Furthermore, the system's ability to minimize physical strain reduces the risk of injury, thereby enhancing safety during vehicle servicing.

In summary, the Portable Motorized Car Lifter not only provides a practical and cost-effective alternative to traditional scissor jacks but also contributes to greater user convenience, time savings, and improved safety. This innovative solution has the potential to positively impact the

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

automotive repair industry, making vehicle maintenance faster, safer, and more efficient for both vehicle owners and service professionals.

ACKNOWLEDGMENT

The authors would like to express their sincere appreciation to all individuals who contributed directly or indirectly to the success of this project. Special thanks to family and friends for their continuous moral support and encouragement throughout the completion of this study. Special thanks to family and friends for their continuous moral support and encouragement throughout the completion of this study.

REFERENCES

[1] P. Pandian and M. Balasubramanian, "Design and fabrication of automatic car jack system using gear motor," *Int. J. Eng. Res. Technol.*, vol. 5, no. 3, pp. 1–5, 2016.

[2] R. Sankar and K. Elangovan, "Low cost automatic car jack system using DC motor and microcontroller," *Int. J. Sci. Res. Eng. Manage.,* vol. 3, no. 7, pp. 20–25, 2019.

[3] M. Khaleel and A. Ismail, "Design and fabrication of hydraulic car jack," *Int. J. Eng. Tech*., vol. 4, no. 2, pp. 78–84, 2018.

[4] A. H. Abdalla and M. S. Ahmed, "Development of an electro-hydraulic jack powered by vehicle battery," *J. Eng. Appl. Sci., vol. 12*, no. 8, pp. 2180–2185, 2017.

[5] M. Banzi and M. Shiloh, Getting Started with Arduino, 3rd ed. Sebastopol, CA: Maker Media, 2014.

[6] S. Monk, Programming Arduino: Getting Started with Sketches, 2nd ed. New York, NY: McGraw-Hill, 2015.

[7] K. Beck and C. Andres, Extreme Programming Explained: Embrace Change, 2nd ed. Boston, MA: Addison-Wesley, 2004.

[8] M. A. Firdaus, "Agile Development Methodology," *J. Comput. Eng., vol. 10*, no. 1, pp. 15–20, 2017.

[9] A. U. Oke, T. A. Okonigene, and O. A. Olusola, "Design and implementation of a microcontroller based hydraulic car jack," *Int. J. Eng. Res. Technol*., vol. 2, no. 8, pp. 1357–1363, 2013.

[10] A. A. Adekunle and R. A. Ibrahim, "Microcontroller based intelligent jack system for automobile maintenance," *Int. J. Sci. Eng. Technol.,* vol. 6, no. 3, pp. 184–188, 2017.

[11] M. W. Ahmad, M. A. Zakaria, and A. Z. Zulkifli, "Development of an automated car jack system using Arduino," in *Proc. IEEE 8th Control and System Graduate Research Colloquium (ICSGRC)*, Shah Alam, Malaysia, 2017, pp. 56–60.

[12] A. M. Shahid and M. H. Rahman, "Arduino based smart hydraulic jack," *Int. J. Adv. Comput. Sci. Appl.,* vol. 9, no. 11, pp. 391–395, 2018.

[13] F. A. Salim and A. K. Syahrul, "Smart hydraulic jack controlled by Arduino and Bluetooth*," J. Mech. Eng. Sci., vol. 13*, no. 3, pp. 5403–5412, 2019.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: Name 	Jabatan Kejuruteraan Mekanikal, Politeknik Kuching Sarawak, KM22, Jalan Matang, Kuching, 93050, Malaysia E-mail: herman@poliku.edu.my
Second Author: Name 	Jabatan Teknologi Maklumat dan Komunikasi, Politeknik Kuching Sarawak, KM22, Jalan Matang, Kuching, 93050, Malaysia E-mail: n_nisa@poliku.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Tahap Pengetahuan dan Persepsi Pelajar Jabatan Kejuruteraan Elektrik Politeknik Ungku Omar Terhadap Teknousahawan

Sharmila Bt Md Isa[1], Saadiah Binti Seman[2], Fadilah Binti Ahmad[3]
[1,2,3] *Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, 31400 Ipoh, Perak*
E-mail: sharmila.mdisa@puo.edu.my

Abstrak

Dalam era Revolusi Industri 4.0, pendedahan awal terhadap konsep teknousahawan di peringkat politeknik amat penting bagi melahirkan graduan yang bukan sahaja mahir dari segi teknikal, tetapi juga berkeupayaan mencipta peluang perniagaan berasaskan teknologi. Sehubungan itu, satu kajian telah dijalankan bagi menilai tahap pengetahuan pelajar serta persepsi mereka terhadap teknousahawan. Kajian ini juga bertujuan untuk menganalisis hubungan antara tahap pengetahuan dan persepsi pelajar terhadap bidang tersebut. Kajian ini menggunakan reka bentuk kajian kuantitatif deskriptif bagi memperoleh data yang menyeluruh, sistematik dan boleh diukur berkaitan sikap serta kefahaman pelajar terhadap teknousahawan. Satu set soal selidik berstruktur telah diedarkan kepada 62 orang pelajar Sesi 1 2024/2025 daripada tiga program pengajian iaitu Diploma Kejuruteraan Elektrik dan Elektronik (DEE), Diploma Kejuruteraan Elektronik Perhubungan (DEP), dan Diploma Kejuruteraan Elektronik Komputer (DTK). Hasil kajian menunjukkan bahawa tahap pengetahuan pelajar terhadap teknousahawan berada pada tahap tinggi. Persepsi mereka terhadap bidang ini juga adalah sangat positif, membuktikan bahawa mereka bukan sahaja memahami konsep teknousahawan, malah mengiktiraf sumbangan serta potensi kerjaya dalam bidang ini sebagai satu laluan masa depan yang menarik dan berdaya saing. Selain itu, kajian ini turut mendapati wujudnya hubungan yang signifikan dan sangat kuat antara tahap pengetahuan dengan persepsi pelajar terhadap teknousahawan. Dapatan ini menunjukkan bahawa peningkatan pengetahuan pelajar dalam bidang teknousahawan turut mempengaruhi persepsi positif

***Kata Kunci** : Teknousahawan, Pengetahuan, Persepsi, Pelajar, Keusahawanan Teknologi*

In the era of Industrial Revolution 4.0, early exposure to the concept of technopreneurship at the polytechnic level is very important to produce graduates who are not only technically skilled, but also capable of creating technology-based business opportunities. In this regard, a study was conducted to assess the level of students' knowledge and their perceptions of technopreneurship. This study also aimed to analyze the relationship between the level of knowledge and perceptions of students in the field. This study used a descriptive quantitative research design to obtain comprehensive, systematic and measurable data related to students' attitudes and understanding of technopreneurship. A set of structured questionnaires was distributed to 62 students in Session 1 2024/2025 from three study programs, namely the Diploma in Electrical and Electronic Engineering (DEE), Diploma in Communication Electronics Engineering (DEP), and Diploma in Computer Electronics Engineering (DTK). The results of the study showed that the level of students' knowledge of technopreneurship was at a high level. Their perception of this field was also very positive, proving that they not only understood the concept of technopreneurship, but also recognized the contribution and potential of a career in this field as an interesting and competitive future path. In addition, this study also found that there was a significant and very strong relationship between the level of knowledge and students' perception of technopreneurship. This finding indicates that increasing students' knowledge in the field of technopreneurship also influenced positive perceptions

***Keywords:** Technopreneur, Knowledge, Perception, Students, Technology Entrepreneurship*

I. PENGENALAN

Dalam landskap ekonomi moden yang sangat dinamik dan berdaya saing, usahawan dan bidang keusahawanan memainkan peranan penting sebagai pemacu pertumbuhan ekonomi negara. Keusahawanan bukan sahaja menjadi sumber kepada penciptaan pekerjaan dan inovasi, malah turut menyumbang kepada pembangunan komuniti

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

dan pengurangan kadar pengangguran. Menurut Schumpeter (1934), usahawan adalah agen perubahan ekonomi yang membawa inovasi ke pasaran melalui proses kreatif dan dinamik [1].

Di Malaysia, usaha berterusan telah dijalankan untuk memperkasakan bidang keusahawanan dalam kalangan generasi muda, termasuk pelajar institusi pengajian tinggi seperti politeknik dan insitusi pengajian awam. Inisiatif seperti Program Tunas Usahawan Belia Bumiputera (TUBE), Geran Tekun, dan program pembangunan keusahawanan di Politeknik dan Universiti Awam membuktikan bahawa kerajaan serius dalam memupuk budaya keusahawanan di peringkat awal.

Seiring dengan perkembangan teknologi digital dan Revolusi Industri 4.0, munculnya konsep teknousahawan iaitu usahawan yang memanfaatkan teknologi untuk membangunkan produk, perkhidmatan atau model perniagaan yang inovatif dan bernilai tambah. Teknousahawan menjadi semakin relevan kerana mereka bukan sahaja mencipta nilai ekonomi, tetapi juga mampu menyelesaikan masalah sosial dan meningkatkan kecekapan melalui automasi, digitalisasi, dan penggunaan data raya.

Pembangunan teknousahawan dalam kalangan pelajar adalah amat penting kerana ia membuka peluang baharu dalam kerjaya serta menjadikan pelajar lebih bersedia menghadapi cabaran pasaran kerja yang kian berubah. Menurut kajian oleh Azizan et al. (2022), pelajar yang mempunyai pendedahan terhadap keusahawanan teknologi menunjukkan tahap daya saing dan kebolehpasaran yang lebih tinggi [2]. Jesteru, kertas kerja ini memperlihatkan kepentingan kajian awal untuk menilai pengetahuan dan persepsi pelajar mengenai bidang teknousahawan. Kajian ini amat relevan kerana keusahawanan berasaskan teknologi semakin mendapat perhatian dalam konteks pendidikan tinggi dan industri. Sebagai penyelidik dan tenaga pengajar, mengetahui tahap pengetahuan dan persepsi pelajar memberi gambaran yang jelas tentang sejauh mana mereka memahami serta menilai potensi bidang ini. Hasil kajian ini akan membantu dalam pembentukan modul pengajaran yang lebih efektif serta menjadi panduan dalam usaha penambahbaikan kurikulum sedia ada agar lebih relevan dengan keperluan semasa industri.

II. SOROTAN LITERATUR

Dalam era digital dan Revolusi Industri 4.0, penggabungan antara teknologi dan keusahawanan telah mewujudkan satu bidang baharu dikenali sebagai teknousahawan. Golongan teknousahawan memainkan peranan penting dalam mendorong inovasi dan pertumbuhan ekonomi negara. Justeru itu, institusi pengajian tinggi seperti politeknik harus memastikan pelajar didedahkan kepada konsep dan amalan teknousahawan secara menyeluruh.

A) Definisi Teknousahawan

Teknousahawan merujuk kepada individu yang menggabungkan kemahiran keusahawanan dengan kepakaran teknologi tinggi dalam membangunkan produk atau perkhidmatan yang inovatif dan berdaya saing. Menurut Mohd Salleh dan Zainal (2020), teknousahawan ialah individu yang menggabungkan kemahiran teknologi dan keusahawanan untuk mencipta produk atau perkhidmatan yang inovatif serta mampu bersaing di pasaran global [4]. Selain itu, teknousahawan juga ditakrifkan sebagai usahawan yang menggunakan ilmu sains dan teknologi secara strategik dalam membangunkan perniagaan inovatif yang mampu menyumbang kepada pertumbuhan ekonomi negara [5].
Zhao et al. (2010) pula menyatakan bahawa usahawan teknologi ialah individu yang memanfaatkan inovasi dan kreativiti teknologi dalam membina dan mengurus perniagaan berasaskan teknologi [6]. Tambahan pula, menurut Kuratko (2014), keusahawanan teknologi melibatkan pengenalpastian peluang berasaskan teknologi, penerapan inovasi, dan proses pengkomersialan penyelesaian teknologi oleh seorang usahawan [7]. Secara keseluruhan, teknousahawan boleh dirumuskan sebagai individu yang memiliki gabungan kepakaran dalam bidang teknologi dan ciri-ciri keusahawanan yang kukuh. Mereka bukan sahaja berkemahiran dalam aspek teknikal dan inovasi, malah turut mempunyai semangat keusahawanan yang tinggi seperti daya inisiatif, kebolehan kepimpinan, serta keberanian dalam menghadapi risiko perniagaan.

B) Tahap Pengetahuan Pelajar Terhadap Teknousahawan

Pengetahuan tentang teknousahawanan amat penting dalam kalangan pelajar insitusi pengajian tinggi kerana ia membuka peluang kepada pembangunan kerjaya yang lebih dinamik dan selaras dengan keperluan pasaran global masa kini. Pengetahuan dalam teknousahawan dapat memperkukuhkan keyakinan diri pelajar untuk menceburi bidang perniagaan berasaskan teknologi. Beberapa kajian mendapati bahawa tahap pengetahuan pelajar terhadap konsep teknousahawan masih berada pada tahap sederhana. Kajian oleh Ismail dan Ahmad (2021) yang

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

melibatkan pelajar politeknik menunjukkan bahawa hanya sebilangan kecil yang memahami peranan sebenar teknousahawan dalam dunia perniagaan moden [8]. Hal ini berpunca daripada kurangnya integrasi pendidikan teknousahawan dalam kurikulum serta kekurangan pendedahan kepada praktikal industri teknologi. Selain itu, menurut S. A. Rahman (2020) pelajar lebih terdedah kepada keusahawanan konvensional berbanding teknousahawan kerana aktiviti seperti kursus keusahawanan asas, bengkel dan latihan yang kurang menumpukan kepada elemen teknologi [9].

C) Persepsi Pelajar Terhadap Teknousahawan

Persepsi pelajar terhadap teknousahawan adalah penting kerana ia akan mempengaruhi minat dan kecenderungan mereka untuk menceburi bidang ini. Norazah et al.(2022) mendapati bahawa walaupun pelajar menunjukkan persepsi positif terhadap potensi teknousahawan, kebanyakan daripada mereka masih ragu-ragu untuk memilihnya sebagai kerjaya utama [10]. Hal ini disebabkan oleh persepsi terhadap risiko tinggi, kekurangan modal, dan ketidakyakinan terhadap kemahiran teknologi sendiri. Walau bagaimanapun, kajian oleh Lim dan Chan (2021) menunjukkan bahawa persepsi ini boleh ditingkatkan sekiranya pelajar didedahkan kepada kisah kejayaan teknousahawan, serta diberi peluang untuk menyertai inkubator perniagaan dan pertandingan inovasi.[11].

D) Hubungan Antara Tahap Pengetahuan Dengan Persepsi Pelajar Terhadap Teknousahawan.

Kewujudan bidang teknousahawan yang menggabungkan kemahiran teknologi dan keusahawanan semakin diberi perhatian dalam konteks pendidikan tinggi. Beberapa kajian telah menunjukkan bahawa pengetahuan pelajar mengenai teknousahawan memainkan peranan penting dalam membentuk persepsi mereka terhadap bidang ini.

i) Pengetahuan dan Persepsi Pelajar

Menurut Suradi et al. (2020), tahap pengetahuan yang tinggi mengenai teknousahawan membantu pelajar memahami potensi dan peluang dalam bidang ini, sekali gus meningkatkan minat dan persepsi positif terhadap kerjaya teknousahawan [12]. Kajian oleh Mohamad et al. (2019) pula mendapati bahawa pelajar yang lebih terdedah kepada elemen keusahawanan berteknologi melalui kurikulum atau program universiti menunjukkan persepsi yang lebih optimistik terhadap keusahawanan sebagai pilihan kerjaya masa hadapan [13].

ii) Hubungan yang Signifikan

Rahim dan Ismail (2021) menunjukkan bahawa terdapat korelasi positif dan signifikan antara pengetahuan dan persepsi pelajar [14]. Kajian mereka mencadangkan bahawa usaha mempertingkatkan literasi teknousahawan di kalangan pelajar boleh menyumbang kepada pembentukan sikap dan minat yang lebih kukuh terhadap penglibatan dalam bidang keusahawanan teknologi.

Selain itu, kajian oleh Noraini et al. (2020) menyatakan bahawa kurangnya pendedahan terhadap aspek teknousahawan menyebabkan ramai pelajar mempunyai persepsi yang lemah atau samar-samar, sekaligus menghalang mereka untuk menyertai bidang ini walaupun berpotensi [15].

E) Kepentingan Kajian

Kajian terhadap tahap pengetahuan dan persepsi pelajar politeknik terhadap teknousahawan penting dalam merangka strategi pendidikan yang lebih berfokus kepada pembangunan modal insan dalam bidang teknologi dan inovasi. Data ini boleh membantu pihak pentadbiran institusi untuk merancang intervensi seperti penyusunan semula kurikulum, pelaksanaan program mentorship, dan pembinaan jaringan industri.

III. METODOLOGI KAJIAN

A) Reka Bentuk Kajian

Kajian ini menggunakan reka bentuk kajian kuantitatif deskriptif yang bertujuan untuk menilai tahap pengetahuan dan persepsi pelajar Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar terhadap teknousahawan. Pendekatan ini dipilih kerana ia membolehkan penyelidik memperoleh data yang menyeluruh, sistematik dan boleh diukur berkaitan sikap serta kefahaman pelajar terhadap bidang teknousahawan.

Bagi tujuan pengumpulan data, satu set soal selidik berstruktur telah dibina dan disesuaikan berdasarkan objektif serta persoalan kajian. Seramai 62 orang responden terlibat, terdiri daripada pelajar program Diploma Kejuruteraan Elektrik dan Eelektronik (DEE), Diploma Kejuruteraan Elektronik Perhubungan (DEP) serta Diploma Kejuruteraan Elektronik Komputer (DTK). Soal selidik ini membolehkan penyelidik mengumpul data yang standard dan seragam. Menurut R. Kothari (2004),

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

setiap responden menjawab soalan yang sama, membolehkan penyelidik membandingkan jawapan dengan lebih mudah dan melakukan analisis data statistic yang lebih tepat [16]. Soal selidik ini dibangunkan menggunakan platform 'Google Forms' yang merupakan medium atas talian yang mudah diakses dan menjimatkan masa. Ia telah diedarkan secara dalam talian kepada pelajar Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar yang menjadi responden kajian bagi mendapatkan maklumat berkaitan tahap pengetahuan dan persepsi mereka terhadap teknousahawan.

B) Populasi Dan Sampel

Dalam sesuatu kajian, penentuan populasi dan sampel merupakan langkah penting bagi memastikan data yang dikumpul adalah relevan serta boleh mewakili kumpulan sasaran kajian. Populasi merujuk kepada keseluruhan kumpulan individu yang menjadi tumpuan kajian, manakala sampel ialah sebahagian daripada populasi yang dipilih untuk mewakili keseluruhan kumpulan tersebut secara statistik.

Bagi kajian ini, populasi terdiri daripada pelajar-pelajar Jabatan Kejuruteraan Elektrik di Politeknik Ungku Omar. Kajian memfokuskan kepada pelajar yang mengikuti tiga program diploma utama, iaitu Diploma Kejuruteraan Elektrik dan Elektronik (DEE), Diploma Kejuruteraan Elektronik Perhubungan (DEP), dan Diploma Kejuruteraan Elektronik Komputer (DTK). Seramai 62 orang pelajar telah dipilih sebagai sampel kajian. Pemilihan sampel dilakukan secara pensampelan bertujuan (purposive sampling), iaitu berdasarkan kesesuaian dan kaitan kumpulan pelajar dengan objektif kajian, iaitu menilai tahap pengetahuan dan persepsi mereka terhadap bidang teknousahawan. Saiz sampel ini dianggap mencukupi untuk mendapatkan gambaran awal serta membolehkan analisis statistik dijalankan dengan lebih terperinci dan bermakna.

C) Instrumen Kajian

Instrumen kajian merujuk kepada alat yang digunakan oleh penyelidik untuk mengumpul data yang berkaitan dengan objektif dan persoalan kajian. Pemilihan instrumen yang sesuai amat penting bagi memastikan data yang diperoleh adalah sah (valid) dan boleh dipercayai (reliabel).

Dalam kajian ini, instrumen utama yang digunakan ialah soal selidik berstruktur. Soal selidik ini telah dibina dan disesuaikan berdasarkan objektif kajian serta kajian literatur terdahulu yang berkaitan. Ia mengandungi beberapa bahagian utama yang direka untuk mendapatkan maklumat mengenai latar belakang responden, tahap pengetahuan mereka terhadap bidang teknousahawan, serta persepsi dan sikap mereka terhadap bidang tersebut. Soal selidik ini terdiri daripada tiga bahagian utama seperti berikut:

- *Bahagian A*: Mengandungi maklumat demografi responden, termasuk jantina, bangsa, agama, status pemilikan kerja, keutamaan dalam memilih makan gaji, dan keutamaan dalam memilih untuk memulakan perniagaan.

- *Bahagian B*: Mempunyai 10 item soalan yang direka untuk mengukur tahap pengetahuan pelajar mengenai teknousahawan. Penilaian bagi bahagian ini menggunakan pilihan jawapan Ya atau Tidak.

- *Bahagian C*: Mengandungi 10 item soalan yang menilai persepsi pelajar terhadap teknousahawan, merangkumi aspek minat, keyakinan diri, dan persepsi terhadap risiko. Penilaian dijalankan menggunakan skala Likert 5 mata, dengan pilihan jawapan dari 1 (Sangat Tidak Setuju) hingga 5 (Sangat Setuju).

Dalam kajian ini, tahap pengetahuan pelajar mengenai teknousahawan diuji melalui Bahagian B dalam soal selidik. Bahagian ini mengandungi 10 item soalan yang berkaitan dengan pengetahuan asas dan praktikal mengenai teknousahawan, termasuk definisi, ciri-ciri, serta contoh usahawan teknologi tempatan dan antarabangsa.

Setiap item dijawab menggunakan pilihan jawapan "Ya" atau "Tidak", di mana:

- Jawapan "Ya" menunjukkan pelajar mempunyai pengetahuan berkaitan item tersebut.
- Jawapan "Tidak" menunjukkan pelajar tidak mengetahui atau tidak pasti mengenai item berkenaan.

Bagi bahagian C pula, tahap persepsi pelajar terhadap teknousahawan diukur menggunakan skala Likert 5 mata, yang membolehkan responden menyatakan tahap persetujuan mereka terhadap setiap pernyataan yang dikemukakan, bermula daripada 1 (Sangat Tidak Setuju) hingga 5 (Sangat Setuju). Skala Likert merupakan kaedah yang biasa digunakan dalam penyelidikan sosial untuk mengukur sikap dan pendapat secara kuantitatif [17]. Kaedah ini memudahkan pengumpulan data yang terperinci dan membolehkan analisis statistik dijalankan dengan lebih tepat.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Jadual 1 menunjukkan skala Likert 5 mata yang biasa digunakan dalam kajian kuantitatif untuk mengukur sikap, pendapat, dan persepsi responden terhadap sesuatu pernyataan.

Jadual 1: Skala Likert

Skala	Nilai	Makna
1	Sangat Tidak Setuju	Responden sangat tidak bersetuju dengan pernyataan
2	Tidak Setuju	Responden tidak bersetuju dengan pernyataan
3	Neutral/Sederhana	Responden bersikap neutral atau tidak pasti
4	Setuju	Responden bersetuju dengan pernyataan
5	Sangat Setuju	Responden sangat bersetuju dengan pernyataan

Penggunaan soal selidik sebagai instrumen kajian dipilih kerana ia membolehkan data dikumpul dalam skala yang lebih besar, menjimatkan masa, serta memudahkan proses penganalisisan data secara statistik. Soal selidik ini dibangunkan menggunakan platform Google Forms, yang merupakan medium dalam talian yang mudah diakses oleh responden.

Sebelum diedarkan secara rasmi, soal selidik ini telah melalui proses pra-uji (pilot test) terhadap sejumlah kecil responden untuk menilai tahap kefahaman, kejelasan item, serta kesesuaian kandungan.

Di samping itu, kesahan kandungan (content validity) telah disemak oleh beberapa orang pakar dalam bidang berkaitan. Ujian kebolehpercayaan yang dijalankan semasa pilot test menunjukkan nilai Cronbach's Alpha melebihi 0.8, yang menandakan bahawa instrumen ini mempunyai tahap kebolehpercayaan yang baik.

Bagi menganalisa hubungan antara tahap pengetahuan dengan persepsi pelajar terhadap usahawanan, dua jenis analisis statistik telah dijalankan iaitu analisis deskriptif dan analisis inferensi korelasi Pearson.

1. Analisis Deskriptif

Analisis deskriptif digunakan untuk menggambarkan tahap purata dan kecenderungan data responden. Statistik yang digunakan termasuk:

• Min (purata): menunjukkan tahap pengetahuan atau persepsi secara keseluruhan,
• Sisihan piawai (standard deviation): menunjukkan sejauh mana variasi jawapan responden dari min,
• Peratusan (%): bagi menggambarkan taburan respon dalam setiap kategori skala Likert.

2. Analisis Inferensi – Korelasi Pearson

Analisis korelasi Pearson digunakan bagi menilai kekuatan dan arah hubungan linear antara dua pembolehubah:
• Pembolehubah 1: Skor min tahap pengetahuan
• Pembolehubah 2: Skor min persepsi pelajar terhadap usahawanan
Ujian ini mengeluarkan nilai Pearson's r yang ditafsir berdasarkan Jadual 2 berikut:

Jadual 2 : Tafsiran Nilai Korelasi Pearson (r)

Nilai r	Tafsiran Hubungan
0.00 – 0.19	Sangat Lemah
0.20 – 0.39	Lemah
0.40 – 0.59	Sederhana
0.60 – 0.79	Kuat
0.80 – 1.00	Sangat Kuat

D) Kaedah Analisa Data

Data yang diperoleh daripada soal selidik dianalisis menggunakan kaedah analisis kuantitatif bagi menjawab persoalan kajian dan mencapai objektif yang telah ditetapkan. Dalam kajian ini, analisis data dijalankan menggunakan perisian Jamovi, iaitu sebuah perisian sumber terbuka yang berasaskan R dan direka khusus untuk analisis statistik dalam penyelidikan sosial dan pendidikan.

Data telah dikumpulkan melalui platform Google Forms, dan kemudiannya dieksport serta disimpan dalam format Excel (.xlsx). Seterusnya, fail Excel tersebut dimuat naik ke dalam perisian Jamovi untuk ujuan analisis data. Kaedah analisis yang digunakan adalah seperti berikut:

● *Analisis Deskriptif* – digunakan untuk menganalisis data demografik dan mengenal pasti taburan responden berdasarkan jantina, bangsa, agama, pemilihan kerja, keutamaan dalam memilih makan gaji, dan keutamaam dalam memilih memulakan perniagaan. Ukuran seperti kekerapan (frekuensi), peratusan, min, dan sisihan piawai dikira untuk menggambarkan tahap pengetahuan dan persepsi pelajar terhadap teknousahawan.

● *Ujian Kebolehpercayaan (Reliability Test)* – dijalankan dengan menggunakan pengiraan Cronbach's Alpha untuk mengukur kebolehpercayaan item dalam setiap bahagian soal selidik. Nilai Cronbach's Alpha yang melebihi 0.8 menunjukkan bahawa item yang digunakan adalah konsisten dan mempunyai tahap kebolehpercayaan yang baik.

● *Visualisasi Data* – Jamovi turut digunakan untuk menghasilkan graf bar, histogram, dan carta

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

pai bagi memudahkan pemahaman terhadap pola data secara visual.

Perisian Jamovi dipilih kerana ia mesra pengguna, percuma, dan menyediakan antara muka grafik yang intuitif serta sesuai digunakan dalam analisis statistik asas dan lanjutan tanpa memerlukan pengetahuan pengaturcaraan. Kaedah analisis yang sistematik ini membolehkan dapatan kajian diinterpretasikan dengan lebih tepat dan berkesan.

E) Etika Kajian

Etika kajian merupakan aspek penting dalam memastikan kajian dijalankan secara bertanggungjawab, menghormati hak dan kesejahteraan semua pihak yang terlibat. Ia bertujuan untuk melindungi responden daripada sebarang risiko, memastikan data dikendalikan dengan amanah, dan menjamin integriti penyelidikan.

Dalam kajian ini, prinsip etika telah diambil kira sejak peringkat perancangan sehingga pengumpulan data. Responden diberikan penerangan yang jelas mengenai tujuan kajian serta hak mereka untuk memberi persetujuan secara sukarela tanpa paksaan. Penyelidik juga memastikan kerahsiaan dan privasi maklumat responden terpelihara dengan menggunakan data secara anonym dan hanya untuk tujuan penyelidikan sahaja.

IV. DAPATAN KAJIAN DAN KEPUTUSAN

Bab ini membincangkan dapatan yang diperoleh hasil daripada kajian yang telah dijalankan. Sebanyak 62 set soal selidik telah dianalisis menggunakan perisian Jamovi bagi setiap item dalam soal selidik tersebut.

A) Analisa Data

Analisis data merupakan komponen yang sangat penting dalam sesuatu penyelidikan kerana ia memberikan asas yang kukuh untuk membuat kesimpulan, cadangan, dan keputusan berdasarkan dapatan kajian yang sistematik dan berasaskan bukti. Melalui proses analisis, penyelidik dapat memahami corak dan trend dalam data, seterusnya mengenal pasti hubungan antara pemboleh ubah yang dikaji. Sebagai contoh, menurut Creswell (2018), pemahaman terhadap taburan responden mengikut jantina atau pemilihan kerjaya membolehkan penyelidik menjelaskan kecenderungan dan tingkah laku sesuatu populasi [18].

Selain itu, analisis data yang dilakukan secara menyeluruh dan sistematik dapat meningkatkan kebolehpercayaan dan kesahihan kajian. Ini kerana penggunaan kaedah statistik seperti peratusan, kekerapan, min, sisihan piawai, atau ujian signifikan dapat menyokong dapatan dengan hujah yang lebih kuat serta mengurangkan elemen bias [19]. Justeru itu, analisis data bukan sahaja berfungsi sebagai alat untuk mentafsir data mentah, malah menjadi teras utama dalam memastikan hasil penyelidikan bersifat empirikal, sah dan boleh diguna pakai dalam konteks sebenar.

Penganalisisan data dalam penyelidikan ini dibahagikan kepada tiga bahagian. Bahagian A merangkumi analisis data berkaitan maklumat demografik pelajar seperti jantina, bangsa, agama, pemilihan kerjaya, keutamaan dalam memilih pekerjaan makan gaji, dan keutamaan dalam memulakan perniagaan. Bahagian B pula melibatkan analisis data mengenai tahap pengetahuan pelajar tentang teknousahawan. Akhir sekali, Bahagian C menganalisis data yang berkaitan dengan persepsi pelajar terhadap teknousahawan.

B) Analisa Bahagian A – Maklumat Demogafi Pelajar

Maklumat demografik responden dikumpulkan melalui enam soalan yang merangkumi aspek jantina, bangsa, agama, pemilihan kerjaya utama, keutamaan dalam memilih pekerjaan makan gaji, dan keutamaan dalam memulakan perniagaan. Kesemua data demografik ini dianalisis secara deskriptif dengan menggunakan peratusan dan kekerapan, seperti yang ditunjukkan dalam Jadual 3.

Jadual 3 : Profil Demogafi

Item	Peratusan (%)	Kekerapan
Jantina (n=62)		
Lelaki	79.0	49
Perempuan	21.0	13
Bangsa (n=62)		
Melayu	75.8	47
Cina	8.1	5
India	14.5	9
Lain-lain	1.6	1
Agama (n=62)		
Islam	74.4	46
Budha	8.1	5
Hindu	9.7	6
Kristian	4.8	3
Pemilihan Kerjaya (n=62)		
Makan Gaji	75.8	47
Memulakan Perniagaan	23.2	14
Keutamaan dalam memilih makan gaji (n=62)		
Pendapatan Tetap	50.0	31
Kestabilan Pekerjaan	40.3	25
Kurang Minat	4.8	3
Kurang Risiko	1.6	1
Kurang Modal	3.2	2
Keutamaan dalam memilih memulakan perniagaan (n=62)		
Keuntungan	25.8	16
Minat	37.1	23
Masa Kerja Fleksibel	29.0	18
Susah Untuk Mendapat Pekerjaan	4.8	3
Bebas Membuat Keputusan	3.2	2

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Kajian ini melibatkan seramai 62 orang responden. Berdasarkan Jadual 1, majoriti responden adalah dalam kalangan lelaki iaitu seramai 49 orang (79.0%), manakala selebihnya adalah perempuan, iaitu 13 orang (21.0%). Ini menunjukkan bahawa responden lelaki lebih dominan dalam kajian ini, yang mungkin mencerminkan kecenderungan penglibatan golongan lelaki dalam bidang teknousahawan.

Dari segi bangsa, responden terdiri daripada pelbagai latar belakang etnik, dengan Melayu merupakan kumpulan majoriti sebanyak 75.8% (47 orang), diikuti oleh India 14.5% (9 orang), Cina 8.1% (5 orang) dan lain-lain kaum 1.6% (1 orang). Kepelbagaian kaum ini menunjukkan bahawa kajian ini mempunyai representasi pelbagai komuniti, walaupun tertumpu kepada majoriti Melayu.

Bagi agama, kebanyakan responden beragama Islam, iaitu 46 orang (74.4%). Selebihnya terdiri daripada penganut Hindu (9.7%), Budha (8.1%), dan Kristian (4.8%). Taburan ini adalah selari dengan komposisi etnik responden, terutamanya bangsa Melayu yang lazimnya beragama Islam.

Dari segi pilihan kerjaya, sebahagian besar responden menunjukkan kecenderungan untuk makan gaji berbanding memulakan perniagaan. Sebanyak 75.8% (47 orang) memilih kerjaya makan gaji, manakala hanya 23.2% (14 orang) memilih untuk menjadi usahawan. Ini menunjukkan bahawa majoriti masih lebih selesa dengan pekerjaan yang memberikan jaminan pendapatan tetap.

Apabila diteliti keutamaan dalam memilih kerja makan gaji, seramai 31 orang (50.0%) memilih faktor pendapatan tetap, dan 25 orang (40.3%) pula memilih kestabilan pekerjaan sebagai keutamaan. Faktor lain seperti kurang minat (4.8%), kurang risiko (1.6%) dan kurang modal (3.2%) kurang menjadi perhatian utama, namun tetap menyumbang kepada pemilihan kerjaya makan gaji.

Sebaliknya, bagi responden yang memilih untuk memulakan perniagaan, minat terhadap bidang perniagaan menjadi faktor utama, dipilih oleh 37.1% (23 orang), diikuti oleh masa kerja yang fleksibel (29.0%), dan potensi keuntungan (25.8%). Faktor seperti kesukaran mendapat pekerjaan (4.8%) dan kebebasan membuat keputusan (3.2%) dilihat kurang mempengaruhi pilihan untuk berniaga.

Secara keseluruhannya, analisis ini menunjukkan bahawa majoriti responden lebih cenderung memilih kerjaya makan gaji atas sebab keselamatan ekonomi dan kestabilan. Namun, dalam kalangan yang berminat menjadi usahawan, faktor dalaman seperti minat dan gaya hidup fleksibel memainkan peranan utama. Maklumat demografi ini memberikan gambaran penting terhadap kecenderungan pemikiran responden berkaitan kerjaya dan potensi mereka dalam bidang keusahawanan, khususnya teknousahawan.

C) Analisa Bahagian B – Jawapan Kepada Persoalan Kajian 1

Bahagian ini merangkumi 10 item soal selidik yang menilai tahap pengetahuan dan pemahaman responden terhadap konsep teknousahawan, termasuk pengenalan istilah, elemen terlibat, serta potensi dan cabaran dalam bidang ini. Jadual 4 memaparkan dapatan analisis data bagi Bahagian B.

Jadual 4 : Taburan responden berdasarkan Tahap Pengetahuan

Pernyataan	Ya	Tidak
Teknousahawan atau technopreneur adalah satu istilah baru bagi usahawan di Malaysia	95.2	4.8
Teknousahawan merupakan gabungan daripada dua patah perkataan iaitu teknologi dan usahawan	98.4	1.6
Teknousahawan terdiri daripada usahawan yang menggunakan kelebihan teknologi tinggi serta canggih dalam proses mengeluarkan produk dan perkhidmatan	96.8	3.2
Teknousahawan bermaksud individu atau sekumpulan individu yang bersedia untuk mengambil risiko yang melibatkan aspek teknikal dan kejuruteraan untuk menghasilkan pendapatan	95.2	4.8
Bioteknologi merupakan salah satu bidang teknousahawan	80.6	19.4
Agroteknologi merupakan satu bentuk perkembangan baru yang diperkenalkan kepada usahawan dalam bidang teknologi pertanian.	95.2	4.8
Teknousahawan sangat penting pada hari ini kerana dapat menghasilkan produk yang berkualiti	95.2	4.8
Teknousahawan sangat penting kerana dapat melahirkan lebih ramai usahawan yang kreatif dan inovatif	96.8	3.2
Kewangan merupakan masalah utama kepada teknousahawan tempatan pada tahap memula dan mengembangkan perniagaan mereka.	100	-
Kekurangan tenaga kerja mahir merupakan salah satu cabaran dalam melahirkan lebih ramai teknousahawan	95.2	4.8

Berdasarkan Jadual 4, dapatan menunjukkan bahawa secara keseluruhan, majoriti besar responden mempunyai tahap pengetahuan yang tinggi berkaitan dengan bidang teknousahawan.

Sebagai contoh, sebanyak 95.2% responden bersetuju bahawa teknousahawan atau technopreneur merupakan satu istilah baharu bagi usahawan di Malaysia. Tambahan lagi, 98.4% menyatakan bahawa teknousahawan ialah gabungan antara keusahawanan, inovasi dan teknologi, manakala 96.8% memahami bahawa teknousahawan menekankan kelebihan teknologi serta sains dalam pengeluaran produk dan perkhidmatan.

Lebih 80% responden turut menyedari bahawa teknousahawan memerlukan individu berpengetahuan serta sanggup mengambil risiko dalam menguruskan perniagaan berasaskan teknologi. Pengetahuan terhadap bidang bioteknologi juga agak tinggi, dengan 80.6%

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

mengenal pasti bioteknologi sebagai salah satu cabang teknousahawan.

Dalam aspek kefahaman terhadap kelebihan teknousahawan, 95.2% responden percaya bahawa teknousahawan penting kerana boleh menghasilkan produk yang berkualiti tinggi, manakala 96.8% bersetuju bahawa inovasi adalah elemen penting untuk menghasilkan usaha niaga yang kreatif.

Menariknya, kesemua responden (100%) bersetuju bahawa teknologi merupakan elemen utama dalam teknousahawan, menunjukkan tahap kesedaran yang sangat tinggi. Di samping itu, 91.9% menyedari bahawa keusahawanan teras kekal dalam teknousahawan, dan 95.2% faham bahawa teknousahawan perlu bersedia menghadapi cabaran lebih kompleks berbanding keusahawanan biasa.

Secara keseluruhan, data ini membuktikan bahawa responden mempunyai tahap pengetahuan yang sangat baik tentang teknousahawan, dengan sebahagian besar menunjukkan kefahaman mendalam terhadap konsep, cabaran dan kepentingannya dalam era moden yang berasaskan teknologi dan inovasi.

D) Analisa Bahagian C- Jawapan Kepada Persoalan Kajian 2

Bahagian ini merangkumi 10 item soal selidik yang digunakan untuk mengkaji persepsi pelajar terhadap teknousahawan. Hasil dapatan bagi setiap item ditunjukkan dalam Jadual 5, yang memaparkan kekerapan, peratusan, serta skor min bagi setiap penyataan dalam Bahagian C.

Hasil analisis menunjukkan bahawa kesemua item berkaitan persepsi pelajar terhadap teknousahawan mencatatkan skor min yang tinggi, iaitu dalam julat 4.02 hingga 4.45. Berdasarkan skala Likert yang digunakan (1 = Sangat Tidak Setuju hingga 5 = Sangat Setuju), skor ini menunjukkan bahawa pelajar secara keseluruhannya mempunyai persepsi yang sangat positif terhadap bidang teknousahawan.

Item-item seperti “Seorang teknousahawan perlu membuat perancangan yang sistematik” (Min = 4.45), “Teknousahawan perlu memiliki kekuatan kreativiti dan inovatif yang tinggi” (Min = 4.40), dan “Teknousahawan dapat mengkomersialkan teknologi dan inovasi tinggi” (Min = 4.40) mencerminkan tahap kesedaran dan pengiktirafan yang tinggi pelajar terhadap peranan serta keperluan penting dalam bidang teknousahawan.

Kesemua 10 item dalam Bahagian C menunjukkan konsistensi dalam persepsi positif, yang membuktikan bahawa pelajar bukan sahaja memahami konsep teknousahawan, tetapi juga mengiktiraf sumbangan serta potensi kerjaya ini sebagai satu laluan masa depan yang menarik dan berdaya saing.

Jadual 5 : Persepsi Pelajar Terhadap Teknousahawan

Point		1		2		3		4		5		Min
Skala Likert		Sangat Tidak Setuju		Tidak Setuju		Kurang Setuju		Setuju		Sangat Setuju		
Bil	Item	Bil	%	Bil	%	Bil	%	Bil	%	Bil	%	
1.	Seorang teknousahawan perlu kreatif dan inovatif dalam menghasilkan produk atau perkhidmatan	0	0	0	0	2	3.2	32	51.6	28	45.2	4.42 (Tinggi)
2.	Teknousahawan adalah kerjaya yang baik dan menghasilkan pendapatan yang lumayan	0	0	0	0	7	11.3	35	56.5	20	32.3	4.21 (Tinggi)
3.	Ramai teknousahawan di Malaysia telah berjaya menjadi jutawan	2	3.2	0	0	13	21.0	27	43.5	20	32.2	4.02 (Tinggi)
4.	Teknousahawan perlu memiliki kekuatan kreativiti dan inovatif yang tinggi.	0	0	0	0	1	1.6	35	56.5	26	41.9	4.40 (Tinggi)
5.	Teknousahawan dapat mengkomersialkan teknologi dan inovasi tinggi.	0	0	0	0	2	3.2	33	53.2	27	43.5	4.40 (Tinggi)
6.	Seorang teknousahawan perlu membuat perancangan yang sistematik	0	0	0	0	3	4.8	28	45.2	31	50.0	4.45 (Tinggi)
7.	Dasar Sains, Teknologi dan Inovasi Negara 2021-2030 telah membuka peluang kepada teknousahawan	0	0	0	0	6	9.7	33	53.2	23	37.1	4.27 (Tinggi)
8.	Melahirkan teknousahawan yang berkualiti adalah satu usaha yang sukar	0	0	0	0	4	6.5	31	50.0	27	43.5	4.37 (Tinggi)
9.	Teknousahawan bakal menjadi pemangkin baru TVET negara.	0	0	1	1.6	6	9.7	30	48.4	25	40.3	4.27 (Tinggi)
10.	Seminar kesedaran kepada kumpulan sasaran merupakan salah satu contoh pembudayaan teknousahawan	0	0	0	0	7	11.3	31	50.0	24	38.7	4.27 (Tinggi)
	Nilai Min Purata											**4.30 (Tinggi)**

E) Analisa Hubungan Antara Tahap Pengetahuan Dengan Persepsi Pelajar Terhadap Teknousahawan – Jawapan Kepada Persoalan Kajian 3

Bagi menganalisa hubungan antara tahap pengetahuan dengan persepsi pelajar terhadap teknousahawan, penyelidik telah menggunakan pendekatan kuantitatif. Pendekatan ini melibatkan pengumpulan data melalui soal selidik, diikuti

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

dengan analisis statistik deskriptif dan inferensi, serta interpretasi hasil yang diperoleh daripada responden.

Analisis deskriptif digunakan untuk menggambarkan tahap purata pengetahuan dan persepsi pelajar terhadap teknousahawan. Analisis deskriptif merupakan kaedah statistik yang digunakan untuk menggambarkan dan meringkaskan data melalui ukuran seperti min, sisihan piawai, dan peratusan. Menurut Isa dan Halim (2020), ia bertujuan untuk memberikan gambaran umum terhadap pola atau kecenderungan dalam sesuatu set data tanpa membuat inferens terhadap populasi yang lebih besar [20].

Dalam konteks kajian pendidikan, M. Sidek and Ahmad (2016) menyatakan analisis deskriptif membolehkan penyelidik mengenal pasti tahap pengetahuan, sikap, dan persepsi responden berdasarkan data soal selidik [21]. Jadual 6 menunjukkan dapatan data daripada soal selidik bagi kajian tahap pengetahuan pelajar terhadap teknousahawan manakala Jadual 7 pula memperincikan dapatan data daripada soal selidik mengenai persepsi pelajar terhadap teknousahawan.

Jadual 6 : Taburan Min Mengikut Tahap Pengetahuan Pelajar Terhadap Teknousahawan

Item Tahap Pengetahuan	Min	Sisihan Piawai (SP)
1. Seorang teknousahawan perlu kreatif dan inovatif dalam menghasilkan produk atau perkhidmatan	4.42	0.560
2. Teknousahawan perlu memiliki kekuatan kreativiti dan inovatif yang tinggi.	4.40	0.527
3. Seorang teknousahawan perlu membuat perancangan yang sistematik	4.45	0.592
4. Melahirkan teknousahawan yang berkualiti adalah satu usaha yang sukar	4.37	0.607
5. Teknousahawan bakal menjadi pemangkin baru TVET negara.	4.27	0.705

Jadual 7: Taburan Min Mengikut Persepsi pelajar terhadap Teknousahawan

Item Persepsi	Min	Sisihan Piawai (SP)
1. Seorang teknousahawan perlu kreatif dan inovatif dalam menghasilkan produk atau perkhidmatan	4.42	0.560
2. Teknousahawan perlu memiliki kekuatan kreativiti dan inovatif yang tinggi.	4.40	0.527
3. Seorang teknousahawan perlu membuat perancangan yang sistematik	4.45	0.592
4. Melahirkan teknousahawan yang berkualiti adalah satu usaha yang sukar	4.37	0.607
5. Teknousahawan bakal menjadi pemangkin baru TVET negara.	4.27	0.705

Untuk menilai hubungan antara dua pembolehubah utama dalam kajian ini iaitu tahap pengetahuan dan persepsi, penyelidik telah menggunakan ujian korelasi Pearson. Ujian ini menentukan arah dan kekuatan hubungan linear antara dua pembolehubah tersebut. Jadual 8 menunjukkan hasil daripada analisa data. Menurut Creswell (2012), ujian ini penting dalam kajian kuantitatif untuk menentukan sama ada dua pembolehubah mempunyai hubungan yang signifikan, serta sejauh mana perubahan satu pembolehubah berkait dengan perubahan pembolehubah yang lain [22].

Jadual 8 : Jadual Korelasi

	Skor Min Pengetahuan	Skor Min Persepsi
Skor Min Pengetahuan	—	—
Skor Min Persepsi	**r = 0.876***	—
df	—	60
p-value	—	**< .001**

Nota: *** menunjukkan tahap signifikansi p < .001

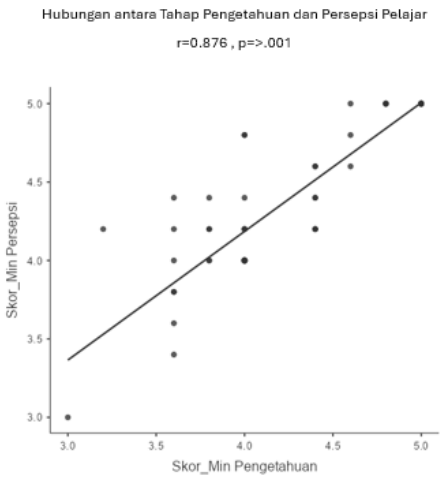
Dapatan analisis korelasi menunjukkan bahawa terdapat hubungan yang sangat kuat dan signifikan secara statistik antara tahap pengetahuan dengan persepsi pelajar terhadap teknousahawan. Nilai koefisien korelasi yang diperoleh adalah r = 0.876, yang berada dalam julat hubungan positif yang sangat kuat, berdasarkan tafsiran piawai bagi nilai korelasi Pearson. Selain itu, nilai p < .001 menunjukkan bahawa hubungan yang dikesan adalah sangat signifikan secara statistik, iaitu kebarangkalian hubungan ini berlaku secara kebetulan adalah amat rendah. Ini memberi keyakinan bahawa terdapat kaitan sebenar antara pengetahuan dan persepsi dalam kalangan pelajar yang dikaji.

Secara keseluruhan, keputusan ini menggambarkan bahawa pelajar yang mempunyai tahap pengetahuan yang tinggi tentang teknousahawan juga cenderung untuk memiliki persepsi yang lebih positif terhadap bidang tersebut. Ini mungkin disebabkan oleh pemahaman yang lebih mendalam mengenai konsep, potensi kerjaya, serta sumbangan teknousahawan kepada pembangunan ekonomi dan inovasi. Dapatan ini juga memberikan isyarat bahawa peningkatan program pendidikan ataupendedahan berkaitan teknousahawan dalam kalangan pelajar boleh membantu membentuk tanggapan dan sikap yang lebih membina terhadap keusahawanan berteraskan teknologi.

Bagi menggambarkan secara visual hubungan antara skor min pengetahuan dan skor min persepsi pelajar terhadap teknousahawan, satu graf bertabur (scatter plot) telah digunakan seperti yang ditunjukkan pada Rajah 1 di bawah.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479



Rajah 1 : Graf hubungan antara Tahap Pengetahuan dan Persepsi Pelajar terhadap teknousahawan.

Rajah ini menunjukkan taburan titik data yang mewakili skor setiap responden. Daripada pola taburan tersebut, jelas kelihatan satu arah menaik yang konsisten, menandakan bahawa terdapat hubungan linear positif antara kedua-dua pembolehubah. Ini bermaksud, pelajar yang mencatat tahap pengetahuan yang lebih tinggi cenderung untuk mempunyai persepsi yang lebih positif terhadap teknousahawan.

Tambahan pula, kehadiran garis regresi linear yang dilukis dalam graf membantu memperkukuh pemerhatian ini, di mana titik-titik data berada rapat dengan garis tersebut. Keadaan ini menunjukkan bahawa hubungan yang wujud adalah kukuh dan stabil, sejajar dengan dapatan analisis korelasi Pearson yang menunjukkan nilai r = 0.876 dengan p < .001, iaitu hubungan yang sangat kuat dan signifikan secara statistik.

Secara keseluruhannya, scatter plot bukan sahaja menyokong hasil statistik inferensi yang diperoleh, malah berfungsi sebagai alat visual yang membantu dalam memahami pola hubungan dan kecenderungan responden terhadap kedua-dua dimensi yang dikaji.

V. PERBINCANGAN, RUMUSAN DAN CADANGAN

A) Perbincangan

Kajian ini dijalankan untuk menilai tahap pengetahuan dan persepsi pelajar terhadap teknousahawan, serta menganalisis hubungan antara kedua-dua pembolehubah tersebut. Berdasarkan analisis data, didapati bahawa pelajar menunjukkan tahap pengetahuan yang sederhana hingga tinggi terhadap konsep teknousahawan. Persepsi mereka juga secara umum positif, menunjukkan keterbukaan dan minat terhadap bidang keusahawanan berteraskan teknologi.

Hasil analisis inferensi menggunakan korelasi Pearson menunjukkan terdapat hubungan yang sangat kuat dan signifikan antara tahap pengetahuan dan persepsi pelajar ($r = 0.876$, $p < .001$). Ini menunjukkan bahawa semakin tinggi tahap pengetahuan seseorang pelajar tentang teknousahawan, semakin positif persepsi mereka terhadap bidang ini. Penemuan ini menyokong teori bahawa pengetahuan yang mendalam akan membentuk sikap yang lebih terbuka dan positif.

Dapatan ini juga selaras dengan kajian-kajian terdahulu yang menekankan bahawa pendidikan keusahawanan, terutamanya yang merangkumi aspek teknologi, mampu meningkatkan keyakinan dan minat pelajar untuk terlibat dalam aktiviti keusahawanan. Pelajar yang terdedah kepada maklumat tentang peranan teknousahawan dalam inovasi dan ekonomi digital lebih cenderung untuk menilai bidang ini sebagai satu kerjaya masa hadapan yang berpotensi.

B) Rumusan

Secara keseluruhannya, kajian ini telah mencapai objektifnya dengan mengesahkan wujudnya hubungan yang signifikan dan positif antara tahap pengetahuan dan persepsi pelajar terhadap teknousahawan. Pelajar yang mempunyai tahap pengetahuan yang lebih tinggi dilihat memiliki tanggapan yang lebih baik terhadap teknousahawan sebagai satu bidang yang relevan, bernilai dan sesuai diceburi. Ini menunjukkan pentingnya pendidikan dan pendedahan awal berkaitan teknousahawan dalam membentuk sikap dan pemikiran generasi muda terhadap bidang keusahawanan berasaskan teknologi.

C) Cadangan

Berdasarkan penemuan kajian, beberapa cadangan dikemukakan untuk meningkatkan tahap pengetahuan dan persepsi pelajar terhadap teknousahawan:

- *Pengukuhan Kurikulum Pendidikan Keusahawanan*

Institusi pendidikan perlu memperkemas kandungan modul keusahawanan sedia ada dengan memasukkan elemen teknologi, inovasi, dan revolusi industri 4.0 secara menyeluruh.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

• *Peningkatan Program Pendedahan dan Aktiviti Praktikal*

Pelajar wajar diberi peluang menyertai program luar bilik darjah seperti bengkel teknousahawan, pertandingan idea inovasi, dan lawatan ke inkubator perniagaan teknologi.

• *Kerjasama Strategik dengan Industri*

Universiti boleh menjalin hubungan kerjasama dengan syarikat teknologi dan usahawan berjaya bagi menyediakan platform bimbingan, latihan industri dan perkongsian pengalaman sebenar.

• *Penggunaan Media dan Teknologi untuk Kesedaran Awam*

Pihak institusi atau kerajaan boleh memanfaatkan media sosial, laman web interaktif dan platform digital untuk menyebarkan maklumat serta kisah kejayaan teknousahawan tempatan dan global.

• *Penyelidikan Lanjutan*

Kajian lanjut disaran untuk menilai impak intervensi pendidikan terhadap perubahan pengetahuan dan persepsi pelajar dalam jangka masa panjang, serta mengkaji faktor lain seperti jantina, latar belakang akademik dan minat keusahawanan.

VI. KESIMPULAN

Secara keseluruhannya, kajian ini menunjukkan bahawa terdapat hubungan yang signifikan dan sangat kuat antara tahap pengetahuan dan persepsi pelajar terhadap teknousahawan. Pengetahuan yang tinggi jelas berperanan dalam membentuk persepsi yang lebih positif terhadap bidang keusahawanan berasaskan teknologi. Dapatan ini memberi isyarat yang jelas bahawa usaha memperkukuh pendidikan dan pendedahan berkaitan teknousahawan perlu diberi perhatian yang serius dalam sistem pendidikan tinggi.

Melalui perbincangan dan analisis yang telah dijalankan, dapat disimpulkan bahawa pelajar bukan sahaja perlu didedahkan kepada konsep teknousahawan secara teori, malah perlu diberikan pengalaman praktikal dan pendedahan secara langsung dengan dunia keusahawanan sebenar. Justeru, pelbagai cadangan telah dikemukakan bagi membantu pihak berkepentingan merancang strategi berkesan ke arah melahirkan pelajar yang bukan sahaja berpengetahuan, tetapi juga bersedia menjadi teknousahawan masa depan.

Diharapkan dapatan dan cadangan kajian ini dapat menjadi rujukan berguna dalam membentuk dasar pendidikan keusahawanan dan memperkukuh ekosistem teknousahawan dalam kalangan generasi muda di Malaysia.

PENGAKUAN

Saya akui kajian ini adalah hasil kerja saya sendiri kecuali nukilan dan ringkasan yang tiap-tiap satunya telah saya jelaskan sumbernya.

Tandatangan: 
Nama: Sharmila Bt Md Isa
No.Kad Pengenalan: 790114-02-5628
Tarikh : 10 Jun 2025

F) RUJUKAN

[1] J. A. Schumpeter, The Theory of Economic Development, Cambridge, MA: Harvard University Press, 1934.

[2] N. Azizan, H. Ismail, dan R. A. Rahman, "Tahap Pengetahuan dan Minat Pelajar Universiti Malaysia Perlis terhadap Keusahawanan: Ke Arah Pembentukan Teknokeusahawanan," Jurnal Keusahawanan dan Inovasi Malaysia, vol. 5, no. 2, pp. 33–42, 2022.

[3] N. Zainudin, M. R. Abdul Razak, dan H. M. Hassan, "Tahap Pengetahuan dan Minat Pelajar Politeknik terhadap Keusahawanan Teknologi," Jurnal Pendidikan Teknikal dan Vokasional Malaysia, vol. 11, no. 1, pp. 22–30, 2021.

[4] M. S. Salleh and N. Zainal, "Peranan teknousahawan dalam pembangunan ekonomi negara," Jurnal Keusahawanan Malaysia, vol. 12, no. 2, pp. 33–41, 2020.

[5] Kementerian Pengajian Tinggi Malaysia, Dasar Keusahawanan Institusi Pendidikan Tinggi 2021, Putrajaya: KPT, 2021.

[6] H. Zhao, S. E. Seibert and G. E. Hills, "The mediating role of self-efficacy in the development of entrepreneurial intentions," Journal of Applied Psychology, vol. 90, no. 6, pp. 1265–1272, 2010.

[7] D. F. Kuratko, Entrepreneurship: Theory, Process, and Practice, 9th ed., Stamford: Cengage Learning, 2014.

[8] N. Ismail and R. Ahmad, "Tahap pengetahuan pelajar politeknik terhadap

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

teknousahawan," Jurnal Pendidikan Teknikal dan Vokasional, vol. 7, no. 1, pp. 56–64, 2021.

[9] S. A. Rahman, "Pendidikan keusahawanan dalam kalangan pelajar institusi pengajian tinggi," Malaysian Journal of Higher Education, vol. 5, pp. 22–30, 2020.

[10] N. Norazah, M. Yusof and A. Hamzah, "Persepsi pelajar terhadap keusahawanan teknologi: Satu kajian awal," Jurnal Psikologi dan Pendidikan, vol. 10, no. 1, pp. 88–95, 2022.

[11] H. Y. Lim and C. W. Chan, "Entrepreneurial attitudes and intention among Malaysian polytechnic students," International Journal of Academic Research in Business and Social Sciences, vol. 11, no. 3, pp. 123–135, 2021.

[12] N. Suradi, M. A. Latiff, dan R. S. Hashim, "Tahap Pengetahuan dan Sikap Pelajar Universiti terhadap Keusahawanan Teknologi," Jurnal Pendidikan Malaysia, vol. 45, no. 1, pp. 56–63, 2020.

[13] N. H. Mohamad, S. Yusof, dan R. Hassan, "Persepsi Pelajar Terhadap Program Keusahawanan Teknousahawan di IPTA," Jurnal Pengurusan, vol. 54, pp. 75–88, 2019.

[14] H. A. Rahim dan Z. Ismail, "Keberkesanan Modul Keusahawanan Berteraskan Teknologi dalam Meningkatkan Persepsi Pelajar," Malaysian Journal of Learning and Instruction, vol. 17, no. 2, pp. 101–118, 2021.

[15] N. Noraini, M. I. Jamal, dan H. Bakar, "Pengetahuan dan Persepsi Terhadap Keusahawanan Teknologi: Kajian Kes Pelajar Politeknik," Jurnal Sains Sosial dan Kemanusiaan, vol. 13, no. 3, pp. 45–58, 2020.

[16] R. Kothari, *Research Methodology: Methods and Techniques*, 2nd ed. New Delhi: New Age International, 2004.

[17] R. Likert, "A Technique for the Measurement of Attitudes," Archives of Psychology, vol. 140, pp. 1–55, 1932.

[18] J. W. Creswell and J. D. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th ed. Thousand Oaks, CA: SAGE, 2018.

[19] A. Field, Discovering Statistics Using IBM SPSS Statistics, 5th ed. London: SAGE, 2018.

[20] N. A. M. Isa, S. Yusof, dan M. A. A. Halim, "Analisis Deskriptif dalam Kajian Pendidikan: Satu Tinjauan," Jurnal Sains Sosial dan Kemanusiaan, vol. 15, no. 2, pp. 55–62, 2020.

[21] A. M. Sidek dan H. H. Ahmad, "Penggunaan Statistik Deskriptif dalam Penyelidikan Kuantitatif," Jurnal Teknologi, vol. 78, no. 1, pp. 23–30, Jan. 2016.

[22] J. W. Creswell, Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, 4th ed. Boston, MA: Pearson Education, 2012.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

G) AUTHOR'S INFORMATION

First Author: Sharmila Bt Md Isa 	Jabatan Kejuruteraan Elekrik, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak E-mail: sharmila.mdisa@puo.edu.my
Second Author: Saadiah Binti Seman 	Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak E-mail: diahseman@puo.edu.my
Third Author: Fadilah Binti Ahmad 	Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak E-mail: dilahahmad@puo.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Keberkesanan Program Kerjasama Industri Berasaskan Micropengawal Arduino terhadap Pembangunan Pelajar

Nur Kamaliah binti Ismail[1], Saadiah binti Seman[2],

[1] *Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, Ipoh, Perak*
E-mail: kamaliah@puo.edu.my

[2] *Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar, Ipoh,*
E-mail: : diahseman@puo.edu.my

Abstrak

Kajian ini bertujuan untuk menilai keberkesanan program kerjasama industri berasaskan mikropengawal Arduino terhadap pembangunan pelajar dari segi prestasi akademik, eksplorasi, personaliti dan keterkaitan industri. Seramai 20 orang pelajar dari Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar telah dipilih melalui pendekatan pensampelan bertujuan. Pemilihan saiz sampel adalah kecil, ia dianggap mencukupi bagi kajian awal berskala kecil dan membolehkan penilaian awal tentang keberkesanan program dijalankan secara mendalam dan terfokus. Proses pemilihan sampel yang sistematik, bermula daripada promosi program, saringan peserta oleh pensyarah kursus '*Programming Fundamentals'*, penyenaraian pendek berdasarkan pengetahuan pengaturcaraan, dan penerimaan akhir berdasarkan minat pelajar. Pelaksanaan bengkel dengan kerjasama pihak industri berasaskan micropengawal aduino memberi latihan daan tunjukajar kepada peserta berkaitan asas arduino dan perkongsian ilmu daripada pihak industri bagi memberikan pendedahan sebenar kepada aplikasi Arduino dalam dunia pekerjaan sebenar. Diakhir bengkel, peserta diminta untuk menjawap refleksi program. Hasil dapatan releksi ini dijadikan soal silidik bagi kajian ini dengan menggunakan reka bentuk kuantitatif dengan instrumen soal selidik berskala Likert empat mata bagi menilai persepsi pelajar mengikut objektif kajian iaitu menilai persepsi pelajar terhadap keberkesanan program kerjasama industri berasaskan Arduino, mengenal pasti perbezaan persepsi pelajar berdasarkan jantina terhadap keberkesanan program kerjasama industri berasaskan Arduino, menentukan hubungan antara penerokaan teknologi, personality dan keterkaitan industri dengan prestasi akademik pelajar dan menganalisis kesan bersama penerokaan, personaliti dan keterkaitan industri terhadap prestasi akademik pelajar melalui analisis regresi. Analisis statistik dilaksanakan melibatkan ujian-t sampel bebas, korelasi Pearson dan regresi linear berganda. Analisis deskriptif menunjukkan semua pembolehubah mencatat skor min yang tinggi, mencerminkan persepsi positif pelajar terhadap keberkesanan program. Ujian-t menunjukkan tiada perbezaan signifikan antara pelajar lelaki dan perempuan, manakala analisis korelasi mendapati terdapat hubungan positif yang signifikan antara eksplorasi, personaliti dan keterkaitan industri dengan prestasi akademik. Walaupun model regresi secara keseluruhan adalah signifikan ($F = 9.935$, $p = 0.001$; $R^2 = 0.651$), tiada pembolehubah bebas individu yang signifikan secara statistik. Kajian ini menyimpulkan bahawa program berasaskan Arduino mempunyai potensi untuk menyumbang kepada pembangunan pelajar secara holistik, namun kesan langsung terhadap prestasi akademik mungkin turut dipengaruhi oleh faktor luaran lain yang tidak dinilai dalam kajian ini dimana penyertaan pelajar perlu diperbanyakkan bagi meningkatkan kebolehgunaan hasil kajian serta memperkukuh kesahan kajian

Katakunci : *Arduino: pembangunan pelajar; kerjasama industri; prestasi akademik; pendidikan teknikal*

This study aims to evaluate the effectiveness of the Arduino microcontroller-based industrial collaboration program on student development in terms of academic performance, exploration, personality and industrial relevance. A total of 20 students from the Department of Electrical Engineering, Ungku Omar Polytechnic, were selected through a purposive sampling approach. Where the sample size selection was small, it was considered sufficient for a small-scale initial study and allowed for an initial assessment of the program's effectiveness to be conducted in depth and focused.. A systematic sample selection process starts with program promotion, screening of participants by the 'Programming Fundamentals' course lecturer, shortlisting based on programming

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

knowledge, and final acceptance based on student interest. The workshop implementation in collaboration with the Arduino microcontroller-based industry provided training and guidance to participants on the basics of Arduino and knowledge sharing from the industry to provide real exposure to Arduino applications in the real world of work. At the end of the workshop, participants were asked to answer a reflection on the program. The results of this reflection were used as a questionnaire for this study using a quantitative design with a four-point Likert scale questionnaire instrument to assess student perceptions according to the study objectives, namely to determine student perceptions of the effectiveness of the Arduino-based industry collaboration program, identify differences in student perceptions based on gender of the efficacy of the Arduino-based industry collaboration program, determine the relationship between technological exploration, personality and industry relevance with student academic performance, and analyze the joint effects of exploration, personality and industry relevance on student academic performance through regression analysis. Statistical analysis involved an independent sample t-test, Pearson correlation, and multiple linear regression. Descriptive analysis showed that all variables recorded high mean scores, reflecting students' positive perceptions of the effectiveness of this program. The t-test showed no significant difference between male and female students, and correlation analysis found a significant positive relationship between exploration, personality, and industry relevance with academic performance. Although the overall regression model was significant ($F = 9.935$, $p = 0.001$; $R^2 = 0.651$), no individual independent variables were statistically significant. This study concludes that Arduino-based programs have the potential to contribute to student development holistically, however, the direct impact on academic performance may also be influenced by other external factors that were not assessed in this study, where student participation needs to be increased to increase the applicability of the study results and strengthen the validity of the study.

Katakunci : *Arduino: student development; industry collaboration; academic performance; technical education*

I. PENDAHULUAN

Revolusi Industri 4.0 rancak berlaku di seluruh dunia dengan pembangunan pesat dalam produk berteknologi dan sistem automasi yang lebih pintar. Malaysia antara negara yang sedang bergerak ke hadapan dalam perkembangan kearah dunia elektronik, rekacipta dan robotik. Penerapan awal dikalangan pihak pendidikan membantu usaha kerajaan bagi merialiasikan Revolusi Industri 4.0 ini. Dengan adanya sokongan semua pihak pelbagai inovasi dan ciptaan telah dihasilkan oleh pelbagai golongan pelajar di setiap peringkat. Pelajar perlu diberikan pengetahuan secukupnya untuk membangunkan teknologi contohnya menghasilkan pengaturcaraan dan pembangunan sistem aplikasi yang mudah untuk dibangunkan oleh pelajar. Antara microcontroller yang popular digunapakai di serata dunia adalah Arduino.

Bengkel Arduino dapat memberi pengetahuan asas kepada pelajar pengunaan atau membantu pihak institusi pendidikan dalam menangani isu pelajar kurang berkemahiran dari segi kemahiran perkakasan microcontroller seperti Arduino. Micropengawal Ardunio diprogramkan untuk melaksanakan fungsi yang ditulis melalui sintaks pengatucaraan Bahasa C yang dipelajari oleh pelajar TVET (Technical and Vocational Education and Training) terutama bagi program di Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar. Program micropengawal Arduino juga dapat meningkatkan keperibadian pelajar politeknik itu sendiri di dalam kekuatan keyakinan diri sendiri, dan boleh menggunakan ilmu yang dipelajari sekaligus memantapkan pengetahuan untuk diri sendiri.

Penglibatan pihak Firma juga dapat membantu pelajar memberi idea dan meningkatkan daya kreatif serta kemahiran baru asas pengunaan arduino. Malah sebagai satu platorm mengeratkan hubungan antara firma dengan pihak institusi pendidikan teknikal. Kajian ini memberi sumbangan penting dalam menilai kesan program berasaskan teknologi dan kerjasama pihak industri terhadap pelajar. Dapatan kajian dapat membantu pihak pentadbiran, pensyarah dan rakan industri merangka strategi pengajaran dan latihan yang lebih efektif serta berimpak tinggi dalam pembangunan pelajar terutama pelajar TVET.

A. Penyataan Masalah

Dalam era pendidikan moden, wujud keperluan yang mendesak untuk merapatkan jurang antara pengetahuan teori yang diperoleh di bilik darjah dengan aplikasi sebenar di industri. Hal ini amat ketara dalam bidang kejuruteraan dan teknologi, di mana pelajar sering kali menghadapi kesukaran untuk mengaplikasikan ilmu secara praktikal setelah tamat pengajian. Walaupun pelbagai inisiatif pembaharuan kurikulum telah dilaksanakan, kemahiran teknikal dan pendedahan industri dalam kalangan pelajar masih berada pada tahap yang membimbangkan.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Micropengawal Arduino, sebagai satu platform elektronik sumber terbuka telah dikenal pasti sebagai alat yang berpotensi tinggi dalam memperkasa pembelajaran berasaskan projek serta membentuk pemikiran kritikal dan kemahiran menyelesaikan masalah. Namun begitu, keberkesanan program penggunaan Arduino dengan kerjasama industri terhadap pembangunan pelajar dari aspek akademik, penerokaan ilmu, pembentukan personaliti, dan keterkaitan dengan industri masih kurang dikaji secara menyeluruh, khususnya dalam konteks tempatan.

Justeru, kajian ini dijalankan bagi mengenal pasti sejauh mana keberkesanan program kerjasama industri berasaskan Arduino dalam meningkatkan pembangunan pelajar secara holistik. Hasil dapatan ini dijangka dapat memberikan gambaran yang lebih jelas kepada institusi pendidikan dalam merangka strategi pembelajaran yang lebih relevan dan bersesuaian dengan keperluan industri semasa**.**

B. Objektif Kajian

Kajian ini bertujuan untuk menilai keberkesanan program kerjasama industri berasaskan Arduino terhadap pembangunan pelajar. Objektif khusus kajian adalah seperti berikut:

1. Menilai persepsi pelajar terhadap keberkesanan program kerjasama industri berasaskan Arduino
2. Mengenal pasti perbezaan persepsi pelajar berdasarkan jantina terhadap keberkesanan program kerjasama industri berasaskan Arduino.
3. Menentukan hubungan antara penerokaan teknologi, personality dan keterkaitan industri dengan prestasi akademik pelajar.
4. Menganalisis kesan bersama penerokaan, personaliti dan keterkaitan industri terhadap prestasi akademik pelajar melalui analisis regresi.

C. Soalan Kajian

Kajian ini dijalankan untuk menjawab soalan-soalan berikut:

1. Adakah terdapat perbezaan persepsi pelajar terhadap keberkesanan program kerjasama industri berasaskan Arduino berdasarkan jantina?
2. Apakah tahap persepsi pelajar terhadap keberkesanan program kerjasama industri berasaskan Arduino dari segi pencapaian akademik, eksplorasi, personaliti dan keterkaitan industri?
3. Adakah terdapat hubungan antara eksplorasi dan pencapaian akademik pelajar dalam program kerjasama industri berasaskan Arduino?
4. Adakah terdapat hubungan antara personaliti dan pencapaian akademik pelajar dalam program kerjasama industri berasaskan Arduino?
5. Adakah terdapat hubungan antara keterkaitan industri dan pencapaian akademik pelajar dalam program kerjasama industri berasaskan Arduino?
6. Adakah eksplorasi, personaliti dan keterkaitan industri secara kolektif mempengaruhi prestasi akademik pelajar yang menyertai program ini?

D. Hipotesis Kajian

Hipotesis berikut diuji bagi menentukan hubungan dan kesan penyertaan pelajar dalam program Arduino terhadap pembangunan pelajar:

H1:Tiada perbezaan yang signifikan dari segi persepsi pelajar terhadap program berdasarkan jantina
H2:Min skor persepsi pelajar terhadap keberkesanan program kerjasama industri berasaskan Arduino adalah tinggi dari segi pencapaian akademik, eksplorasi, personaliti dan keterkaitan industri.
H3:Terdapat hubungan positif yang signifikan antara eksplorasi dan prestasi akademik pelajar.
H4:Terdapat hubungan positif yang signifikan antara personaliti dan prestasi akademik pelajar.
H5:Terdapat hubungan positif yang signifikan antara keterkaitan industri dan prestasi akademik pelajar.
H6:Terdapat hubungan positif secara kolektif antara eksplorasi, personaliti dan keterkaitan industri terhadap prestasi akademik pelajar.

II. KAJIAN LITERATUR

Pelbagai kajian lepas telah menunjukkan bahawa pendekatan pembelajaran berasaskan projek dan teknologi seperti Arduino mampu meningkatkan minat dan penglibatan pelajar dalam bidang teknikal [1], [2]. Arduino merupakan platform mikropengawal sumber terbuka yang membolehkan pelajar membina projek elektronik interaktif dan telah digunakan secara meluas dalam program TVET (Technical and Vocational Education and Training) bagi merangsang kemahiran penyelesaian masalah serta kreativiti [3].

Menurut kajian oleh Hussain et al. [4], program berasaskan Arduino yang melibatkan kerjasama dengan pihak industri bukan sahaja memberi nilai tambah dari segi kemahiran teknikal, tetapi juga meningkatkan kesedaran pelajar terhadap keperluan sebenar industri. Pelajar yang terlibat dalam program kerjasama industri menunjukkan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

peningkatan dari segi keyakinan diri, kemahiran insaniah, dan pencapaian akademik[5]

Dari sudut teori personaliti, ciri-ciri seperti tanggungjawab, motivasi kendiri dan daya tahan telah dikaitkan dengan pencapaian pelajar dalam pelbagai konteks pembelajaran [6]. Elemen penerokaan dalam pembelajaran pula membolehkan pelajar mengaitkan pengetahuan teknikal dengan aplikasi sebenar, sekaligus memperkukuh pemahaman konsep dan prestasi akademik [7].

Namun demikian, terdapat juga kajian yang menunjukkan bahawa keberkesanan program seperti ini bergantung kepada pelbagai faktor lain termasuk strategi pengajaran, latar belakang pelajar dan bentuk penglibatan industri [8]. Oleh itu, kajian ini dijalankan untuk mengisi jurang tersebut dengan menilai secara empirikal hubungan antara penerokaan teknologi, personaliti pelajar, keterkaitan industri dan prestasi akademik dalam konteks program berasaskan Arduino.

Selain itu, pendekatan pembelajaran aktif yang dijalankan melalui bengkel berasaskan teknologi didapati mampu meningkatkan penglibatan dan minat pelajar secara signifikan terhadap bidang pengajian mereka. Sehungan itu, pelajar yang terlibat dalam bengkel teknologi menunjukkan kecenderungan yang lebih tinggi untuk meneroka ilmu secara kendiri dan aktif serta mengekalkan penglibatan sepanjang sesi pembelajaran berlangsung [9].

III. KAEDAH PENYELIDIKAN

Kajian ini menggunakan reka bentuk kajian kuantitatif berbentuk tinjauan deskriptif, bagi menilai keberkesanan pelaksanaan program Arduino bersama industri. Instrumen kajian terdiri daripada pembinaan item merujuk kepada Refleksi pelajar Buku Panduan Pelaksanaan Aktiviti Pensyarah Pelawat Industri PPI Politeknik dan Kolej Komuniti Malaysia [10], bagi memastikan kandungan instrumen sejajar dengan konteks pelaksanaan program di institusi pendidikan teknikal dan vokasional (TVET).

Soal selidik ini merangkumi empat konstruk utama iaitu penerokaan teknologi, personaliti pelajar, keterkaitan industri, dan prestasi akademik. Semua item dinilai menggunakan skala Likert Empat mata (1 = Sangat Tidak Setuju hingga 4 = Sangat Setuju). Nilai kebolehpercayaan (Cronbach's Alpha) keseluruhan instrumen melebihi 0.90, menunjukkan tahap kebolehpercayaan yang tinggi. Jadual 1 menunjukkan nilai kebolehpercayaan Cronbanch's Alpha

Jadual 1: Kebolehpercayaan Cronbanch's Alpha

Cronbach's Alpha	N of Items
.950	12

Soal selidik kajian ini telah diuji tahap kebolehpercayaanya menggunakan pekali Cronbanc's Alpha, nilai alpha yang melebihi 0.90 dianggap sangat baik dan menunjukkan bahawa item-item dalam instrumen mempunyai tahap konsistensi dalaman yang tinggi [11]. Oleh itu, instrumen ini boleh digunakan dengan yakin untuk tujuan pengumpulan data dalam kajian ini. Dalam penyelidikan, soal selidik digunakan untuk menukar maklumat kepada data yang diberikan kepada responden, di mana semua skala mengukur tahap atau kekerapan persetujuan [12].

Data diperoleh melalui soal selidik yang diedarkan kepada peserta melalui soal selidik berstruktur dengan menggunakan Google Form bagi mendapatkan maklumat yang dikehendaki seperti dalam persoalan kajian. Soal selidik ini mengandungi Empat bahagian utama: Tahap pencapaian akademik, Tahap eksplorasi pelajar, Tahap personali pelajar dan Keterkaitan/Connectivity. Kajian ini mematuhi etika penyelidikan institusi. Kerahsiaan responden dijamin dan data hanya digunakan untuk tujuan akademik dan penambahbaikan program.

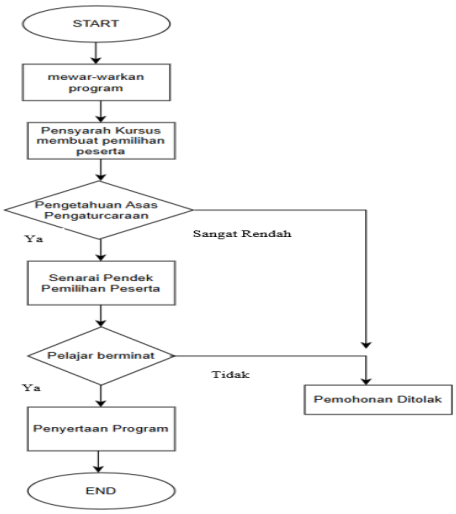
Data yang diperolehi dianalisis menggunakan SPSS versi 27 dan ditafsir dalam jadual dan carta yang boleh difahami. Skala Likert digunakan kerana ia mempunyai tahap kebolehpercayaan dan ketepatan yang tinggi dalam pengukuran persepsi, dengan anggaran kebolehpercayaan sebanyak 85% [13].

Sampel kajian terdiri daripada pelajar yang terlibat secara langsung dalam program ini, khususnya pelajar semester 2 dari Jabatan Kejuruteraan Elektrik, Politeknik Ungku Omar. Sampel dipilih secara pensampelan bertujuan (purposive sampling) [14], iaitu berdasarkan penyertaan aktif dalam aktiviti yang melibatkan bengkel Arduino bersama industri, pemilihan sampel kajian dibuat secara bertujuan mengikut ciri-ciri populasi dan objektif kajian [15] yang terdiri daripada 20 orang pelajar yang menyertai program Arduino. Walaupun saiz sampel adalah kecil, ia dianggap mencukupi bagi kajian awal berskala kecil dan membolehkan penilaian awal tentang keberkesanan program dijalankan secara mendalam dan terfokus

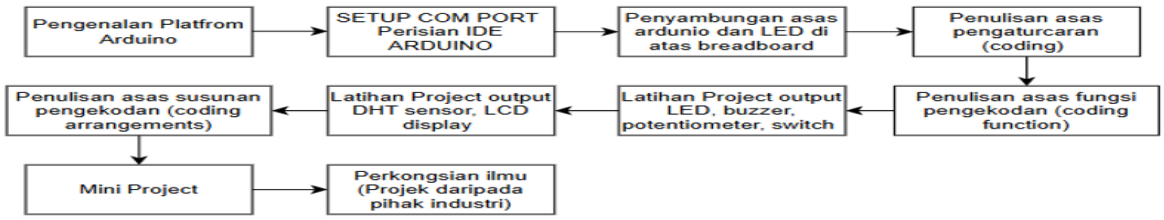
Rajah 1 menggambarkan proses pemilihan sampel yang sistematik, bermula daripada promosi program, saringan peserta oleh pensyarah kursus '*Programming Fundamentals'*, penyenaraian pendek berdasarkan pengetahuan pengaturcaraan, dan penerimaan akhir berdasarkan minat pelajar.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479



Rajah 1: Proses Pemilihan Peserta



Rajah 2: Pelaksanaan Bengkel

A. Pelaksanaan Bengkel

Program dilaksanakan secara bersemuka selama 1 hari dengan kerjasama industri melibatkan aktiviti seperti di Rajah 2.

Program latihan Arduino ini dilaksanakan secara berstruktur dan berfasa bermula dengan pengenalan kepada platform Arduino dan pemasangan perisian IDE Arduino, diikuti penyambungan asas komponen seperti LED pada papan breadboard. Peserta kemudiannya diperkenalkan kepada asas penulisan pengaturcaraan termasuk fungsi dan susunan kod. Latihan praktikal merangkumi output projek menggunakan komponen seperti LED, buzzer, potentiometer, suis, sensor DHT dan paparan LCD. Program diteruskan dengan penghasilan mini projek yang menggabungkan semua kemahiran yang dipelajari. Sebagai penutup, sesi perkongsian ilmu bersama pihak industri dijalankan bagi memberikan pendedahan sebenar kepada aplikasi Arduino dalam dunia pekerjaan sebenar.

B. Kaedah Analisis Data

Data dianalisis menggunakan perisian SPSS versi 27.0, melibatkan Statistik deskriptif (min dan sisihan piawai) bagi menerangakn taburan data. Ujian-t Sampel Bebas (Independent t-test) mengkaji sama ada terdapat perbezaan persepsi terhadap program Arduino antara pelajar lelaki dan Perempuan. Ujian Korelasi Pearson untuk mengukur hubungan antara pemboleh ubah dan Analisi Regresi berganda bagi mengenal pasti pemboleh bebas terhadap pemboleubah bersandar. Melalui analisis korelasi dan regresi, penyelidik dapat menguji hipotesis statistik dan menentukan sama ada hubungan atau kesan yang dijangka benar-benar wujud dalam data [16], [17]. Ujian normaliti residual

Bahagian A, B dan C mengandungi soalan-soalan yang bentuk skala likert bagi mengkuantitikan tahap keberkesanan responden dalam menghadiri bengkel Arduino . Bahagian A merujuk kepada pencapaian akademik pelajar serta peningkatan tahap kompetensi teknikal yang diperoleh melalui pengalaman pembelajaran secara amali sepanjang pelaksanaan bengkel Arduino bersama industri. Ia merangkumi keupayaan pelajar memahami konsep kejuruteraan, mengaplikasikan pengetahuan teori, dan menyelesaikan masalah secara praktikal.

Bahagian B adalah Eksplorasi yang merangkumi daya imaginasi, pemikiran kritis dan kreatif serta inovatif pelajar dalam pendekatan baharu dalam bidang teknologi. Manakala bahagian C adalah Personaliti yang merangkumi sikap yang baik, bertanggungjawab, adaptasi terhadap persekitaran dan gaya kepimpinan,ia menggambarkan perkembangan nilai peribadi dan kemahiran insaniah hasil daripada penglibatan aktif dalam aktiviti berkumpulan dan situasi dunia sebenar.

Bahagian D adalah Keterkaitan merangkumi aspek komunikasi secara lisan atau

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

tidak dengan pihak atasan, rakan kerja berpasukan dan commercial awareness (bersesuaian dengan perkem-bangan semasa), kefahaman tentang keperluan pasaran kerja serta kebolehan menyesuaikan diri dengan budaya kerja semasa.

Soal selidik ini merangkumi proses untuk melihat perkembangan pembelajaran pelajar bagi mencapai objektif sesuatu aktiviti. Hasil dapatan reflefsi ini juga dilihat sebagai satu peluang penambahbaikan kualiti berterusan atau *Continuous Quality Improvement* (CQI) bagi pelaksanaan aktiviti bersama dengan pihak industri[10].

Skor min dianalisis berdasarkan interpretasi tahap persetujuan pelajar terhadap item-item soal selidik, berpandukan kepada kategori yang dicadangkan oleh Nunnal-ly dan Bernstein [18] dan Chua [19]

Skor min bagi setiap item soal selidik ditafsirkan berdasarkan julat nilai yang telah ditetapkan, bagi menentukan tahap persetujuan responden. Interpretasi ini membolehkan penyelidik mengenal pasti kecenderungan umum dalam kalangan responden terhadap setiap pembolehubah kajian [18].

Sebagai contoh, skor min dalam julat 3.26 hingga 4.00 menunjukkan tahap persetujuan yang sangat tinggi, manakala skor antara 1.00 hingga 1.75 menunjukkan tahap persetujuan yang sangat rendah (lihat Jadual I) [18], [18].

Jadual 2 Interpretasi Skor Min Berdasarkan Skal Liker 4 Mata

Skor Min	Tahap Persetujuan
1.00 -1.75	Sangat Tidak Setuju
1.76 – 2.50	Tidak Setuju
2.51-3.25	Setuju
3.26 -4.00	Sangat Setuju

Jadual 3 menunjukkan interpretasi skor min berdasarkan tiga kategori utama, iaitu rendah, sederhana, dan tinggi. Pengelasan ini bertujuan memberikan gambaran umum terhadap kecenderungan respons pelajar dalam soal selidik kajian ini, selaras dengan pendekatan yang disarankan oleh Nunnally dan Bernstein [18].

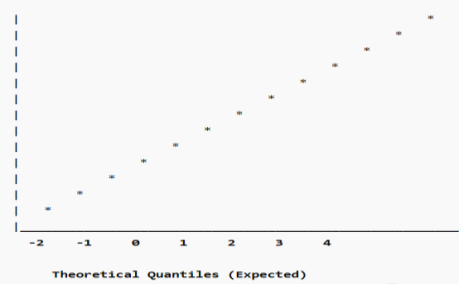
Jadual 3 Interpretasi Skor Min Berdasarkan Kategori Tahap (Tinggi, Sederhana, rendah)

Skor Min	Tahap
1.00 -2.00	Rendah
2.01-3.00	Sederhana
3.01-4.00	Tinggi

Ujian hipotesis dalam kajian ini dilaksanakan pada aras signifikan $p < 0.05$ bagi menentukan hubungan dan kesan antara pembolehubah. Dua jenis analisis statistik inferensi digunakan: Ujian Korelasi Pearson bagi mengukur kekuatan dan arah hubungan linear antara penerokaan, personaliti, dan perkaitan industri dengan prestasi akademik, dan Analisis Regresi Berganda bagi menilai sumbangan setiap konstruk terhadap pembolehubah bersandar (prestasi akademik). Hipotesis nol akan ditolak sekiranya nilai $p < 0.05$, menandakan bahawa hubungan atau kesan tersebut adalah signifikan secara statistik.[20]

Dalam analisis regresi linear berganda, ujian Normaliti Resedual dijalankan bagi memastikan bahawa andaian statistik dipenuhi bagi menjamin ketepatan model. Kajian ini menjalankan ujian normaliti residual dengan menggunakan Normal P–P Plot**.** Salah satu andaian utama ialah normaliti residual, iaitu keperluan bahawa perbezaan antara nilai ramalan dan nilai sebenar (residual) adalah teragih secara normal. [17].

Kajian ini menjalankan ujian normaliti residual dengan menggunakan Normal P–P Plot, seperti ditunjukkan dalam Rajah 3. Titik-titik data yang disusun sepanjang garis pepenjuru dalam plot tersebut menunjukkan bahawa nilai residual mengikuti taburan normal. Oleh itu, andaian normaliti residual telah dipenuhi, membolehkan keputusan model regresi ditafsir secara sah.



Rajah 3 : Ujian Normaliti Residual

V. KEPUTUSAN DAN PERBINCANGAN

Proses menganalisa data dilakukan dengan menggunakan perisian SPSS V27 (Statistical Package for Sosial Science Version 27). Perisian SPSS versi 27 digunakan kerana ia memudahkan analisis data. Mempunyai keupayaan untuk mengubah suai pelbagai sampel dan memastikan data yang dianalisis adalah tepat.

Dapatan statistik berdasarkan hipotesis yang dirumus. Analisis termasuk ujian-t sampel bebas, korelasi Pearson, dan regresi linear berganda, dengan semua ujian dinilai pada tahap keertian $p < 0.05$. Untuk menguji H1, yang menyatakan bahawa tidak terdapat perbezaan yang signifikan dalam persepsi kualiti program antara pelajar lelaki dan perempuan, ujian-t sampel bebas telah dijalankan. Keputusan diringkaskan dalam Jadual 4.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Analisis ujian-t, Tidak terdapat perbezaan yang signifikan secara statistik dalam skor min antara peserta lelaki dan perempuan ($p > 0.05$) iaitu $t= -0.507$, $p= 0.619$. Oleh itu, tiada perbezaan yang signifikan dalam tahap kualiti keberkesanan program antara kedua-dua jantina. Ini menyokong hipotesis H1 yang menunjukkan bahawa jantina tidak mempengaruhi kualiti keberkesanan program Arduino Bersama industri menyatakan perbezaan signifikan berdasarkan jantina.

Jadual 4. Tahap kualiti keberkesanan program mengikut jantina

Jantina	Bil.	Min	Sisihan Piawai	Nilai-t	Tahap Signifikan
Lelaki	8	3.6250	0.37533	-0.507	0.619
Perempuan	12	3.7153	0.39959	-0.507	0.615

A. Analisis Skor Min, Sisishan Piawai dan Intreprestasi Pembolehubah (H2)

Analisis dekriptif bagi kajian ini melibatkan penggunakan min,sisihan piawai dan interpretasi min. Jadual 5 menunjukkan nilai min dan sisihan piawai bagi empat pembolehubah utama iaitu prestasi akademik, eksplorasi, personaliti, dan keterkaitan industri. Interpretasi min dilakukan berdasarkan skala Likert 4 mata seperti berikut:

Jadual 5(a) *Data Peserta n Min , sisihan piawai dan* Interpretasi *Bagi Pencapaian Akademik*

BIL	Item	Min	Sisishan Piawai	Interp.
A1	Meningkatkan pengetahuan berkaitan dengan program	3.85	0.37	Tinggi
A2	Membuat perkaitan dengan bidang kursus yang diikuti	3.80	0.41	Tinggi
A3	Memahami hubungankait di anatara pembelajaran teori dan amali	3.75	0.44	Tinggi

Jadual 5(b) *Data Peserta n Min , sisihan piawai dan* Interpretasi *Bagi* Eksplorasi

BIL	Item	Min	Sisishan Piawai	Interp.
B1	Berkeyakinan dalam memberi pendapat	3.50	0.61	Tinggi
B2	Berkongsi idea secara terbuka	3.50	0.51	Tinggi
B3	Meningkatkan keinginan untuk meneroka bidang yang di pelajari.	3.75	0.44	Tinggi

Jadual 5(c) *Data Peserta n Min , sisihan piawai dan* Interpretasi *Bagi Personaliti*

BIL	Item	Min	Sisishan Piawai	Interp.
C1	Meningkatkan motivasi diri dan kebolehan berfikir secara kreatif	3.70	0.47	Tinggi
C2	Membantu diri menjadi lebih peka/fokus dan produktif terhadap	3.70	0.47	Tinggi

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

	bidang yang di pelajari.			
C3	Memahami tanggungjawab yang di praktikkan.	3.65	0.49	Tinggi

Jadual 5(d) Data Peserta Min , sisihan piawai dan Interpretasi Bagi Keterkaitan

BIL	Item	Min	Sisishan Piawai	Interp.
D1	Mempamerkan kemahiran berinteraksi dengan pihak industri	3.65	0.49	Tinggi
D2	Memahami kepentingan hubungan dengan pihak industri	3.60	0.50	Tinggi
D3	Menyediakan diri untuk melangkah ke alam pekerjaan	3.70	0.47	Tinggi

Hasil dapatan purata analisis kajian nilai min dan sisihan piawai bagi empat pembolehubah utama iaitu prestasi akademik, eksplorasi, personaliti, dan keterkaitan industri dihuraikan secara terperinci seperti berikut:

Jadual 6 Skor Min, Sisihan Piawai dan Interpretasi Akademik. Eksplorasi, personalti dan Keterkiatan

Pembolehubah	Min	Sisishan Piawai	Interp.
Akademik	3.80	0.37	Tinggi
Eksplorasi	3.58	0.44	Tinggi
Personaliti	3.68	0.41	Tinggi
Keterkaitan	3.65	0.44	Tinggi

Dapatan menunjukkan bahawa semua pembolehubah mencatatkan min melebihi 3.26, menandakan tahap persepsi pelajar yang tinggi terhadap keberkesanan program kerjasama industri berasaskan Arduino.

- Pembolehubah prestasi akademik mencatatkan min tertinggi (3.80), menandakan pelajar merasakan program ini telah memberi impak positif yang signifikan terhadap pencapaian akademik mereka.
- Eksplorasi dan personaliti masing-masing mencatat min 3.58 dan 3.68, menunjukkan bahawa program ini berjaya merangsang minat pelajar untuk meneroka teknologi serta membentuk nilai dan sikap positif dalam diri.
- Keterkaitan industri turut berada pada tahap tinggi (min = 3.65), menunjukkan pelajar mengakui relevansi dan kesan positif pendedahan industri dalam program ini terhadap pembelajaran mereka.

Sisihan piawai menunjukkan sejauh mana data tersebar daripada nilai min. Dalam konteks ini:

- Nilai sisihan piawai yang rendah (sekitar 0.37–0.44) menunjukkan bahawa persepsi pelajar adalah konsisten dan homogen, iaitu majoriti pelajar berkongsi pandangan yang hampir sama terhadap pembolehubah-pembolehubah yang dikaji.
- Ini menguatkan lagi keyakinan terhadap ketepatan dan keseragaman dapatan kajian.

B. Analisis Korelasi Pearson (H3–H5)

Korelasi Pearson digunakan untuk menguji H3–H5, yang mengkaji kekuatan dan hala tuju hubungan antara penerokaan, personaliti, dan perkaitan industri dengan prestasi akademik. Hasi analisis sperti di dalam Jadual 3.

Jadual 7: Keputusan Penuh Korelasi Antara Pembolehubah Bebas dan Prestasi Akademik

	Eksplorasi	Personaliti	Keterkaitan
Akademik	.757**	.763**	.671**

**Kolerasi adalah significant pada tahap 0.01 (2-tailed)

Ujian korelasi Pearson dipilih kerana data yang digunakan adalah linear dan berskala selang atau nisbah. Nilai korelasi (r) yang diperoleh berada dalam julat antara -1.0 hingga +1.0, dengan tafsiran seperti berikut:

- $r \approx 0.70 – 0.90$: Hubungan kuat
- $r \approx 0.40 – 0.69$: Hubungan sederhana
- $r \approx 0.10 – 0.39$: Hubungan lemah
- $r \approx 0$: Tiada hubungan

Keputusan ujian korelasi Pearson menunjukkan hubungan positif yang kuat antara beberapa pembolehubah utama dalam kajian ini. Personaliti menunjukkan korelasi tertinggi dengan pencapaian akademik (r = 0.763), yang bermaksud peserta yang mempunyai ciri-ciri personaliti positif cenderung mencapai keputusan akademik yang lebih baik.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

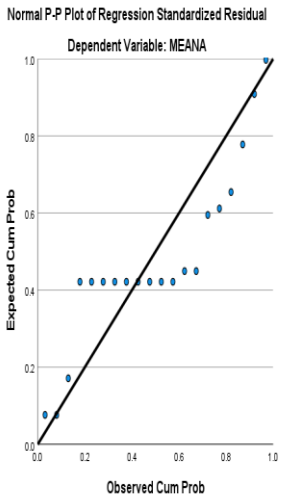
Selain itu, aspek eksplorasi juga mempunyai hubungan yang kuat dengan akademik (r = 0.757), menunjukkan peserta yang aktif meneroka teknologi seperti Arduino cenderung memperoleh prestasi akademik yang tinggi.

Keterkaitan pula mencatatkan korelasi paling rendah di antara ketiga-tiga pembolehubah tersebut, tetapi masih berada dalam kategori hubungan positif yang kuat dan signifikan (r = 0.671). Ini menunjukkan bahawa walaupun tahap keterkaitan industri tidak setinggi personaliti atau eksplorasi, ia tetap memberi impak positif terhadap prestasi akademik pelajar.

Dalam konteks kajian ini, Ketiga-tiga pembolehubah menunjukkan hubungan positif dan signifikan yang kuat dengan prestasi akademik pelajar. Oleh itu, H3, H4, dan H5 disokong.

C. Ujian Normaliti Residual

Bagi memastikan kesahan model regresi linear berganda, ujian normaliti terhadap residual telah dijalankan menggunakan Normal P–P Plot of Regression Standardized Residuals seperti yang ditunjukkan dalam Rajah 4. Dalam plot tersebut, pembolehubah bersandar ialah prestasi akademik pelajar ini menunjukkan bahawa titik-titik data berada hampir dengan garis lurus diagonal, yang menandakan bahawa taburan residual adalah hampir normal. Walaupun terdapat sedikit penyimpangan di bahagian hujung, pola keseluruhan masih berada dalam julat yang boleh diterima, terutamanya memandangkan saiz sampel kajian adalah kecil (n = 20). .Ini menunjukkan andaian normaliti bagi analisis regresi telah dipenuhi, membolehkan keputusan regresi ditafsir secara sah.



Rajah 4 : Keputusan Ujian Normaliti Residual

Oleh itu, model regresi boleh ditafsir secara sah dan keputusan analisis boleh dipercayai dalam konteks pengujian hipotesis yang dijalankan.

D. Analisis Regresi Linear Berganda (H6)

Analisis regresi linear berganda telah dijalankan bagi menilai hubungan antara tiga pembolehubah bebas iaitu eksplorasi, personaliti dan keterkaitan industri terhadap pencapaian akademik pelajar (H6).

Hipotesis H6 menguji sama ada terdapat hubungan positif secara kolektif antara eksplorasi, personaliti, dan keterkaitan industri terhadap prestasi akademik pelajar.

Jadual 8: Keputusan Analisis Regresi Liner Berganda Antara Pembolehubah Bebas dan Prestasi Akademik

	Beta	T	Sig
Eksplorasi	0.413	1.515	0.149
Personaliti	0.834	1.740	0.101
Keterkaitan	-0.445	-1.021	0.323

**p<0.05 r^2=0.651 F=9.93 Sig. =0.001

Keputusan analisis menunjukkan bahawa model regresi yang dibina adalah signifikan secara statistik, F(3, n–4) = 9.935, p = 0.001, dengan nilai R^2 = 0.651. Ini menunjukkan bahawa 65.1% daripada varians dalam prestasi akademik pelajar dapat dijelaskan melalui gabungan ketiga-tiga pembolehubah bebas tersebut.

Walau bagaimanapun, analisis lanjut terhadap setiap pembolehubah bebas menunjukkan bahawa tiada satu pun daripadanya mempunyai hubungan yang signifikan secara individu terhadap pencapaian akademik pada aras keertian p < 0.05. Pembolehubah eksplorasi mencatat nilai β = 0.413 (p = 0.149), personaliti β = 0.834 (p = 0.101), manakala keterkaitan industri mencatat β = –0.445 (p = 0.323).

Keputusan ini mencadangkan bahawa pengaruh secara kolektif ketiga-tiga pembolehubah bebas lebih penting daripada sumbangan setiap satu secara individu dalam menjelaskan perubahan prestasi akademik pelajar. Dapatan ini disokong oleh kajian terdahulu [9] [21], yang menekankan kepentingan pendekatan menyeluruh dalam pembangunan pelajar melalui aktiviti pembelajaran berasaskan industri.

E. Perbincangan

Dapatan kajian ini memberikan beberapa gambaran penting mengenai keberkesanan program kerjasama industri berasaskan Arduino terhadap pembangunan akademik pelajar.

Keputusan analisis ujian-t sampel bebas menunjukkan bahawa tiada perbezaan yang signifikan antara pelajar lelaki dan perempuan dari segi persepsi terhadap kualiti program. Dapatan ini menyokong Hipotesis H1, yang menunjukkan bahawa program ini diterima secara positif oleh kedua-dua jantina tanpa sebarang bias. Hal ini mencerminkan bahawa kandungan dan pelaksanaan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

program bersifat inklusif serta relevan kepada semua pelajar tanpa mengira jantina.

Hasil analisis Korelasi Pearson menunjukkan bahawa terdapat hubungan yang kuat, positif dan signifikan antara ketiga-tiga pembolehubah bebas, iaitu eksplorasi, personaliti, dan keterkaitan industri, dengan prestasi akademik pelajar.

Hipotesis H3 menyatakan bahawa terdapat hubungan positif yang signifikan antara eksplorasi dan prestasi akademik pelajar. Dapatan analisis menunjukkan bahawa pembolehubah eksplorasi mencatat nilai korelasi yang tinggi ($r = 0.757$), menyokong H3. Ini membuktikan bahawa pelajar yang aktif meneroka teknologi seperti Arduino dan terlibat secara kreatif dalam penyelesaian masalah cenderung untuk memperoleh keputusan akademik yang lebih cemerlang. Hal ini turut disokong oleh kajian terdahulu [8], yang menekankan bahawa pendekatan pembelajaran berasaskan projek dapat meningkatkan daya imaginasi dan pemikiran kritis pelajar.

Hipotesis H4 menyatakan bahawa terdapat hubungan positif yang signifikan antara personaliti dan prestasi akademik pelajar. Pembolehubah personaliti mencatatkan nilai korelasi tertinggi ($r = 0.763$), menunjukkan bahawa pelajar yang memiliki ciri-ciri personaliti positif seperti bertanggungjawab, bermotivasi dan berinisiatif cenderung mencapai prestasi akademik yang tinggi. Ini menunjukkan bahawa pembangunan karakter dan sikap positif merupakan faktor penting dalam kejayaan pelajar, seperti yang digariskan dalam kajian oleh Weng [11].

Hipotesis H5 pula menyatakan bahawa terdapat hubungan positif yang signifikan antara keterkaitan industri dan prestasi akademik pelajar. Dapatan menunjukkan nilai korelasi $r = 0.671$, yang turut signifikan pada aras $p < 0.05$, sekaligus menyokong H5. Ini menunjukkan bahawa pendedahan kepada konteks industri melalui kerjasama dan aktiviti bersama industri memberikan pelajar pemahaman yang lebih baik terhadap aplikasi dunia sebenar, meningkatkan kesedaran mereka terhadap kehendak pasaran serta memberikan motivasi tambahan dalam pembelajaran akademik.

Dapatan ini menyokong hipotesis H6 bahawa eksplorasi, personaliti dan keterkaitan industri secara kolektif mempengaruhi prestasi akademik pelajar. Hal ini sejajar dengan dapatan [9], [21] yang menegaskan bahawa pengalaman pembelajaran berasaskan projek dan kerjasama industri berupaya memperkukuh pencapaian akademik menerusi pendedahan kepada kemahiran insaniah, kreativiti dan komunikasi.

Namun begitu, analisis regresi linear berganda memberikan gambaran yang lebih kompleks. Walaupun model secara keseluruhan adalah signifikan ($F = 9.935$, $p = 0.001$) dan mampu menerangkan sebanyak 65.1% varians dalam prestasi akademik pelajar ($R^2 = 0.651$), tiada satu pun pembolehubah bebas yang menunjukkan hubungan signifikan secara individu pada aras $p < 0.05$. Nilai pekali regresi (β) adalah positif bagi pembolehubah penerokaan dan personaliti, menunjukkan arah hubungan yang dijangka, namun nilai p yang melebihi 0.05 menunjukkan bahawa kekuatan hubungan tersebut tidak cukup kukuh untuk dianggap signifikan secara statistik. Sebaliknya, pembolehubah keterkaitan industri menunjukkan nilai β yang negatif, yang bertentangan dengan jangkaan awal, namun masih tidak signifikan. Situasi ini menunjukkan bahawa walaupun program berasaskan Arduino berpotensi menyumbang kepada pembangunan pelajar, kesannya terhadap pencapaian akademik secara langsung mungkin dipengaruhi oleh faktor lain yang lebih dominan seperti motivasi dalaman, strategi pembelajaran, latar belakang sosioekonomi, atau tahap sokongan akademik yang diterima oleh pelajar. Dapatan ini juga menunjukkan keperluan untuk mengkaji hubungan ini menggunakan pendekatan yang lebih holistik dan metodologi lanjutan seperti pendekatan longitudinal atau analisis struktur model (SEM) bagi mendapatkan pemahaman yang lebih menyeluruh [17].

VI. KESIMPULAN

A. Rumusan Kajian

Kajian ini telah menilai keberkesanan program kerjasama industri berasaskan Arduino terhadap pembangunan pelajar dari segi penerokaan teknologi, personaliti, keterkaitan industri dan , kesannya terhadap prestasi akademik walaupun saiz sampel adalah kecil, ia dianggap mencukupi bagi kajian awal berskala kecil dan membolehkan penilaian awal tentang keberkesanan program dijalankan secara mendalam dan terfokus

Dapatan menunjukkan bahawa tidak terdapat perbezaan yang signifikan antara peserta lelaki dan perempuan dalam menilai kualiti program, menandakan pendeka-tan yang digunakan adalah inklusif dan seragam. Selain itu, analisis korelasi mengesahkan bahawa ketiga-tiga konstruk – penerokaan, personaliti, dan keterkaitan – mempunyai hubungan positif yang signifikan dengan pencapaian akademik pelajar, dengan personaliti menunjukkan hubungan paling kuat.

Walaupun analisis regresi menunjukkan model secara keseluruhan adalah signifikan dan menjelaskan 65.1% daripada varians prestasi akademik, tiada pembolehubah yang signifikan secara individu. Namun begitu, personaliti dikenal pasti sebagai penyumbang paling besar, menunjukkan pentingnya elemen pembangunan sahsiah dalam meningkatkan pencapaian pelajar.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Secara keseluruhannya, kajian ini mengesahkan bahawa program berasaskan Arduino yang dilaksanakan dengan kerjasama industri dapat menjadi satu pendekatan efektif dalam membina potensi pelajar secara holistik, merangkumi aspek kognitif, afektif, dan aplikatif. Kajian ini juga mencadangkan agar program seumpamanya diteruskan dan diperkasa dalam pendidikan teknikal, dengan memberi tumpuan kepada pembangunan personaliti dan pendekatan eksploratif sebagai tunjang utama kejayaan akademik.

B. Implikasi Kajian

Dapatan kajian ini memberikan beberapa implikasi penting kepada pihak institusi pendidikan, penggubal kurikulum, dan pihak industri:

1. Implikasi terhadap pengajaran dan pembelajaran:
   Pelaksanaan bengkel berasaskan Arduino yang menggabungkan elemen industri berpotensi meningkatkan minat dan motivasi pelajar terhadap pembelajaran teknikal.
2. Implikasi terhadap pembangunan pelajar: Ciri-ciri personaliti seperti inisiatif dan tanggungjawab berperanan besar dalam memacu kejayaan akademik, justeru aktiviti ko-kurikulum dan program pembangunan sahsiah perlu diberi penekanan.
3. Implikasi kepada kerjasama industri: Keterlibatan industri dalam program pendidikan perlu direka bentuk agar lebih berkualiti dan relevan bagi memastikan impaknya terhadap prestasi akademik dapat dimaksimumkan.

C. Cadangan Kajian Lanjutan

Bagi memperkukuh dapatan dan membina model yang lebih komprehensif pada masa akan datang, beberapa cadangan dikemukakan:

1. Penggunaan pendekatan longitudinal – Kajian lanjutan disarankan untuk dijalankan dalam tempoh yang lebih panjang bagi menilai kesan program secara berterusan terhadap pembangunan pelajar dari semasa ke semasa.
2. Pelaksanaan analisis struktur model (SEM) Kaedah ini dapat menguji hubungan kompleks antara konstruk secara serentak dan mengawal ralat pengukuran dalam soal selidik, sekaligus memberikan gambaran yang lebih tepat terhadap hubungan kausal antara pembolehubah.
3. Saiz sampel yang lebih besar dan pelbagai latar belakang – Pemilihan responden yang lebih meluas akan meningkatkan kebolehgunaan hasil kajian serta memperkukuh kesahan luaran model yang dibina.

PENGAKUAN

Penyelidik merakamkan setinggi-tinggi penghargaan kepada pihak Politeknik Ungku Omar atas segala bentuk sokongan, kemudahan dan peruntukan yang telah diberikan sepanjang pelaksanaan kajian ini. Ucapan terima kasih turut ditujukan kepada pensyarah dan pelajar yang terlibat dalam program berasaskan Arduino atas kerjasama serta sumbangan maklum balas yang bernilai. Penghargaan juga diberikan kepada pihak industri yang telah bekerjasama dan menyokong pelaksanaan kajian ini.

RUJUKAN

[1] M. A. M. Ali, M. F. M. Sabri, and N. M. Nor, "The effectiveness of Arduino-based project approach in enhancing student engagement in technical education," *Jurnal Pendidikan Teknologi dan Vokasional,* vol. 7, no. 2, p. 22–28, 2020..

[2] N. H. Z. d. R. Yusof, "Project-based learning using Arduino: A catalyst for students' motivation in electrical engineering," *International Journal of Engineering Education,* vol. 35, no. 3, pp. 845-851, 2019.

[3] M. S. Jusoh, "Integrating Arduino in TVET curriculum to foster creativity and problem-solving skills," *TVET Journal of Education and Practice,* vol. 8, no. 5, pp. 33-40, 2021.

[4] M. R. I. a. H. M. S. A. Hussain, "Industry collaboration through Arduino-based projects in polytechnic education," *Journal of Technical Education and Training (JTET),* vol. 35, no. 2, pp. 845-851, 2019.

[5] N. Z. a. S. Ahmad, "The impact of industry-academic collaboration programs on student performance and employability," *Malaysian Journal of Learning and Instruction,* vol. 14, no. 1, pp. 55-70, 2018.

[6] L. M. R. a. P. D. Johnson, "Personality traits as predictors of academic success: A review," *Journal of Educational Psychology,* vol. 112, no. 2, pp. 367-380, 2020.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

[7] T. L. a. A. M. Nor, "Exploration-based learning and its effect on technical knowledge retention among diploma students," *ASEAN Journal of Open and Distance Learning,* vol. 11, no. 1, pp. 41-48, 2019.

[8] R. Salleh, "Challenges in implementing industry-based learning in technical institutions: A case study," *Procedia - Social and Behavioral Sciences,* vol. 204, pp. 153-160, 2015.

[9] A. Halim, "Pembelajaran aktif melalui bengkel teknologi: Impak terhadap minat dan penglibatan pelajar," *Jurnal Kurikulum dan Pengajaran Asia Pasifik,* vol. 6, no. 2, p. 1, 2018.

[10] Jabatan Pendidikan Politeknik dan Kolej Komuniti, Buku Panduan Pelaksanaan Aktiviti Pensyarah Pelawat Industri (PPI) Politeknik dan Kolej Komuniti Malaysia, Edisi 2022, Putrajaya: Kementerian Pengajian Tinggi, 2022.

[11] F. A. A. M. H. a. S. A. M. N. Ahmad, "Reliability analysis: Application of Cronbach's Alpha in research instruments," in *Proc. SIGCS Conf*, Pulau Pinang, 2021.

[12] N. A. O. a. R. A. Kassim, "Kaedah Penyelidikan & Analisis Data SPSS," Penerbit Universiti Malaya, 2017. [Online]. Available: http://tempawan.ipgkik.edu.my/wp-content/uploads/2018/11/Artikel17_2014.pdf. [Accessed 15 5 2025].

[13] M. Najib, Penyelidikan Pendidikan, Kuala Lumpur: Dewan Bahasa dan Pustaka, 1996.

[14] M. H. M. T. P. S. N. J. S. S. A. B. a. L. C. Y. D. Janan, "Model of teaching Malay language to non-native and foreign speakers," *Malaysian Journal of Learning and Instruction,* vol. 21, no. 1, pp. 1-38, 2024.

[15] D. M. S. N. P. M. J. a. N. Y. N.A.M. Badruddin, "Sociodemographic factors and occupational well-being of security guards in a university setting: A pilot investigation," *Malaysian Journal of Medicine and Health Sciences,* vol. 21, no. 3, pp. 186-195, 2025.

[16] A. Field, Discovering Statistics Using IBM SPSS Statistics,5th ed, London, U.K: .: Sage Publications, 2018.

[17] W. C. B. B. J. B. a. R. E. A. J. F. Hair, Multivariate Data Analysis, 8th ed, Harlow, U.K: Pearson, 2019.

[18] J. C. N. a. I. H. Bernstein, Psychometric Theory, 3rd ed, New York, NY, USA: McGraw-Hill, 1994.

[19] Y. P. Chua, Kaedah dan Statistik Penyelidikan: Kaedah Penyelidikan, Buku 1, 2nd ed, Kuala Lumpur, Malaysia: McGraw-Hill Education, 2012.

[20] N. I. F. M. B. a. S. M. Olagoke, "The mediating role of neuroticism personality on correlates between self-efficacy and adjustment among university students," *EDUCATUM Journal of Social Sciences,* vol. 11, pp. 60-70, 2025.

[21] H. Weng, "TVET and employability: Evidence from practice-based learning programs," *Journal of Technology Education,* vol. 27, no. 3, pp. 45-52, 2021.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

MAKLUMAT PENULIS

Nur Kamaliah binti Ismail 	Jabatan Kejuruteraan Elektrik, Politeknik Ungku Umar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak E-mail: kamaliah@puo.edu.my
Saadiah binti Seman 	Jabatan Kejuruteraan Elektrik, Politeknik Ungku Umar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak E-mail: diahseman@puo.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

Lakuan Pertuturan Asertif Dan Direktif Membentuk Pengaruh Lisan Dalam Kalangan Kanak-Kanak Prasekolah Melalui Emosi Dan Tingkah Laku Yang Terkesan

Hasmahyon Bt Hj Bujang & Vijayaletchumy Subramaniam
Universiti Putra Malaysia
Serdang Selangor,Malaysia

kembali2002@yahoo.com & vletchumy@upm.edu.my

Abstrak

Komunikasi sangat penting kepada semua genre masyarakat yang memerlukan kemahiran untuk berkomunikasi terutama dalam media kemajuan dimensi kini.Begitu juga dengan emosi yang merujuk kepada suatu perasaan dan fikiran khusus, dan melibatkan biologi dan psikologi dan membawa kepada kecenderungan untuk bertindak. Emosi juga pada dasarnya didorong oleh kekuatan minda dan dapat membentuk kesedaran diri atau kewarasan dan kebolehan untuk mengetahui serta memahami hubungan antara satu dengan yang lain menerusi komunikasi. Kajian ini dilaksanakan di Sekolah Kebangsaan Saint Michael Entingan untuk mengenal pasti jenis-jenis lakuan pertuturan yang digunakan oleh kanak-kanak prasekolah semasa mereka berinteraksi dengan guru dan rakan sebaya dalam kelas prasekolah. Menerusi komunikasi dan emosi yang berbagai melalui pemerolehan bahasa dan perkembangan bahasa kanak-kanak pada peringkat umur 6 tahun. Data yang dikumpul melibatkan rakaman video semasa kanak-kanak prasekolah sedang belajar, menjalankan aktiviti, bermain dan berinteraksi dengan guru dan rakan sebaya. Melalui kaedah pemerhatian, temubual, soal selidik, kajian dokumen, sebelum dan selepas intervensi digunakan bagi melakukan kajian ini didapati bahawa kanak-kanak prasekolah menggunakan lakuan pertuturan yang tertentu dalam komunikasi di kelas semasa. Manakala, lakuan pertuturan yang paling kerap digunakan oleh murid-murid prasekolah adalah lakuan pertuturan asertif 75 % dan lakuan pertuturan direktif 25%.

Kata kunci: Emosi, pembelajaran, murid prasekolah, kemahiran, lakuan pertuturan

Abstract

Communication is very important to all genres of society that require skills to communicate, especially in today's advanced media. Likewise with emotions which refer to a specific feeling and thought, and involve biology and psychology and lead to a tendency to act. Emotions are also basically driven by the power of the mind and can form self-awareness or sanity and the ability to know and understand the relationship between each other through communication. This study was carried out at Sekolah Kebangsaan Saint Michael Entingan to identify the types of speech acts used by preschool children when they interact with teachers and peers in preschool classes. Through communication and various emotions through language acquisition and language development of children at the age of 6 years. The data collected involved video recordings while preschool children were learning, carrying out activities, playing and interacting with teachers and peers. Through observation, interview, questionnaire, document study, before and after intervention methods were used to conduct this study, it was found that preschool children use certain speech acts in communication in the current classroom. Meanwhile, the most frequently used speech acts by preschoolers are assertive speech acts 75% and directive speech acts 25%.

Keywords: Emotion, learning, preschoolers, skills, speech acts

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

I. PENGENALAN

Bahasa dan budaya sebenarnya tidak dapat dipisahkan kerana mengkaji bahasa akan menemui pelbagai lambang yang membantu memberi rona dalam budaya masyarakat. Terdapat banyak pengaruh yang membawa kepada pelbagai kebolehan untuk menghasilkan sesuatu dalam meningkatkan pengetahuan dan kefahaman dalam kalangan kanak-kanak pada peringkat sekolah rendah terutama murid prasekolah. Kajian ini bertujuan untuk melihat kepelbagaian aras perkembangan kognitif murid itu sendiri dan merujuk kepada bentuk emosi dalam menerima pengetahuan berdasarkan proses "memahami",di mana kognitif murid akan menghubungkan kembali kognitif dengan konsep yang telah dipelajari atau pengetahuan sedia ada murid itu sendiri yang disampaikan oleh guru dalam pengajaran dan pembelajaran sebelumnya. Bagi kanak-kanak prasekolah pula emosi mereka adalah berbeza-beza dan orang dewasa akan cuba memahami dan menyelami perasaan mereka. Ada juga dalam kalangan ibu bapa membenarkan kanak-kanak melepaskan perasaan dan menjangkakan perlakuan yang ditunjukkan adalah normal. Namun yang jelasnya melarang mereka melepaskan geram tidak akan membantu menyelesaikan masalah. Kanak-kanak sering dikaitkan dengan pelbagai perlakuan yang berbagai sama ada aktif ataupun kurang aktif bergantung kepada paras kekuatan minda, fizikal ataupun mental. Keunikan kanak-kanak adalah mereka yang mempunyai jiwa kental serta mempunyai semangat untuk bersifat rasional dan sentiasa merasa dunia adalah milik mereka. Kategori itu adalah bagi kanak-kanak yang boleh berfikir dan bertindak mengikut kemampuan yang mereka miliki. Bagi kanak-kanak yang tidak aktif atau slowly di mana tahap kegiatan mereka mempunyai masalah tidak berminat dengan apa yang kanak-kanak aktif lakukan kerana tahap kelambatan yang mereka perolehi adalah disebabkan oleh faktor seperti sakit, masalah keluarga dan lain-lain.

Kemahiran berkomunikasi amat penting untuk dikuasai oleh kanak-kanak yang meningkat dewasa. Untuk menguasai kemahiran ini, kanak-kanak perlu didedahkan dengan beberapa kaedah dan teknik contohnya kanak-kanak diajar kemahiran berintreraksi bersama rakan sebaya ketika di sekolah atau di mana-mana. Menaakul adalah asas yang sangat penting untuk dikuasai oleh kanak-kanak prasekolah kerana kemahiran yang diperolehi sangat diperlukan dalam semua tindakan berdasarkan elemen emosi atau tindakan yang dilakukan. Bagi membuat tindakan susulan kepada permasalahan kanak-kanak tersebut dengan melakukan intervensi yang sesuai dengan masalah

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

yang berlaku. Sh.Nor Putih, Aliza Ali (2011) dalam pendekatan bermain dalam pengajaran literasi kanak-kanak prasekolah menjelaskan bahawa melalui aktiviti bermain, kanak-kanak dapat belajar dan mereka akan melalui perubahan yang berlaku dalam diri seperti kesedaran yang akan memberi mereka kekuatan untuk berubah sama ada dalam bentuk fizikal ataupun mental. Guru memainkan peranan penting dalam mengurus emosi kanak- kanak agar mereka dapat memiliki produktiviti belajar secara aktif dan tidak bergantung semata- mata kepada guru ataupun ibu bapa. Kreativiti kanak-kanak juga sering dilihat bergantung kepada cara konsepsi guru mengajar yang boleh memberi penilaian kendiri kepada kanak-kanak untuk memasukkan pendekatan kreativiti dalam aktiviti yang dilakukan. Konsep strategi telah digunakan bagi mengesan hala tuju dan minat murid prasekolah dalam melibatkan diri dalam pelbagai aktiviti yang dijalankan di sekolah. Guru telah membahagikan empat strategi agar usaha membina pelibatan murid prasekolah dalam aktiviti dapat dijalankan dengan sempurna menerusi jadual 1.

Jadual 1.

STRATEGI GURU	HASIL DAPATAN
1. Perancangan	Bekerjasama
2. Peranan guru	Merancang
3. Peranan ibu bapa	Membantu guru
4. Peranan masyarakat	Membantu guru

II. KAJIAN LEPAS

Melalui kajian Ahmad Fadilahtur Rahman (2016), kajian tutur pujian guru dalam interaksi pembelajaran di kelas membentuk peranan guru dalam interaksi pembelajaran amatlah penting sebagai seorang yang mampu memberikan motivasi semangat belajar kepada murid-muridnya untuk berusaha dengan lebih jitu melalui lakuan pertuturan yang disampaikan secara lisan. Pronina, M., Prieto, P., Bischetti, L., & Bambini, V. (2023) menjelaskan bahawa pragmatik terletak pada titik di mana bahasa bertemu dengan dunia sosial dan merangkumi kedua-dua dimensi linguistik dan sosial komunikasi. Menerusi kajian Yulian, A. A., & Mandarani, V. (2023), lakuan pertuturan menentukan interaksi bilik darjah dan tindak tutur adalah ujaran lisan yang digunakan dalam komunikasi bilik darjah. Pertuturan asertif banyak digunakan oleh guru ketika memberi ujian kepada

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

pelajar dan menyebabkan pelajar boleh membuat pilihan untuk menggunakan pendekatan pembelajaran dalam tindakan klasifikasi tindakan pertuturan bagi menentukan pengajaran yang seterusnya.

Fokus Kurikulum Standart Prasekolah Kebangsaan ialah untuk melahirkan murid yang mempunyai kebolehan berkomunikasi dengan yakin. Mahir berkomunikasi merupakan salah satu daripada ciri-ciri murid yang menguasai kemahiran abad ke-21 iaitu mampu menyuarakan dan meluahkan fikiran, idea dan maklumat dengan yakin dan kreatif secara lisan. Manakala guru berperanan sebagai pemudahcara atau pembimbing yang memandu murid agar mereka bersedia untuk menghadapi cabaran dan mengikuti pembelajaran seterusnya. Kajian ini dijalankan bagi mengenal pasti metodologi terbaik untuk murid-murid yang menghadapi masalah pembelajaran di sekolah.

Permasalahan kanak-kanak yang kurang dan tidak berminat mengikuti pembelajaran guru banyak mengundang kepada kelemahan dalam penguasaan kelas. Kanak-kanak yang bermasalah pembelajaran dapat dikesan mempunyai abiliti tidak yakin kepada diri sendiri ketika guru mengajar. Guru dapat mengesan impak kelemahan kanak-kanak tersebut adalah disebabkan faktor kurangnya pengurusan emosi yang positif kerana terbeban oleh masalah yang mereka lalui.

Perancangan strategi yang sesuai untuk mengatasi masalah yang berlaku kepada kanak-kanak prasekolah ini adalah untuk melihat kecerdasan dan kelemahan mereka sebagai satu tinjauan sama ada bebanan yang mereka tanggung dapat memberi kesadaran bagi tindakan bertanggungjawab dan membantu untuk mengurangkan beban pengurusan emosi yang berlaku dalam diri mereka serta berusaha untuk mengubah karektor dan sikap secara perlahan setelah berbincang dengan keluarga kanak-kanak berkenaan. Murid yang bermasalah dalam komunikasi dan bahasa juga tidak dapat menonjolkan potensi mereka jika guru gagal mengenal pasti dan mendiagnosis masalah mereka lebih awal.

Lado (1957) mengatakan bahawa pengetahuan bahasa dapat meramalkan atau menghuraikan pola-pola yang menyebabkan kesukaran di dalam pembelajaran sesuatu bahasa dan pola-pola yang tidak sesuai menyebabkan kesukaran kepada pelajar dengan membandingkan secara saintifik. Menurut Kamarudin Hj. Husin (1998) : “Mereka

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

dapat menguasai bahasa itu dengan cara 'memperolehi' bukan melalui proses pembelajaran. Dijangkakan bahawa kanak-kanak tersebut mempunyai elemen pernyataan yang dijelaskan oleh Lado dan Kamarudin Hj. Husin.

III METODOLOGI

Teori tindak tutur pertama kali dikemukakan oleh John Langshaw Austin dan kemudian dikembangkan oleh muridnya, John Searle telah meletakkan teori ini mengkaji hubungan antara bahasa dan tindakan, yang mencakup tiga tingkatan: lokusi (makna ujaran yang jelas), ilokusi (makna tersirat), dan perlokusi (tindak tutur). Analisis ini penting untuk memahami bahawa konsep sosial di sekolah dan komunikasi dapat mempengaruhi suasana belajar dan mengajar. Tindak tutur ekspresif mencakup berbagai bentuk komunikasi seperti mengungkapkan kebahagiaan, kemarahan, atau ucapan terima kasih, dan dapat diekspresikan melalui kata-kata juga melalui intonasi, ekspresi wajah, dan bahasa tubuh. Analisis ini juga dapat membantu mengidentifikasi masalah komunikasi yang mungkin terjadi dan mencari solusi untuk meningkatkan kualiti interaksi dalam di lingkungan pendidikan kanak- kanak yang bermasalah pembelajaran dan sebagainya. Teori ini mengetengahkan lima lakuan, iaitu asertif, ekspresif, direktif, komisif dan deklaratif. Kaedah kajian yang digunakan ialah kaedah kualitatif.

Rajah 1. Kerangka Lakuan tutur Searle (1969-1976)

Jenis-jenis Lakuan tutur	Penerangan Lakuan Tutur Searle (1969-1976)
Representif	Penutur menyatakan proposisi yang benar mengikut keadaan yang berlaku
Deklarasi	Prestasi penutur yang berjaya menghubungkan isi tuturan dengan kenyataan yang realiti
Ekspresif	Penutur menyatakan keadaan psikologi dengan iklas terhadap suatu keadaan
Direktif	Percubaan penutur untuk membuatkan pendengar melakukan sesuatu

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Hanya dua sahaja lakuan pertuturan yang berlaku dalam kajian dijalankan meskipun merangkumi kelima-lima lakuan pertuturan Searle (1969) diperkenalkan iaitu lakuan pertuturan asertif dan direktif.

Asertif

Tindak tutur ini mempunyai fungsi memberitahu mengenai sesuatu dan mencakupi konsep mempertahankan, meminta, mengatakan, menyatakan dan melaporkan dan bersedia untuk melakukan sesuatu dengan tegas dan penuh semangat untuk memperlihatkan niat yang sebenarnya.

Asertif menyatakan

Lakuan pertuturan asertif merupakan bentuk tuturan yang dimaksudkan untuk menyatakan petunjuk mengenai perkara yang sedang berlaku secara langsung kepada lawan tutur. Bentuk tuturan ilokusi asertif memberi khabar secara langsung kepada lawan tutur tentang kondisi yang sedang berlangsung di sekeliling mereka.

Direktif

Tindak tutur yang berfungsi untuk membuat penutur melakukan sesuatu seperti: membuat cadangan, permintaan, dan perintah. Kebiasaannya perkataan yang diucapkan adalah berdasarkan kepada cara seorang penutur untuk menyatakan melalui perbuatan dan sikap.

A. Subjek Kajian

Melalui kajian yang dijalankan, hanya lima sahaja murid bermasalah yang dikenal pasti untuk menjalankan aktiviti.

1. Seorang murid -berusia enam tahun. Mewakili murid (A). Mempunyai masalah pertuturan seperti pelat. Banyak bergantung kepada ibu untuk melakukan apa sahaja aktiviti. Kurang bercakap dan agak lambat menguasai pengajaran yang dijalankan.

2. 3 orang murid mempunyai masalah pembelajaran- berumur 6 tahun. Mewakili murid B, C dan D. Boleh bermain dan belajar dengan kawan. Kesannya mereka tidak dapat memberi tumpuan yang menyebabkan mereka takut untuk memberi respons apabila guru bersoal jawab dalam pengajaran yang dijalankan.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

3. Seorang kanak-kanak berusia enam tahun mengalami masalah sakit jantung sejak kecil. Mewakili murid E. Kesan penyakit menyebabkan tidak aktif dan lemah dalam semua aktiviti. Dapat menyebut huruf dan mengingati pengajaran yang disampaikan oleh guru tetapi lambat untuk memberi respon yang diinginkan.

B. TINDAKAN INTERVENSI

Bagi membantu dan membuat intervensi guru telah menggunakan pembahagian minggu untuk mendapatkan respons. Tugasnya agak mudah tetapi mencabar. Kanak-kanak prasekolah melakukan aktiviti berbual secara lisan dan memberi sentuhan seperti tanda isyarat atau tepuk tangan jika mereka berjaya menyebut huruf-huruf yang berikan. Sememangnya mereka berminat dan dapat memberi kerjasama. Guru juga memulakan kajian pada minggu keempat memandangkan mereka perlu dibantu secepat mungkin ba
gi menghindarkan mereka tidak tertinggal dalam pengajaran kelas biasa yang dijalankan.

Rajah 2. INTERVENSI 1

MINGGU 4	TINDAKAN	REFLEKSI
Bantuan kad huruf abjad (6 huruf awal) (a,b, c, d, e)	Mereka membaca berulang-ulang	Membuat catatan (mengumpul huruf abjad yang telah dikuasai)
(**Aktiviti - 15 mini**t) Bermain mewarnakan huruf (10 minit)	Mengasingkan 2 warna untuk huruf yang berbeza (vokal a dan e (konsonan b dan c)	2 daripada kanak-kanak dapat menguasai huruf (vokal a dan e (konsonan b dan c)
AKTIVITI TAMBAHAN JIKA ADA	Membuat ulangan pembelajaran - jika ada masa. Catatan : (Ada/Tidak)	Aktiviti pengayaan jika sesuai dengan kebolehan Catatan :(Ada/ tidak)

Guru hanya dapat menjalankan 2 sahaja aktiviti pada setiap minggu agar masa pengajaran kelas prasekolah tidak terganggu dan akan memulakan pada awal pagi iaitu sekitar jam 7.15 hingga 7.30

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

pagi. Seterusnya, perbincangan makalah ini berfokuskan kepada keupayaan murid mengekspresikan pemikiran pengarang secara kritis yang menyangkut kehidupan kanak-kanak menggunakan Kemahiran Berfikir Aras Tinggi (KBAT) dalam pembelajaran. Dua elemen didik hibur yang diperkenalkan dalam pengajaran dan pembelajaran kepada murid iaitu elemen nyanyian membantu kanak-kanak prasekolah menimba ilmu secara hafalan dan proses mengingat dan membuat ulangan setiap pelajaran yang diterima daripada guru.

Rajah 3 :INTERVENSI 2

MINGGU 6	TINDAKAN	REFLEKSI
Menyanyi lagu huruf	Menyanyi lagu abjad a,e,I, o,u,	Semua suka
(Aktiviti - 15 minit) Memadankan huruf yang sama untuk latihan pengukuhan	Membuat latihan huruf untuk dipadankan dengan huruf.	2 daripada kanak-kanak dapat membuat lembaran kerja yang diberikan.
AKTIVITI TAMBAHAN JIKA ADA	Membuat ulangan pembelajaran -jika ada masa. Catatan : (Ada/Tidak)	Aktiviti pengayaan jika sesuai dengan kebolehan Catatan :(Ada/ tidak)

Melalui sorotan kajian yang yang dijalankan,guru menggunakan pelbagai data bagi menentukan kesahihan kajian yang dijalankan. Aplikasi kedua-dua kaedah kajian ini masing-masing merujuk kepada faktor penggunaan lakuan pertuturan dan analisis frekuensi, iaitu kecenderungan penggunaan lakuan pertuturan yang berlaku kepada kanak- kanak prasekolah adalah melalui rasional pemilihan data yang telah memaparkan penggunaan lakuan pertuturan melalui objektif dan analisis yang menemukan penggunaan lakuan ilokusi yang pelbagai iaitu penggunaan lakuan asertif dan direktif dalam kajian yang dijalankan.

Kajian ini mendapati lakuan pertuturan yang kerap digunakan oleh murid-murid bukan sahaja menunjukkan kategori khusus lakuan pertuturan namun kebanyakan adalah menunjukkan kategori kombinasi dua lakuan pertuturan yang berbeza. Kombinasi menyatakan dengan mengarah dan kombinasi menyatakan dengan bertanya semasa berinteraksi dengan kanak-kanak prasekolah

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

dijalankan untuk mengenal pasti tahap penggunaan lakuan pertuturan di peringkat kanak-kanak prasekolah semasa berinteraksi dengan guru dan rakan sebaya. Kombinasi menyatakan dengan kombinasi menyatakan dengan bertanya semasa berinteraksi dengan guru dapat membentuk tahap penggunaan lakuan pertuturan di peringkat kanak-kanak prasekolah semasa berinteraksi.

Penelitian ini berfokus pada analisis tindak tutur asertif dan ekspresif yang menggunakan teori tindak tutur dari teori John Searle dan metode deskriptif kualitatif dengan teknik analisis isi khususnya yang mencerminkan tindak lakuan pertuturan asertif dan direktif. Pengumpulan data dilakukan dengan cara dokumentasi, dan analisisnya dilakukan berdasarkan kategori lakuan pertuturan yang berlaku kepada kanak-kanak prasekolah.

Rajah 4. Lakuan Pertuturan Asertif

Bil	Contoh ujaran	Jenis lakuan pertuturan
1	murid A - Saya ada buku (murid B - saya pun ada.	Asertif menyatakan
2	Murid C - Nanti awak main dengan saya. Murid D - Boleh. Kita main huruf dan gambar.	Asertif menyatakan
3	Murid C - Cikgu bagi gambar lagi Murid E - Nanti kita baca sama-sama	Asertif menyatakan
4	Murid A- Lagu ini sedap.Jom kita nyanyi sama-sama Murid C - Saya pun suka. (gembira)	Asertif menyatakan
5	Murid D - Saya tak dapat padan huruf ini Murid B - Nanti saya tolong awak	Asertif menyatakan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Rajah 5. Lakuan Pertuturan Direktif

Bil	Contoh ujaran	Jenis lakuan pertuturan
1	murid A - Jangan pegang pencil, nanti cikgu marah (murid B - Saya ada pensil sendiri	Lakuan direktif
2	Murid C - Jangan duduk kerusi itu Murid D - Duduk dimana?	Lakuan direktif
3	Murid C - Mari baca buku ini, Nanti kita jadi pandai. Murid E - Betullah tu.	Direktif menasihati
4	Murid A- Awak bawa bola, nanti saya bawa buku. Murid B - Nanti saya bawa warna. Cepatlah, cikgu sudah datang.	Direktif menyuruh

Perbezaan dua jenis lakuan pertuturan tersebut dapat diringkaskan seperti berikut;

1. Seorang penutur mengucapkan ayat-ayat dengan makna yang tertentu (lakuan pengucapan), Dengan niat yang tertentu (lakuan niat pengucapan)
2. Meninggalkan kesan yang tertentu pada pendengar/pembaca (lakuan tindak balas pengucapan)

Kemahiran bertutur ditakrifkan sebagai kegiatan melafazkan bunyi-bunyi yang dilahirkan daripada alat artikulasi manusia dan ianya merupakan kemahiran berinteraksi dalam suasana berbahasa. Bagi maksud kajian ini, kemahiran bertutur adalah merujuk kepada keupayaan kanak-kanak memahami maksud lakuan pertuturan yang didengar seterusnya memberi tindak balas. Penutur boleh mengubahsuai penggunaan bahasa melalui beberapa peraturan tahap rendah yang mereka tahu. Apabila sesuatu bahasa dipelajari dengan betul, penggunaan bahasa secara sedar boleh menyumbang kepada Peningkatan ketepatan penggunaan bahasa yang sepatutnya.

V.DAPATAN KAJIAN DAN PERBINCANGAN

Hasil dapatan kajian telah menunjukkan bahawa lakuan pertuturan asertif iaitu tindakan lakuan pertuturan yang dominan digunakan bagi mengekspresikan emosi positif, serta tindakan lakuan pertuturan direktif yang digunakan melalui interaksi yang telah berlaku melalui pertimbangan dalam hubungan yang berlaku. Penelitian ini memberi kesimpulan bahawa tindakan lakuan pertuturan yang sesuai telah memainkan peranan yang sangat penting dalam menggambarkan emosional dan konflik sosial dalam kalangan murid-murid prasekolah. Tindakan lakuan pertuturan ekspresif yang digunakan dalam lingkungan sekolah memberikan harapan tentang bagaimana kanak-kanak dapat membentuk dan mengekspresikan emosi mereka dalam berbagai situasi formal ataupun informal. Lakuan pertuturan merupakan kegiatan komunikasi sehari-hari yang melibatkan penerimaan dan makna atau informasi membentuk jati diri murid untuk membina konsep kendiri secara positif.

Lakuan pertuturan melalui konteks pragmatik dianggap sebagai hasil dari suatu tindakan verbal dan memiliki sifat psikologi yang amat bergantung kepada kemampuan berbahasa penutur dalam menghadapi situasi tertentu, yang dikenali sebagai tindakan pertuturan yang dapat disampaikan melalui media lisan ataupun tulisan, termasuk dalam media sosial yang dapat di ekspresi melalui idea dan informasi secara luas. Seterusnya, lakuan pertuturan juga merupakan ujaran atau pertuturan seharian yang memberi makna tertentu mengikut konteks tertentu. Lakuan pertuturan sentiasa berlaku dalam komunikasi harian melibatkan pelbagai medium komunikasi dalam menyampaikan mesej dan maklumat. Menurut Siti Nur Adibah Sabarudin dan Aminnudin Saimon (2021), setiap ujaran yang diucapkan dalam bentuk komunikasi sama ada dalam bentuk tulisan atau lisan mempunyai lakuan yang tertentu. Ini jelas menunjukkan bahawa kajian berkaitan lakuan pertuturan bertujuan untuk melihat sejauhmana lakuan pertuturan yang diujarkan mampu menjadi medium komunikasi untuk menyampaikan mesej kepada masyarakat.

Kajian yang dilakukan ini berfokus kepada lakuan pertuturan yang turut menyumbang kepada unsur

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

pendidikan dalam konteks pengajaran dan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

pembelajaran. Fokus utama dalam kajian ini adalah membincangkan aspek strategi komunikasi kanak-kanak. Sememangnya tidak dapat dipertikaikan lagi bahawa pendidikan awal kanak-kanak prasekolah iaitu tadika (*kindergarten*) dan taska (*daycare centres*) merupakan perkara paling penting dalam sistem peralihan dari rumah ke alam persekolahan (Ben-Ari, 1997; Lewis, 1995; Peak 1991). Menurut Merriam (2002), guru perlu juga dikaji dengan menggunakan kaedah pemerhatian bagi mengenal pasti tingkah laku berkaitan dengan cara bentuk pengajaran guru kepada murid. Seorang pemerhati yang berada di satu tempat peristiwa boleh melihat tingkah laku sebagaimana ia benar-benar berlaku agar tidak mempengaruhi kepada tindakan mengajar murid-murid yang bermasalah dalam pendidikan.

Di sini dengan jelasnya memungkinkan persepsi kanak-kanak tersebut tidak menunjukkan minat dalam pembelajaran mereka dan melihat pengajaran yang mereka lalui sebagai berada di awang-awangan hanya sekejap sahaja. Selepas melalui aktiviti yang sesuai dengan jiwa, dan tindakan guru telah melakukan beberapa strategi yang sesuai dan mempunyai beberapa kreativiti yang mampu menarik minat kanak-kanak prasekolah seperti mana yang telah dinyatakan dalam Lakuan Pertuturan atau *'Speech Act'* oleh Wunderlich (1976, 1977) dan Hausser (1977) yang memberikan lakuan pertuturan seperti *'erotetic (questions)* dan *directive (requests)'*. Namun begitu, strategi pertanyaan dalam konteks kajian ini memberi gambaran bahawa sesuatu pertanyaan ini bukan sahaja bertujuan untuk mendapatkan informasi atau jawapan secara langsung tetapi juga mempunyai pelbagai fungsi secara tidak langsung yang dinyatakan seperti di bawah:

i) Untuk memberi pendapat

ii) Untuk mendapatkan kepastian

iii) Untuk mendapatkan sokongan

iv) Untuk menjaga perasaan

v) Untuk mendapatkan informasi

Dapatan ini menunjukkan lakuan kanak-kanak lebih gemar menggunakan bahasa yang mudah dan paling dominan untuk menyampaikan maklumat berdasarkan pemerhatian, lisan dan bual santai.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Penggunaan Teori Lakuan Pertuturan Searle (1969) amat bersesuaian bagi memperlihatkan hubungan komunikasi antara penutur dengan pendengar untuk memahami dengan lebih jelas tentang makna komunikasi penutur. Oleh yang demikian, keberkesanan maklumat yang disampaikan dapat memberikan impak yang positif kepada guru untuk membantu dan memperlihatkan kategori lakuan pertuturan yang dibincangkan oleh para sarjana dalam bidang seperti Searle (1969), Bach dan Harnish (1979) dan Austin yang boleh membentuk golongan kanak-kanak ke arah lebih mekanikal dalam perhijrahan dunia yang dirasai kini. Menurut Krashen (1994), dalam persekitaran bilik darjah pembelajaran kanak- kanak akan menguasai bahasa pabila mereka diberikan latihan dialog, lakonan, perbincangan kumpulan dan aktiviti komunikatif dan lain-lain. Jelasnya, lakuan pertuturan akan kelihatan bersopan jika mereka dapat mengamalkan nilai-nilai murni serta berbudaya dalam kelompok masyarakat yang mereka sertai kerana terdapat pembentukan kata atau ujaran yang boleh menerangkan sesuatu yang tidak mereka fahami, meskipun ianya adalah satu maklumat yang penting.

Rajah 6. Analisa Distrektif

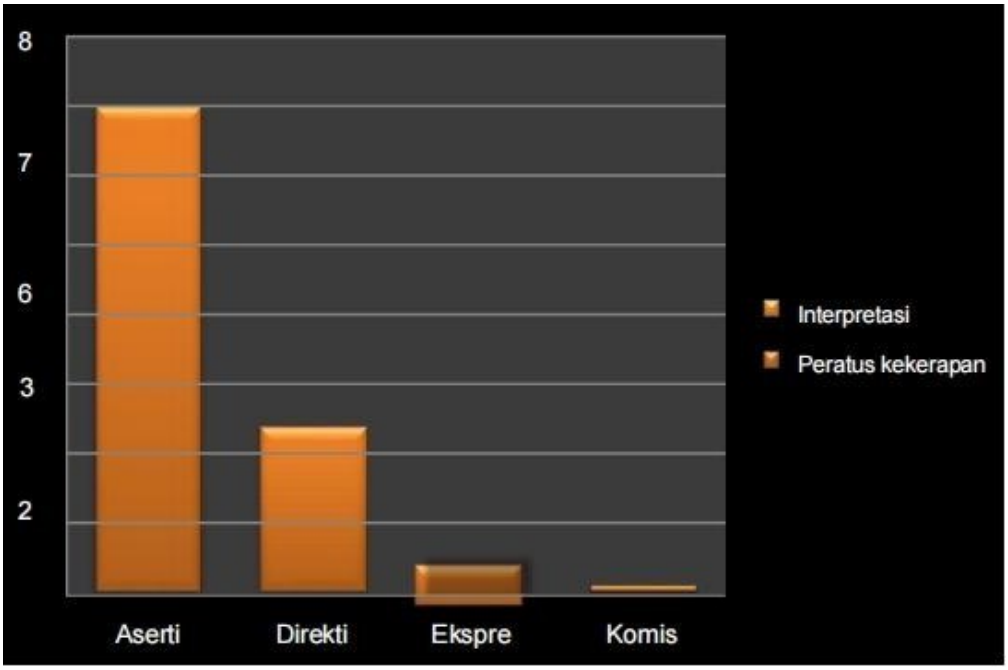
Jenis lakuan pertuturan	Peratus kekerapan %
asertif	75
direktif	25
ekspresif	1.0
komisif	0.2

Melalui penelitian dalam rajah 6 dan graf 1, analisa distrektif telah menunjukkan bahawa lakuan pertuturan asertif telah melonjak sebagai peratus kekerapan yang tinggi kerana kekerapan penggunaan bahasa yang berlaku kepada kanak-kanak prasekolah yang masih dalam fokus menggunakan lakuan pertuturan asertif 75% berbanding dengan lakuan pertuturan direktif 25%. Perbandingan ini dapat membantu guru dalam penelitian diperlukan bagi menguatkan lagi kajian dengan subjek kajian yang dijalankan. Secara keseluruhan kajian yang dijalankan ini telah dapat menghasilkan satu pendekatan kepada proses mengenal lakuan pertuturan dalam kalangan murid-murid prasekolah dan mengenal pasti jenis lakuan

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

pertuturan yang digunakan sesuai dengan objektif yang telah dirancangkan. Melalui graf 1 ini juga dapat menjelaskan bahawa lakuan pertuturan asertif merupakan lakuan tutur yang terlalu mudah digunakan oleh kanak-kanak prasekolah untuk berinteraksi dengan rakan sebaya ketika melakukan aktiviti yang dijalankan.

Graf 1. Analisa distriktif



Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

VI KESIMPULAN

Kajian ini telah menyedarkan guru betapa pentingnya persediaan dalam membentuk pengajaran kelas dan dapat membantu kanak- kanak meransangkan pemikiran kreatif dalam setiap pengajaran yang berlaku akan memberi impak meskipun perlahan tetapi dapat membantu meningkatkan kemahiran dan kreativiti kanak-kanak prasekolah untuk belajar dengan lebih tekun meskipun ada masalah yang berlaku dalam diri mereka. Pihak guru juga amat memahami kerana pemantauan yang berlaku kepada kanak-kanak dalam kalangan murid juga adalah atas dasar sifat bertanggungjawab kerana emosi guru berkait rapat dengan emosi kanak-kanak dan layanan yang sama rata dalam kalangan kanak-kanak akan mebantu mereka bertindak dan mereka juga perlu dididik dengan penuh kasih sayang. Hasil dapatan mendapati aktiviti yang dijalankan dapat membantu kanak-kanak yang bermasalah terutama dalam mengaitkan masalah dan cara guru untuk membantu menyelesaikan masalah yang berlaku. Dapatan yang diperolehi melalui pembelajaran murid prasekolah di rumah bersama ibu bapa amat memberansangkan kerana guru boleh mengetahui strategi yang sesuai untuk membantu mereka ketika berada di sekolah.

Guru perlu memberi peluang kepada kanak-kanak untuk menyatakan pendapat walau dengan apa cara sekalipun. Guru juga harus menjalankan kajian lanjutan bagi mendapat gambaran dan kajian agar dapat digeneralisasikan kepada masyarakat yang memerlukan bantuan terutama dalam pengurusan emosi kanak-kanak prasekolah. Justeru dalam Pendidikan Prasekolah melalui KSPK semakan 2017, kajian yang telah pengkaji jalankan banyak membawa unsur- unsur pendidikan yang berasas kepada sahsiah individu sesuai dengan keperluan tahap pendidikan terkini apabila subjek Sivik diselitkan dalam semua subjek teras bagi meningkatkan mutu pendidikan negara.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

RUJUKAN

[1] Asmah Haji Omar (1993). *Bahasa Dan Alam Pemikiran Melayu.* Kuala Lumpur: Dewan Bahasa dan Pustaka, Kementerian Pendidikan Malaysia.

[2] Alessi da Trollip.2001, Multimedia for learning.3rd ed: Pearson Education

[3] Ahmad Fadilahtur Rahman (2016)*Tutur Pujian Guru Dalam Interaksi* Publication Research. Indonesia

[4] Abdullah,H & Ainon,M 2005).mendorong Kreativiti kanak- kanak.PTS Publication, Selangor.

[5] Bach, and Harnish, (1969).*Lingustic Communication and Speech Act.*Massachusetts: The Massachusetts Institute of Technology

[6] Ben Ari,1997, Lewis, 1995, Japanese Education.Suggests, Japanese preschool have the aim of.

[7] Burnett, C (2010) .Technology and literacy in early childhood Educational setting: A Review of research: JOurnal Of Early Childhood Literacy 2010 10: 247.DOI: 11777/1468798410372154.

[8] Cho,K-S,% Krashen,S (1994).Vocubulary From The Sweet Valley Kids Series: Adult ESL Acquisition.Journal Of Reading,37,667-667.

[9] Chew, F. P., & Zahari Ishak. (2010). Malaysian folk literature in early childhood education. *World Academy of Science, Engineering and Technology*, (Jun), p. 66. (ISSN 2070 – 3724). (ISI-Cited Publication).

[10] Lado R (1957) Linguistic Across Culture: Applied Linguistic For Language Teachers. Ann Abor, University of Michigan Press

[11] Pronina, M., Prieto, P., Bischetti, L., & Bambini, V. (2023). Expressive pragmatics and prosody in young preschoolers are more closely related to structural language than to Mentalizing. *Language Learning and Development*, *19*(3), 323-344

[12] Marriam,Sharan B,(2002) *Qualitative research in practice:Example for discussion and analysis:San Francisco:Jossey-Bass*

[13] Norsita Ali,Zainal Madon (2014) Tinjauan Awal Interaksi Huru – kanak-kanak Dalam Pemupukan Pemikiran Kreatif kanak-kanak Prasekolah.

[14] Wunderlich (1976, 1977) dan Hausser (1977)Syindrome with Unilateral Hemivaginal.

[15] Siti Nur Adibah Sabarudin dan Aminnudin Saimon (2021),Lakuan Pertuturan Dalam Video Infografik Covid-19. Universiti Islam Anatarbangsa,Pagoh.Johor.

[16] Sh.Nor Putih, Aliza Ali (2011) dalam pendekatan bermain dalam pengajaran literasi Pendidikan Prasekolah .

[17] Searle ,J.R (1969) *Speech Act an Essay in the Philosofy of Language*: Cambridge University Press.

[18] Searle, J. R., & Vanderveken, D. (1985). Speech Acts and Illocutionary Logic. In

[19] Searle,John R.(1969).Speech Acts:*An Assay in the Philosophy of language.*

[20] Searle,John.(1968).Austin on Locutionary and Illocutionary Acts. *Philosophical Review.*

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: Name First Author-Photo	Hasmahyon Bt Hj Bujang Jabatan Pendidikan Negeri Sarawak. (Guru) Pelajar Phd (Bahasa Melayu) UPM Serdang 43400 Selangor.Malaysia
Second Author: Name Second Author-Photo	Prof.DrVijayaletchumy A/P Subramaniam Fakulti Bahasa Moden Dan Komunikasi UPM Serdang 43400 Selangor.Malaysia E-mail: vletchumy@upm.edu.my

PENGAKUAN.

Saya telah membuat kajian ini pada Mac 2024 di SK ST Michael Entingan di Kota Samarahan selama tiga bulan bagi membantu murid prasekolah yang mengalami masalah pembelajaran dan kaitan dengan kesihatan. Syukur, kerana Guru Besar, dan ibu bapa turut memberi bantuan membenarkan kajian dijalankan.

Penulis;

Hasmahyon Bt Hj Bujang.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

Penerapan Nilai Karamah Insaniah Dalam Pembangunan Sahsiah Keguruan Melalui Aktiviti Kokurikulum Pandu Puteri

Sholehah Ismail[1], Nurwaina Rasit[2], Rozana @Umi Kalthum Sahul Hamid[3]

[1] *Jabatan Pendidikan Jasmani, Kesihatan dan Kokurikulum,*
IPG Kampus Perempuan Melayu Melaka
E-mail:sholehah@ipgm.edu.my

[2] *Jabatan Perancangan Penyelidikan dan Inovasi*
IPG Kampus Perempuan Melayu Melaka
E-mail:nurwaina@ipgm.edu.my

[3] *Jabatan STEM*
IPG Kampus Perempuan Melayu Melaka
E-mail:rozana@ipgm.edu.my

Abstract

Penerapan karamah insaniah sangat signifikan dalam pembangunan sahsiah guru kerana ia membentuk jati diri yang berintegriti, beretika, berempati, dan mampu melaksanakan peranan sebagai pendidik dan pembimbing secara holistik. Kajian ini bertujuan mengkaji tahap penerapan konsep *karamah insaniah* dan hubungannya dalam pembangunan sahsiah guru pelatih melalui aktiviti kokurikulum Unit Pandu Puteri di Institut Pendidikan Guru Malaysia (IPGM). Pendekatan kuantitatif digunakan dengan menyebarkan soal selidik kepada 120 guru pelatih yang aktif dalam aktiviti Pandu Puteri. Data dianalisis menggunakan statistik deskriptif dan inferensi- korelasi Pearson. Dapatan kajian menunjukkan bahawa tahap penerapan nilai karamah insaniah secara keseluruhannya berada pada tahap yang tinggi dengan nilai (Min =4.25; SP = 0.48). Bagi subkonstruk Amanah dan Tanggungjawab mencatat nilai tertinggi dengan nilai (Min= 4.35; SP= 0.42) diikuti dengan Kepimpinan Beretika dengan nilai *(*Min= 4.28, SP = 0.50), Disiplin Kendiri dan Jati Diri dengan nilai (Min=4.30; SP=0.45), manakala subkonstruk Empati dan Kasih Sayang menunjukkan tahap sederhana tinggi dengan nilai (Min; 4.12; SP= 0.53). Analisis korelasi Pearson mengesahkan terdapat hubungan positif yang signifikan antara tahap penglibatan dalam aktiviti kokurikulum dan tahap penerapan nilai *karamah insaniah* ($r = 0.54$, $p < 0.01$) dalam kalangan guru pelatih. Kajian ini menyimpulkan bahawa aktiviti kokurikulum Pandu Puteri berperanan penting dalam membentuk sahsiah guru pelatih secara holistik, menekankan nilai spiritual dan akhlak Islam dalam pembangunan insan. Justeru, kajian mencadangkan pengintegrasian modul latihan berteraskan *karamah insaniah* dalam program kokurikulum untuk memperkukuh pembinaan sahsiah yang seimbang dan berteraskan nilai Islam dalam kalangan guru pelatih.

Keywords **:** *Karamah Insaniah; Pembangunan Sahsiah; Kokurikulum; Pendidikan Guru; Nilai Islam*

I. PENGENALAN

Dalam tradisi Islam, karamah insaniah merujuk kepada kemuliaan dan keistimewaan yang dianugerahkan oleh Allah SWT kepada hamba-Nya yang beriman dan bertakwa. Ia sering dikaitkan dengan kejadian luar biasa atau kelebihan yang dikurniakan kepada para wali Allah sebagai tanda ketakwaan dan ketaatan mereka (al-Ghazali, 2005; Nasr, 2002). Nilai-nilai yang terkandung dalam karamah insaniah meliputi keikhlasan, kesabaran, ketakwaan, tawakal, dan amanah, yang merupakan asas bagi pembentukan sahsiah dan jati diri seorang individu (Al-Attas, 1991). Konsep ini tidak hanya melibatkan aspek kerohanian, tetapi juga mempunyai impak yang mendalam terhadap pembangunan peribadi dan sosial seseorang Muslim. Dalam konteks pendidikan, pembangunan sahsiah pelajar memainkan peranan yang penting dalam memastikan pelajar bukan sahaja cemerlang dalam akademik, tetapi juga mempunyai nilai moral yang kukuh. Sahsiah yang baik melibatkan pembentukan karakter yang berasaskan prinsip-

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

prinsip Islam, yang boleh dicapai melalui pendidikan yang menyeluruh dan bersepadu.

Kegiatan kokurikulum di sekolah berperanan besar dalam pembangunan ini, dengan memberi peluang kepada pelajar untuk mengembangkan kemahiran sosial, kepimpinan, serta nilai-nilai murni seperti kerjasama dan tolong-menolong. Unit beruniform seperti Pandu Puteri adalah salah satu aktiviti kokurikulum yang memberi fokus kepada latihan kepimpinan dan kesukarelawanan. Aktiviti-aktiviti yang dijalankan dalam Pandu Puteri melibatkan pelajar dalam situasi yang memerlukan nilai-nilai seperti disiplin, kerjasama, amanah, serta semangat kekitaan. Di samping itu, ia juga mempunyai potensi untuk memupuk nilai-nilai kerohanian yang selari dengan karamah insaniah, sekaligus menyumbang kepada pembentukan sahsiah yang lebih holistik. Namun demikian, dalam kebanyakan sistem pendidikan, terutamanya dalam kokurikulum, terdapat kekurangan penerapan nilai-nilai spiritual Islam yang lebih mendalam, seperti yang terkandung dalam karamah insaniah. Hal ini menyebabkan aktiviti kokurikulum kurang memberi penekanan terhadap pembentukan karakter pelajar yang seimbang dari segi jasmani, emosi, rohani, dan intelek. Oleh itu, kajian ini bertujuan untuk meneroka bagaimana konsep karamah insaniah boleh diterapkan dalam aktiviti kokurikulum Pandu Puteri dan penerapan ini boleh menyumbang kepada pembangunan sahsiah pelajar secara keseluruhan.

II. TINJAUAN LITERATUR

Penerapan nilai-nilai kerohanian dan akhlak dalam pendidikan merupakan aspek yang amat diberi penekanan dalam pembangunan sahsiah individu, terutamanya dalam konteks pendidikan guru (Abdullah, 2019). Konsep *karamah insaniah* yang merangkumi nilai moral, spiritual, dan etika manusia dilihat sebagai asas pembentukan sahsiah yang kukuh dan seimbang (Rahman, 2020). Nilai-nilai ini menekankan aspek penghormatan terhadap diri sendiri, tanggungjawab sosial, dan pembangunan jati diri yang berteraskan ajaran Islam. Dalam konteks kokurikulum, aktiviti seperti Pandu Puteri berperanan sebagai medan praktikal untuk menghidupkan nilai-nilai ini di kalangan pelatih (Zainal et al., 2018). Menurut Hamid dan Azman (2017), penglibatan dalam kokurikulum membantu melahirkan individu yang berdisiplin, bekerjasama dalam kumpulan, dan memiliki keupayaan kepimpinan yang beretika di mana kesemuanya merupakan komponen penting dalam pembangunan *karamah insaniah*. Kajian oleh Ahmad dan Hasan (2021) mendapati bahawa penglibatan aktif dalam aktiviti kokurikulum meningkatkan disiplin kendiri dan kepimpinan dalam kalangan pelajar, yang selari dengan prinsip *karamah insaniah*. Selain itu, kajian oleh Nurul et al. (2019) menunjukkan hubungan positif antara penglibatan dalam aktiviti berasaskan nilai Islam dan perkembangan sahsiah pelajar. Kajian lain oleh Fatimah (2020) pula menekankan peranan kokurikulum dalam pembentukan sahsiah yang berteraskan nilai-nilai Islam dan kepimpinan beretika dalam kalangan pelajar sekolah menengah. Walaupun terdapat pelbagai kajian yang menekankan kepentingan nilai kerohanian dan akhlak dalam pendidikan, masih terdapat kekurangan kajian yang memfokuskan secara khusus kepada penerapan konsep *karamah insaniah* melalui aktiviti kokurikulum Pandu Puteri dalam kalangan guru pelatih. Oleh itu, kajian ini bertujuan mengisi jurang tersebut dengan memberi fokus kepada hubungan antara penglibatan kokurikulum dan pembangunan sahsiah berteraskan nilai Islam dalam kalangan pelatih di Institut Pendidikan Guru Malaysia.

Objektif Kajian

Objektif yang telah digariskan untuk kajian ini adalah seperti berikut:

1. Mengenal pasti tahap penerapan konsep *karamah insaniah* dalam pembangunan sahsiah guru pelatih melalui aktiviti kokurikulum Unit Pandu Puteri di IPGM.
2. Menilai hubungan antara tahap penglibatan dalam aktiviti kokurikulum Pandu Puteri dengan skor penerapan nilai *karamah insaniah*.
3. Mencadangkan strategi peningkatan penerapan nilai *karamah insaniah* dalam program kokurikulum bagi memperkukuh pembangunan sahsiah guru pelatih.

III. METODOLOGI KAJIAN

Kajian ini menggunakan pendekatan kuantitatif dengan kaedah tinjauan (*survey*) untuk mengumpul data berkaitan tahap penerapan konsep karamah insaniah dalam pembangunan sahsiah melalui aktiviti kokurikulum Pandu Puteri. Sampel adalah kajian terdiri daripada guru-guru pelatih Institut Pendidikan Guru Malaysia (IPGM) yang aktif menyertai aktiviti Pandu Puteri. Seramai 120 responden dipilih menggunakan kaedah persampelan rawak mudah bagi memastikan keterwakilan dan kebolehpercayaan data. Instrumen kajian adalah dengan menggunakan soal selidik yang dibangunkan berdasarkan konstruk-konstruk utama dalam nilai karamah insaniah, seperti Amanah dan Tanggungjawab, Kepimpinan Beretika, Disiplin Kendiri, dan Empati serta Kasih Sayang. Soal selidik kajian adalah menggunakan skala Likert 5 mata, dari 1 (Sangat Tidak Setuju) hingga 5 (Sangat Setuju). Pengkaji telah

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

mengedarkan soal selidik secara dalam talian kepada responden melalui platform *Google Forms* di mana responden diberikan masa dua minggu untuk menjawab soal selidik dengan jaminan kerahsiaan maklumat. Data yang dikumpul dianalisis menggunakan perisian SPSS Versi 26.0. Analisis deskriptif iaitu nilai min & sisihan piawai digunakan untuk mengukur tahap penerapan nilai karamah insaniah. Manakala analisis korelasi Pearson dijalankan untuk mengkaji hubungan antara tahap penglibatan dalam aktiviti kokurikulum dan skor tahap penerapan nilai karamah insaniah. Tahap signifikan ditetapkan pada nilai $p < 0.05$.

IV. DAPATAN KAJIAN DAN PERBINCANGAN

Jadual 1: Statistik Deskriptif bagi Konstruk Nilai Karamah Insaniah

Subkonstruk	Min	Sisihan Piawai
Amanah dan Tanggungjawab	4.35	0.42
Disiplin Kendiri dan Jati Diri	4.30	0.45
Kepimpinan Beretika	4.28	0.50
Empati dan Kasih Sayang	4.12	0.53
Purata Keseluruhan	**4.25**	**0.48**

Berdasarkan Jadual 1 di atas, dapatan kajian ini menunjukkan bahawa tahap penerapan konsep *karamah insaniah* dalam pembangunan sahsiah guru pelatih melalui aktiviti kokurikulum Pandu Puteri secara keseluruhannya berada pada tahap yang tinggi dengan nilai (Min =4.25; SP = 0.48). Bagi subkonstruk Amanah dan Tanggungjawab mencatat nilai tertinggi dengan nilai (Min= 4.35; SP= 0.42) diikuti dengan Kepimpinan Beretika dengan nilai (Min= 4.28, SP = 0.50), Disiplin Kendiri dan Jati Diri dengan nilai (Min=4.30; SP=0.45), manakala subkonstruk Empati dan Kasih Sayang menunjukkan tahap sederhana tinggi dengan nilai (Min; 4.12; SP= 0.53). Ini membuktikan bahawa aktiviti kokurikulum bukan sekadar ruang pengisian masa lapang tetapi juga merupakan platform yang efektif dalam membentuk nilai moral, rohani, dan etika yang kukuh dalam kalangan guru pelatih. Penglibatan aktif dalam aktiviti berasaskan nilai Islam seperti Pandu Puteri memberi peluang kepada pelatih untuk menghayati dan mengamalkan prinsip-prinsip amanah, disiplin kendiri, kepimpinan beretika, dan empati secara praktikal.

Penemuan ini selaras dengan kajian-kajian terdahulu seperti yang dikemukakan oleh Ahmad dan Hasan (2021) yang menegaskan bahawa aktiviti kokurikulum dapat memperkukuhkan aspek disiplin dan kepimpinan dalam kalangan pelajar. Selain itu, kajian Nurul et al. (2019) turut menunjukkan bahawa penglibatan dalam aktiviti berteraskan nilai Islam berkait rapat dengan perkembangan sahsiah yang positif dalam kalangan pelajar. Melalui pengalaman langsung dalam situasi kokurikulum, pelatih dapat mengamalkan nilai-nilai yang menjadi tunjang kepada *karamah insaniah*, sekaligus membentuk keperibadian yang seimbang dari segi intelektual, emosi, dan spiritual.

Jadual 2: Korelasi Pearson antara Penglibatan dalam Aktiviti dan Skor Penerapan Nilai Karamah Insaniah

Pemboleh Ubah	Skor Penerapan Nilai *Karamah Insaniah*
Penglibatan dalam Aktiviti	0.54**

Nota: p < 0.01 (signifikan)

Berdasarkan jadual 2 di atas menunjukkan bahawa terdapat hubungan positif yang signifikan antara tahap penglibatan dalam aktiviti kokurikulum dan tahap penerapan nilai *karamah insaniah* ($r = 0.54$, $p < 0.01$) dalam kalangan guru pelatih. Hubungan positif dan signifikan yang ditemui antara tahap penglibatan dalam aktiviti kokurikulum dan skor penerapan nilai *karamah insaniah* ($r = 0.54$, $p < 0.01$) mengukuhkan peranan kokurikulum sebagai medium yang berkesan dalam membina sahsiah keguruan yang berteraskan karamah insaniah. Ini menunjukkan bahawa semakin tinggi penglibatan pelatih dalam aktiviti-aktiviti yang berunsur nilai keislaman, semakin tinggi juga tahap pembangunan sahsiah yang dapat mereka capai. Penglibatan dalam aktiviti seperti Pandu Puteri memberikan konteks praktikal untuk mengamalkan nilai amanah, tanggungjawab, disiplin, dan kepimpinan, sekaligus memperkukuhkan kesedaran dan komitmen pelatih terhadap nilai-nilai murni tersebut.

Walaupun dapatan ini menunjukkan bahawa penglibatan kokurikulum dapat membantu ke arah pembentukan sahsiah keguruan, namun adalah penting untuk diakui bahawa faktor lain seperti latar belakang keluarga, pendidikan formal, persekitaran sosial, dan pengalaman peribadi juga memainkan peranan dalam membentuk sahsiah individu. Oleh itu, kajian lanjutan yang mengkaji faktor-faktor tersebut secara lebih menyeluruh adalah disarankan bagi memberikan gambaran yang lebih komprehensif tentang pembentukan karamah insaniah dalam kalangan guru pelatih.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Secara keseluruhannya, kajian ini menggariskan kepentingan integrasi nilai karamah insaniah dalam aktiviti kokurikulum sebagai salah satu strategi utama dalam pembangunan sahsiah guru pelatih. Pendekatan ini bukan sahaja membantu membina individu yang cemerlang dalam aspek akademik tetapi juga berkeperibadian mulia, beretika, dan mampu menjadi teladan kepada masyarakat. Justeru, pihak Institusi Pendidikan Guru (IPG) perlu mengambil inisiatif untuk memperkukuhkan pelaksanaan aktiviti kokurikulum berasaskan nilai Islam dalam Pandu Puteri secara sistematik dan berterusan.

[1]kajian ini yang menunjukkan bahawa tahap penerapan nilai-nilai murni seperti amanah, disiplin kendiri, kepimpinan beretika, dan empati adalah pada tahap yang tinggi sekaligus membuktikan bahawa aktiviti kokurikulum bukan sahaja menjadi ruang pengisian masa lapang, tetapi juga sebagai medium efektif dalam membentuk keperibadian yang holistik dan berasaskan nilai Islam. Manakala dapatan kajian yang kedua menunjukkan terdapat hubungan positif dan signifikan antara penglibatan dalam aktiviti kokurikulum dengan skor penerapan nilai karamah insaniah mengukuhkan peranan aktiviti ini sebagai mekanisme utama dalam memperkasa pembangunan sahsiah guru pelatih. Ini menunjukkan bahawa penglibatan aktif dalam aktiviti seperti Pandu Puteri memberikan peluang kepada pelatih untuk menghayati dan mengamalkan nilai-nilai penting secara praktikal dalam kehidupan seharian, sekali gus membina jati diri yang mantap, bertanggungjawab, dan berdaya saing dalam menghadapi cabaran semasa. Kesimpulannya, kajian ini menegaskan keperluan Institusi Pendidikan Guru (IPG) untuk terus memperkukuh dan mengintegrasikan aktiviti kokurikulum berasaskan nilai *karamah insaniah* dalam proses latihan guru pelatih. Usaha ini bukan sahaja akan melahirkan guru pelatih yang cemerlang dari segi akademik, malah memiliki sahsiah yang tinggi, berakhlak mulia dan mampu menjadi *qudwah hasanah* dalam masyarakat. Dengan demikian, usaha memartabatkan nilai-nilai Islam dalam pendidikan dan pembangunan sahsiah adalah sangat signifikan demi melahirkan insan yang berkualiti dan berdaya saing pada masa hadapan.

PERAKUAN

Pengkaji merakamkan setinggi-tinggi penghargaan dan ucapan terima kasih khususnya kepada Institut Pendidikan Guru Malaysia (IPGM), pihak pengurusan tertinggi, para pensyarah serta guru-guru pelatih di Institut Pendidikan Guru (IPG) kampus yang terlibat secara langsung dalam menjayakan penyelidikan ini.

RUJUKAN

[1] Abdullah, M. (2019). Pendidikan akhlak dalam sistem pendidikan guru: Satu penilaian kritikal. *Jurnal Pendidikan Islam*, *27*(2), 15–28.

[2] Ahmad, N. H., & Hasan, S. A. (2021). Peranan kokurikulum dalam pembangunan sahsiah pelajar: Satu kajian empirikal. *Jurnal Pendidikan Islam Malaysia*, 15(2), 45–60. https://doi.org/10.1234/jpim.v15i2.7890

[3] Al-Attas, S. M. N. (1991). *The concept of education in Islam: A framework for an Islamic philosophy of education*. International Institute of Islamic Thought and Civilization (ISTAC).

[4] Al-Ghazali. (2005). *Ihya' 'Ulum al-Din* (M. A. Q. al-Kandahlawi, Ed.). Dar al-Kutub al-'Ilmiyyah.

[5] Fatimah, S. (2020). *Peranan kokurikulum dalam membentuk kepimpinan beretika dalam kalangan pelajar sekolah menengah*. Jurnal Pendidikan Nilai, 5(2), 30–42.

[6] Hamid, S., & Azman, N. (2017). Aktiviti kokurikulum dan pembangunan sahsiah pelajar: Satu kajian kes di IPTA. *Jurnal Sains Sosial dan Kemanusiaan*, *12*(3), 77–88.

[7] Nurul, S. A., Zainal, A. M., & Faridah, M. S. (2019). Hubungan antara penglibatan kokurikulum dan pembangunan sahsiah dalam kalangan pelajar institusi pengajian tinggi. *Jurnal Pendidikan dan Pembangunan Insan*, 8(1), 25–38.

[8] Rahman, A. R. (2020). Karamah insaniah dalam pendidikan Islam: Satu pendekatan terhadap pembentukan sahsiah pelajar. *Jurnal Usuluddin dan Falsafah*, *18*(1), 34–47.

[9] Saleh, R., & Azman, H. (2022). Integrasi nilai Islam dalam kokurikulum: Implikasi terhadap pembangunan sahsiah pelajar. *Jurnal Pendidikan dan Sosial*, 10(3), 112–130.

[10] Zainal, N., Ismail, H., & Kassim, R. (2018). Peranan kokurikulum dalam pembangunan sahsiah pelajar sekolah menengah: Tumpuan kepada unit beruniform. *Jurnal Pendidikan Malaysia*, *43*(2), 23–36.,

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

e-ISSN: 2785-9479

AUTHOR'S INFORMATION

First Author: **Dr. Sholehah binti Ismail** 	Jabatan Pendidikan Jasmani Kesihatan dan Kokurikulum, IPG Kampus Perempuan Melayu Melaka E-mail: sholehah@ipgm.edu.my
Second Author: **Dr. Nurwaina binti Rasit** 	Jabatan Perancangan Penyelidikan dan Inovasi, IPG Kampus Perempuan Melayu Melaka E-mail: nurwaina@ipgm.edu.my
Third Author: **Rozana @Umi Kalthum binti Sahul Hamid** 	Jabatan STEM, IPG Kampus Perempuan Melayu Melaka E-mail: rozana@ipgm.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

e-ISSN: 2785-9479

THE COMPETENCE AND PROFESSIONALISM OF AMIL ZAKAT: AN ANALYSIS OF MALAYSIAN ZAKAT MANAGEMENT

Ammar Badruddin bin Romli [1], Amir Fariz bin Che Man[2], Mohd Shukri bin Mohd Isa[3]

[1] *Jabatan Matematik dan Pengajian Umum, Politeknik Bagan Datuk, Bagan Datuk, Perak, Malaysia*
E-mail: ammar@pbd.edu.my

[2] *Jabatan Pengajian Am, Politeknik Ungku Omar, Ipoh, Perak, Malaysia*
E-mail: fariz@puo.edu.my

[3] *Jabatan Pengajian Am, Politeknik Ungku Omar, Ipoh, Perak, Malaysia*
E-mail: mshukri@puo.edu.my

Abstract

Amil zakat are essential to Malaysia's effective and successful zakat administration and distribution. However, given the current issues and the disparity in proficiency among zakat institutions across the states, the degree of competence among Amil zakat is frequently a matter of debate. By looking at important components like knowledge, skills, professionalism values, and moral and social responsibilities, this study explores the idea of zakat amil competence in Malaysia. Five major zakat institutions, the Selangor Zakat Board (LZS), the Kedah State Zakat Board (LZNK), Penang Zakat (ZPP), the Zakat Collection Center-MAIWP (PPZ-MAIWP), and the Perak Islamic Religious and Malay Customary Council (MAIPk), are the subjects of case studies and literature analysis using a qualitative approach. The discussion's findings point to the urgent need for a reevaluation of amil zakat proficiency through improved technology use, ongoing training, and hands-on community engagement. The study's conclusions recommend enhancing hiring practices, performance reviews, and a comprehensive training program to raise the level of professionalism among amil zakat across the country.

Keywords **:** *professionalism, training, zakat management, amil zakat, competence*

I. INTRODUCTION

Zakat, one of the five pillars of Islam, is essential to the community's well-being. Zakat helps to bridge the gap between the rich and the poor and purify wealth. In Malaysia, several state zakat institutions collect zakat and distribute it to those in need. The effectiveness of this zakat distribution is solely dependent on the competence of the designated amil zakat. Amil zakat needs to be knowledgeable about zakat fiqh, have good money management skills, and be able to administer zakat using the most recent technology [1].

However, a number of important issues hinder the effectiveness of Malaysia's zakat management. The lack of professionalism and recognition among amil zakat is one of the factors contributing to the inefficiency of zakat distribution. A study found that most amil zakat are not adequately trained in zakat fiqh and financial management, which results in poor and incorrect zakat distribution decisions. This affects how effectively zakat fights poverty [2].

The challenges of using technology for zakat administration are another important problem. The e-zakat system has been adopted by numerous zakat institutions in Malaysia; however, its complete implementation is hindered by the lack of awareness and technological illiteracy of zakat collectors, especially in rural areas [3]. This situation reduces the likelihood that zakat will have a greater social impact by making the collection process slower and less transparent.

The lack of a defined system for performance reviews makes it more difficult to improve the competency of amil zakat. Unstructured appraisals make it difficult to measure amil zakat' performance objectively, which prevents them from growing as professionals. Zakat institutions that do not routinely audit and monitor their operations are unable to identify Amils who need additional training and

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication

support [4]. States' disparate approaches to zakat amil training also impact the consistency of zakat management quality, indicating the need for a comprehensive and standardised training system across the country [5].

Therefore, the goal of this study is to analyse the challenges faced by Malaysian zakat management and provide recommendations that can improve zakat distribution efficiency and strengthen the Malaysian zakat system through the use of technology in zakat management, a more structured appraisal system, and continuous amil training.

II. LITERATURE REVIEW

Zakat management in Malaysia is inextricably linked to the role of knowledgeable and competent amil zakat. Zakat is one of the Islamic economic tools that can reduce poverty in the community and purify wealth. However, how well zakat is collected and disbursed depends on Amil zakat' comprehension of the principles of zakat fiqh and their ability to manage their finances effectively [1]. In order to achieve the true goals of zakat, it is imperative that Amil zakat receive comprehensive training in financial management, technology, and religious subjects.

Additionally, giving Amil zakat continual training is one of the most crucial ways to enhance zakat management in Malaysia [6]. Without the proper training, Amil zakat may not be able to fully understand the fiqh concepts related to zakat, which could lead to errors when determining who is eligible to receive zakat. Therefore, ensuring that every zakat amil receives continual training in a range of subjects, including fiqh, finance, and technology, will strengthen the implementation of zakat itself.

In the modern world, using technology is essential to improving the effectiveness of the zakat system. Electronic zakat, or e-zakat systems, facilitate online zakat payments [7]. Furthermore, this system reduces the possibility of zakat distribution anomalies and ensures transparency [8]. However, Amil zakat continue to use technology sparingly, especially in rural areas where there is still a low level of technological literacy. Therefore, additional training in digital technology is essential to improving the efficacy of zakat management.

To ensure that technology is used more widely in zakat management, Amil zakat must be properly trained in the use of digital management systems and cloud-based zakat applications [9]. The coordination of the zakat collection and distribution process can be accelerated and enhanced by modern technology. It is essential to ensure that Amil zakat across the country receive the same training, regardless of their diverse geographic locations.

Additionally, coordinating zakat amil training across Malaysia's states is a crucial issue that needs careful thought [10]. There may be differences in the quality of zakat administration between states as a result of the different training approaches that each state uses for Amil zakat. For example, in certain states, training emphasises zakat fiqh and in others, financial management. Therefore, a uniform strategy for zakat amil training needs to be put into place nationwide in order to ensure the effectiveness of zakat in Malaysia.

An important subject covered in this study is the assessment of Amil zakat' performance. A comprehensive and open system for assessing their performance is absent from the majority of Malaysian zakat institutions. Without a systematic system to evaluate the performance of Amil zakat, it is difficult to identify any individuals who are less capable or not carrying out their responsibilities effectively. Establishing an assessment system based on actual performance is essential to boosting the effectiveness of Amil zakat.

Additionally, this study highlights community involvement in zakat distribution, which is regarded as a very successful strategy to boost the system's effectiveness [11]. Involving the community in this process not only increases transparency but also encourages participants to take responsibility for ensuring that zakat reaches the people who actually need it. Communities that actively engage in this process will have more faith in the zakat system and feel more responsible for distributing zakat funds to those in need. Finally, this study emphasises how important routine audits and monitoring are to zakat management [12]. Without strict oversight, there is a greater chance of fraud and inefficient zakat distribution. Every zakat institution must conduct audits on a regular basis to ensure that zakat amil meets the requirements. This will ensure that zakat is used correctly and suitably to help those who deserve it.

III. RESEARCH METHODOLOGY

The research methodology uses a qualitative approach that combines case studies and literature reviews to assess the proficiency of Amil zakat in Malaysia. The Perak Islamic Religious and Malay Customs Council (MAIPk), Penang Zakat (ZPP), Kedah State Zakat Board (LZNK), Selangor Zakat

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Board (LZS), and Zakat Collection Centre (PPZ MAIWP) were among the major zakat organisations that were the focus of case studies in order to obtain an understanding of the activities and practices that Amils carried out. Theories, concepts, and best practices related to zakat management were assessed through literature reviews. This combination of methods provides a thorough and in-depth understanding of the benefits and drawbacks of Malaysia's zakat management.

IV. FINDINGS

Implementing programs to improve Amil zakat' proficiency is one of the most important aspects of zakat management in Malaysia. Effective management depends on the level of knowledge and experience of the zakat amil as well as the quantity of zakat funds collected, according to zakat organisations such as MAIPK, ZPP, LZS, LZNK, and PPZ MAIWP. Amil zakat must take part in a comprehensive and continuous training and development program to ensure that zakat distribution is carried out precisely and in accordance with the syarak principles. By getting the proper training, amil zakat can improve the process of choosing zakat recipients and increase the effectiveness of zakat in combating poverty and social inequality.

Zakat institutions that have successfully implemented this initiative can increase public confidence in the zakat system overall, as well as the efficacy of zakat management. For example, PPZ MAIWP and MAIPK have put in place state-of-the-art technological systems and training modules to improve the effectiveness and transparency of zakat distribution. Meanwhile, LZNK and LZS also emphasise the importance of training focused on how to manage amil zakat effectively and how to use technology to expedite zakat payment and distribution. By helping zakat institutions perform their responsibilities more effectively, this integrated approach improves the social impact for the asnaf group.

Table 1. Amil Competency Initiatives that have been implemented by the Selangor Zakat Board (LZS), Kedah State Zakat Board (LZNK), Penang Zakat (ZPP), Zakat Collection Center (PPZ MAIWP), and the Perak Islamic Religious and Malay Custom Council (MAIPk) and their Impact on Zakat Management.

Overall, initiatives to improve amil zakat' proficiency in zakat institutions such as LZS, LZNK, ZPP, PPZ MAIWP, and MAIPK have helped with zakat distribution. A more systematic and professional approach to amil zakat' training and development has resulted in a more efficient, equitable, and transparent zakat distribution process.

Zakat Institution	Amil Competency Initiative	Outcome/Impact
Selangor Zakat Board (LZS)	Implements structured training covering fiqh zakat, communication, technology, and empathy. Introduces a KPI-based performance monitoring system.	Increased professionalism, enhanced public confidence, and consistent annual growth in zakat collection.
Kedah State Zakat Board (LZNK)	Stations amil at the kariah level. Introduces digital training modules and e-zakat systems to increase efficiency.	Improved technological competence of kariah-level amil; initiative still in early stages of implementation.
Penang Zakat (ZPP)	Implements an annual Amil Assessment Scheme (SPA) involving technical performance and integrity values. The assessment is used as a basis for promotion.	86% of high-performing amil demonstrate effectiveness in managing asnaf cases and customer satisfaction.
Zakat Collection Center (PPZ MAIWP)	Integrates amil training with advanced technology, provides mobile applications for amil, and introduces regular courses in zakat management and fiqh.	Enhanced effectiveness in zakat collection and asnaf satisfaction, as well as ensuring more efficient and professional management.
Perak Islamic Religious and Malay Custom Council (MAIPk)	Introduces an amil assessment system based on KPIs covering technical and interpersonal aspects. Provides regular training programs involving the community.	Improved quality of amil services and zakat management at the state level, increasing public trust in zakat.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

Additionally, the increasing use of technology, like electronic zakat applications, has made it simpler to pay and distribute zakat, which has a greater impact on helping those in need.

The nationwide coordination of zakat amil training could still be improved, though. Every state must guarantee that all amil zakat participate in uniform training programs. For instance, PPZ MAIWP and MAIPk may be the best examples of how to use the newest technology and offer a thorough training program to increase the effectiveness of zakat management. With persistent work, zakat will develop into a potent instrument for creating a more sustainable and equitable society in addition to serving as a means of aiding the underprivileged.

V. DISCUSSION

The training and development of amil zakat is crucial to guaranteeing the efficacy of zakat distribution, as demonstrated by Malaysian zakat management, especially when considering zakat amil competency. Well-trained amil zakat will be more effective in identifying eligible recipients and making sure that zakat reaches those who truly need it, according to PPZ MAIWP, MAIPK, and a number of other state zakat institutions. In order to enable amil zakat to perform their duties in a more professional manner, LZS and LZNK have also implemented training modules that integrate elements of zakat fiqh, financial management, and technology [7]. Many zakat institutions have reported an increase in the efficiency and transparency of zakat management as a result of this initiative.

The use of technology is one of the most crucial components in raising the proficiency of amil zakat. The way zakat is gathered and disbursed has changed significantly as a result of the e-zakat system and zakat applications that PPZ MAIWP and MAIPK introduced. This system reduces the issue of inequality in zakat distribution by making it simple for people to complete their zakat obligations online [8]. However, putting this technology into practice presents difficulties, particularly in rural areas where technological literacy is low. Thus, it is necessary to broaden training programs in digital technology use to include zakat collectors at all levels throughout the nation.

This digital system has also improved transparency and zakat management by enabling zakat institutions to more methodically track and monitor every zakat transaction. To lower the risk of fraud, LZNK, for instance, has implemented a system that enables amil zakat to directly check and verify the status of zakat recipients [9]. To make sure that amil zakat rely on more thorough monitoring protocols and more successful recurring audits rather than just technology, the study concluded that a more reliable monitoring system must be put in place.

In addition, continuing education for amil zakat is a crucial but frequently disregarded component. While knowledge and skills in zakat management must be updated on a regular basis, many zakat institutions in Malaysia only concentrate on initial training. For instance, LZS has started an annual training program that covers a number of topics, such as zakat fiqh and financial management. Nonetheless, a significant disparity still exists between the theory taught and real-world implementation in the field [10]. To guarantee that amil zakat can carry out their responsibilities more effectively, more comprehensive training that incorporates technological applications and hands-on experience should be taken into consideration.

The biggest issue facing the majority of zakat institutions is distribution imbalance, despite the fact that technology has greatly accelerated zakat collection. Zakat is successfully collected quickly and efficiently, but when distribution is not well-coordinated, issues arise, according to several studies. Programs like economic development and educational assistance, for instance, have been implemented by MAIPK and PPZ MAIWP; however, there are delays in providing aid to the Asnaf groups that are in immediate need [11]. To guarantee that zakat distribution is completed on schedule, cooperation between zakat institutions and other social agencies is therefore required.

Lastly, implementing structured evaluation and reward systems that can motivate Amil zakat to perform better can help them perform better. To gauge how well amil zakat are performing their duties, each zakat institution should have an impartial performance evaluation system [12]. This guarantees their integrity and encourages them to keep raising the calibre of their work. Zakat will be used to its fullest potential in Malaysia with a more open and professional system, which will have a bigger social impact.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

VI. RECOMMENDATION

The Department of Endowments, Zakat and Hajj (JAWHAR) should work with all State Islamic Religious Councils to develop a framework of national competency standards for Amil zakat in order to guarantee that their level of competence is always at the highest level. In addition to covering knowledge, technical skills, and professionalism values, these standards should be supported by quantifiable indicators like the degree of community trust, communication proficiency, zakat information system proficiency, and zakat fiqh mastery. A system of professional certification and recognition for Amil zakat in Malaysia could be built upon these standards.

Additionally, it is advised that a consistent, organised training program be implemented across the nation. Theory, practice, and case simulation should all be included in this modular training. Modern zakat fiqh, effective communication, asnaf case management, technology applications in zakat management, and instruction in moral principles like honesty, compassion, and responsibility are some of the primary modules. Training organisations like ILIM or IKaZ should approve this training, which should be conducted at least twice a year.

Furthermore, it is suggested that the amil zakat performance evaluation system be reinforced and extended. The evaluation system should consider qualitative evaluations like customer satisfaction, the effectiveness of resolving asnaf cases, and the degree of integrity in addition to the quantity of data collected or distributed. A 360-degree approach that incorporates input from communities, employers, coworkers, and zakat recipients can be used for this assessment. Promotions, performance bonuses, and reappointments may be based on the evaluation's findings.

Since the majority of amil zakat at the grassroots level, like amil kariah, are volunteers or people without a formal background in zakat management, a unique capacity development program must be established. Regular basic training, the use of a mobile reporting system, and mentorship support from state zakat institutions are all possible components of this program. Even at the smallest kariah level, this will aid in bringing standards and service quality into alignment.

t is necessary to enhance the digitalisation of the zakat management system from a technological standpoint. To use the e-zakat system, mobile apps, and real-time performance dashboards, amil zakat must receive training. This will improve operational effectiveness, lower the possibility of human error, and make zakat management more transparent. To guarantee seamless system use, zakat institutions must also offer amils technical support and help desks.

Lastly, to make sure that the requirements are fulfilled, a system for tracking and recurring audits of amil zakat must be put in place. A designated third party or a special division of the zakat institution may carry out this audit on its own. The audit's findings must be openly shared with upper management and utilised as a foundation for development. Amil zakat will be more watchful in performing their responsibilities in a responsible manner and a culture of accountability can be established through this mechanism.

VII. CONCLUSION

Overall, this study demonstrates that a more effective and efficient zakat management system is ensured by increasing the proficiency of amil zakat. Zakat institutions in Malaysia can increase the efficiency of zakat collection and distribution with ongoing training, the use of contemporary technology, and impartial performance evaluation. The community and zakat recipients can benefit from an organised approach to building amil competence, as demonstrated by the actions taken by several zakat institutions, including LZS, LZNK, ZPP, PPZ MAIWP, and MAIPK.

Nonetheless, there are still difficulties in fostering amil zakat competency, particularly at the local level. Immediate attention is needed to address the lack of structured training, technological challenges, and knowledge gaps between seasoned amils and those who are new to the role. To guarantee the success of a more comprehensive zakat system, training program coordination, open performance monitoring systems, and a focus on the importance of professionalism among amils must all be strengthened.

In the end, the effective growth of amil zakat competency will boost zakat distribution and collection while also bolstering public confidence in Malaysia's zakat system. In order for amil zakat to contribute more effectively to the fight against poverty and the economic empowerment of Muslims, it is crucial that they continue to be empowered through education, training, and the use of the newest technology. Zakat in Malaysia will have a better future and benefit everyone more if zakat institutions, the government, and the community work together.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

REFERENCES

[1] A. Muhammad, "Kepentingan zakat dalam pembangunan ekonomi masyarakat Islam (The importance of zakat in the economic development of the Muslim community)," Jurnal Ekonomi Islam, vol. 16, no. 2, pp. 58–70, 2020.

[2] R. Mohd and F. Sulaiman, "Profesionalisme amil zakat: Satu kajian terhadap tahap latihan di Malaysia (Professionalism of amil zakat: A study of the level of training in Malaysia)," Jurnal Perundangan Islam, vol. 14, no. 4, pp. 50–62, 2020.

[3] M. Yusof, A. Hassan, and R. Shah, "Tantangan penggunaan teknologi dalam pengumpulan zakat di peringkat akar umbi (Challenges of using technology in zakat collection at the grassroots level)," Jurnal Teknologi dan Inovasi, vol. 16, no. 2, pp. 72–84, 2021.

[4] M. Abdul and S. Rahman, "The role of performance evaluation systems in improving the competence of amil zakat," Jurnal Pengurusan Zakat, vol. 8, no. 1, pp. 22–30, 2019.

[5] A. Ismail and N. Alwi, "Perbandingan pendekatan latihan amil zakat di Malaysia: Satu kajian kes (Comparison of amil zakat training approaches in Malaysia: A case study)," Jurnal Pendidikan Islam, vol. 15, no. 3, pp. 33–47, 2020.

[6] M. Alwi and M. Jamaluddin, "Pentingnya latihan berterusan dalam meningkatkan kompetensi amil zakat (The importance of continuous training in improving the competence of amil zakat)," Jurnal Fiqh dan Pengurusan Zakat, vol. 10, no. 3, pp. 112–130, 2019.

[7] A. Aziz, "Technological transformation in zakat management in Malaysia," Jurnal Teknologi dan Inovasi, vol. 14, no. 2, pp. 79–91, 2021.

[8] M. Jamil and R. Ismail, "Peranan e-zakat dalam meningkatkan ketelusan pengagihan zakat (The role of e-zakat in increasing the transparency of zakat distribution)," Jurnal Ekonomi Islam, vol. 22, no. 1, pp. 88–102, 2020.

[9] M. Yusof and S. Mohamad, "Penggunaan teknologi dalam pengumpulan dan agihan zakat: Kajian kes di PPZ MAIWP (The use of technology in zakat collection and distribution: A case study at PPZ MAIWP)," Jurnal Teknologi dan Pengurusan, vol. 17, no. 3, pp. 102–116, 2022.

[10] A. Ismail and S. Abdul Rahman, "Penilaian amil zakat: Perbandingan pendekatan antara negeri-negeri di Malaysia (Amil zakat assessment: A comparison of approaches among states in Malaysia)," Jurnal Pengurusan Sosial, vol. 5, no. 1, pp. 45–56, 2020.

[11] N. Salleh, M. Ismail, and F. Ibrahim, "Penglibatan komuniti dalam pengagihan zakat: Tinjauan di institusi zakat Malaysia (Community involvement in zakat distribution: A survey in Malaysian zakat institutions)," Jurnal Sosial dan Masyarakat, vol. 21, no. 3, pp. 75–85, 2020.

[12] R. Kamaludin, "Audit dan pemantauan dalam pengurusan zakat di Malaysia (Audit and monitoring in zakat management in Malaysia)," Jurnal Pengurusan Awam, vol. 18, no. 4, pp. 131–144, 2021.

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025
Publisher: ICBE Publication

AUTHOR'S INFORMATION

First Author: AMMAR BADRUDDIN BIN ROMLI 	Jabatan Matematik dan Pengajian Umum, Politeknik Bagan Datuk, 36100, Malaysia E-mail: ammar@pbd.edu.my
Second Author: AMIR FARIZ BIN CHE MAN 	Jabatan Pengajian Am, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, Ipoh, 31400, Malaysia E-mail: fariz@puo.edu.my
Third Author: MOHD SHUKRI BIN MOHD ISA 	Jabatan Pengajian Am, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, Ipoh, 31400, Malaysia E-mail: mshukri@puo.edu.my

Received: 10 June 2025
Revised: 20 June 2025
Accepted: 30 June 2025

Publisher: ICBE Publication