

AWARENESS AND KNOWLEDGE EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE MODULE FOR DIGITAL TECHNOLOGY PROGRAMME

Suriana Alias*¹

Khalid Abdul Wahid²

Nasuhar Ab Aziz³

W. Kairiah Hulaini Wan Ramli⁴

Nur Ainatul Mardiah Mat Naw⁵

Nurulannisa Abdullah⁶

Murtadha Abdullah⁷

¹Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: suria588@uitm.edu.my)

²Faculty of Information Management, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: awkhalid@uitm.edu.my)

³Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: nasuha978@uitm.edu.my)

⁴Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: wkriyah@uitm.edu.my)

⁵Faculty of Information Management, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: ainatulmardiah@uitm.edu.my)

⁶Faculty of Information Management, Universiti Teknologi MARA Cawangan Kelantan, (UiTM), Malaysia, (E-mail: annisa@uitm.edu.my)

⁷Majlis Agama Islam Kelantan (MAIK), Kompleks Islam Darul Naim, Lundang, Jalan Sultan Yahya Petra, 15200 Kota Bharu, Kelantan, Malaysia, (E-mail: unitadat@e-maik.my)

Article history

Received date : 12-6-2026

Revised date : 13-6-2026

Accepted date : 30-7-2026

Published date : 1-8-2026

To cite this document:

Alias, S., Abdul Wahid, K., Ab Aziz, N., Wan Ramli, W. K. H., Mat Naw, N. A. M., Abdullah, N., & Abdullah, M. (2026). Awareness and knowledge effectiveness of artificial intelligence module for digital technology programme. *Journal of Islamic, Social, Economics and Development (JISED)*, 11 (84), 888 – 899.

Abstract: *This study evaluates the effectiveness of a digital technology awareness programme focusing on Artificial Intelligence (AI), Blockchain, and Cryptocurrency (Crypto). The programme aimed to improve participants' knowledge and awareness of emerging technologies that are increasingly important in the digital economy. A quantitative pre-test and post-test design was employed using a structured questionnaire based on a five-point Likert scale. Participants completed the questionnaire before and after the programme, allowing changes in knowledge levels to be measured. The findings revealed significant improvements across all three programme modules. Average post-programme scores for AI, Blockchain, and Cryptocurrency increased substantially compared with the pre-programme assessment, indicating enhanced understanding of concepts, applications, benefits, and challenges related to these technologies. Overall, the programme effectively strengthened participants' digital literacy and awareness of emerging technologies, demonstrating the value of educational initiatives in preparing individuals for digital transformation and Industry 4.0.*

Keywords: *Artificial Intelligence, Blockchain, Crypto, Awareness, Knowledge, Digital technology*

Introduction

Rapid advancements in digital technologies have transformed the way individuals, organizations, and industries operate. Among these technologies, Artificial Intelligence (AI), Blockchain, and Cryptocurrency have emerged as key drivers of digital innovation, influencing various sectors such as education, finance, healthcare, manufacturing, and public services. As these technologies continue to evolve, there is an increasing need to equip students and the community with fundamental knowledge and practical awareness to prepare them for the demands of the digital economy and Industry 4.0.

To address this need, the digital technology programme was organised to introduce participants to the basic concepts, applications, benefits, and challenges of AI, Blockchain, and Cryptocurrency. The programme aimed to enhance participants' understanding of these emerging technologies while encouraging responsible and informed adoption in academic, professional, and everyday contexts.

To evaluate the effectiveness of the programme, a pre-programme and post-programme assessment was conducted using a structured questionnaire based on a five-point Likert scale. Participants completed the questionnaire before and after attending the programme, allowing their level of knowledge and understanding to be compared. The evaluation focused on three main topics:

- Artificial Intelligence (AI)
- Blockchain
- Cryptocurrency (Crypto)

The findings of the assessment are presented in Tables 1–3 and Figures 1–3, which compare the average scores obtained before and after the programme for each topic. The analysis provides valuable insights into the programme's effectiveness in improving participants' knowledge and awareness of emerging digital technologies. Overall, the results demonstrate the programme's contribution to strengthening digital literacy and preparing participants to engage with technological developments in the era of digital transformation.

Therefore, this study examines the awareness and knowledge effectiveness of an Artificial Intelligence Module consisting of AI, blockchain, and cryptocurrency components. The findings are expected to provide valuable insights into improving digital technology education and preparing students with relevant competencies for future digital transformation.

Literature Review

The rapid advancement of emerging technologies has significantly transformed education systems worldwide, particularly through the integration of Artificial Intelligence (AI), blockchain, and cryptocurrency concepts into digital technology programmes.

Artificial Intelligence in Digital Technology Education

Artificial Intelligence has become a fundamental component of digital transformation due to its ability to support automated decision-making, intelligent data analysis, personalized learning, and innovative problem-solving approaches. In higher education, AI is increasingly recognized

as an essential digital competency that enables students to understand, evaluate, and apply intelligent technologies effectively.

Recent studies emphasize that AI education should not only focus on technical skills but also develop awareness, critical understanding, ethical considerations, and responsible usage of AI technologies. According to UNESCO (2024), educational institutions need to prepare learners with AI competencies that enable them to interact effectively with AI-driven environments while understanding issues related to privacy, fairness, transparency, and accountability. Similarly, OECD (2024) highlighted that AI literacy has become an important component of future digital skills required for academic development and workforce readiness.

The implementation of AI modules within digital technology programmes provides opportunities for students to acquire fundamental knowledge of AI concepts, applications, and societal impacts. Such modules contribute to improving students' technological confidence and preparing them for digital transformation challenges. Crompton and Burke (2024) reported that AI integration in higher education has expanded rapidly, particularly in personalized learning systems, learning analytics, intelligent tutoring systems, and automated assessment. However, the effectiveness of AI learning depends largely on students' existing awareness and knowledge of AI technologies.

Awareness of Artificial Intelligence among Students

AI awareness refers to an individual's understanding of AI concepts, applications, benefits, limitations, and ethical implications. Developing AI awareness is essential because students increasingly interact with AI-based applications such as recommendation systems, generative AI tools, automated assistants, and intelligent learning platforms.

Recent research indicates that although students frequently use AI applications, their understanding of AI mechanisms and implications remains limited. Ng (2024) emphasized that AI literacy requires learners to develop not only operational skills but also conceptual understanding and critical evaluation abilities. Without sufficient awareness, students may become passive users of AI technologies without understanding how these systems generate decisions or how biases may influence AI outcomes.

The development of AI awareness through structured learning modules has been identified as an effective approach to improving students' understanding. Kim et al. (2026) demonstrated that AI literacy courses incorporating interactive and game-based learning approaches improved students' cognitive, behavioural, affective, and ethical understanding of AI. This finding indicates that effective AI modules should include engaging learning activities rather than focusing solely on theoretical explanations.

Furthermore, van der Linde et al. (2025) highlighted that AI literacy education plays an important role in preparing students for future digital environments. Their review showed that AI awareness contributes to students' confidence, responsible technology usage, and readiness to participate in AI-driven societies. Therefore, evaluating students' awareness before and after participating in an AI module is important to determine the effectiveness of digital technology education.

Knowledge Effectiveness of Artificial Intelligence Modules

AI knowledge represents students' ability to understand AI principles, techniques, applications, and practical implications. Unlike general awareness, AI knowledge involves deeper cognitive understanding, including machine learning concepts, data processing, algorithmic thinking, and AI problem-solving approaches.

The effectiveness of AI learning modules has received increasing attention due to the growing demand for AI-skilled graduates. Li et al. (2024) conducted a systematic review on AI education and found that effective AI learning activities should involve problem-based learning, computational thinking, and practical applications. The study emphasized that AI education should move beyond theoretical concepts by providing students with opportunities to apply AI knowledge in real-world contexts.

The integration of AI modules within digital technology programmes can improve students' ability to connect technological concepts with practical applications. Luo et al. (2024) demonstrated that AI-supported knowledge mapping algorithms enhanced learners' performance by improving knowledge organization, assessment processes, and data integrity. This finding highlights the potential of AI technologies in supporting effective learning environments.

Moreover, Kwangmuang et al. (2025) proposed an AI-enhanced blockchain and FinTech curriculum that combined emerging technologies with practical learning experiences. Their findings indicated that interdisciplinary technology education improved learners' understanding of AI applications, blockchain systems, and digital financial technologies. Therefore, AI modules that combine multiple emerging technologies may provide more comprehensive learning experiences for digital technology students.

Integration of Blockchain Technology in Digital Technology Programmes

Blockchain technology has emerged as another important component of digital transformation due to its decentralized, transparent, and secure data management capabilities. Although blockchain is commonly associated with cryptocurrency, its applications have expanded into education, healthcare, finance, and information management systems.

In education, blockchain technology provides opportunities for secure academic record management, digital certification, knowledge sharing, and verification of learning achievements. Al-Ragwi and Zahary (2026) reported that blockchain applications in e-learning improve data security, transparency, and trust between educational stakeholders. These characteristics make blockchain an important topic within digital technology programmes.

The integration of blockchain concepts into AI modules can enhance students' understanding of emerging technologies and their relationships. Alwakid et al. (2026) explored blockchain-enabled AI-based educational systems and found that trust, motivation, and perceived value influence users' acceptance of technology. This indicates that students' knowledge and awareness of blockchain technologies may influence their willingness to adopt future digital innovations.

Furthermore, Tajuddin et al. (2025) identified blockchain-based knowledge integration models as valuable approaches for higher learning institutions. Their study emphasized that blockchain

education should focus not only on technical mechanisms but also on practical applications and organizational benefits.

Cryptocurrency Awareness and Knowledge

represents one of the most visible applications of blockchain technology. The increasing popularity of digital currencies such as Bitcoin and Ethereum has created a need for students to understand cryptocurrency concepts, opportunities, risks, and ethical considerations.

White et al. (2025) investigated students' awareness and knowledge of blockchain-related technologies and found that structured educational exposure significantly improved understanding of emerging digital technologies. This suggests that formal learning modules can reduce misconceptions and improve students' confidence in engaging with cryptocurrency-related technologies.

The inclusion of cryptocurrency topics within AI and blockchain modules allows students to develop broader digital technology awareness. Understanding the relationship between AI, blockchain, and cryptocurrency enables learners to recognize how these technologies contribute to digital transformation and future innovation.

Effectiveness of Emerging Technology Learning Modules

The effectiveness of technology-based learning modules can be measured through improvements in knowledge, awareness, confidence, and technology acceptance. A well-designed module should provide meaningful learning experiences through interactive content, practical examples, and assessment activities.

Di Domenico et al. (2025) highlighted that the combination of AI and blockchain education supports interdisciplinary learning by connecting technological concepts with real-world applications. Similarly, Kumar et al. (2025) emphasized that AI and blockchain integration contributes to the development of future-oriented digital skills among learners.

Effective learning modules should also consider students' perceptions and acceptance of technology. Learning effectiveness is influenced by factors such as perceived usefulness, ease of learning, engagement, and relevance to future careers. These factors align with technology acceptance principles, where students are more likely to adopt new technologies when they recognize their value and usability.

Methodology

To evaluate the effectiveness of the programme, a pre-programme and post-programme assessment was conducted to measure participants' knowledge and understanding of three emerging digital technology topics: Artificial Intelligence (AI), Blockchain, and Cryptocurrency (Crypto). Participants completed a structured questionnaire before and after the programme using a five-point Likert scale, where higher scores indicate a greater level of knowledge and understanding.

The 105 students as participants from the secondary school in Kelantan, Malaysia, successfully attended this two-day digital technology programme and completed three modules covering different topics. This program was organized by a local university in Kelantan.

The results are presented in Figures 1–3, which compare the average scores obtained before and after the programme for each topic. The comparison provides an overview of the participants' learning progress and highlights the effectiveness of the programme in enhancing

their understanding of key concepts, practical applications, benefits, and challenges associated with these technologies.

Overall, the figures demonstrate the extent to which the programme contributed to improving participants' digital literacy and awareness of emerging technologies, which are increasingly important in supporting digital transformation, innovation, and the development of Industry 4.0 competencies.

Result and Discussion

This section is divided into three analysis topics of questions, which are awareness, knowledge, and use of AI, indicated by three subtopic which is: Artificial Intelligence (AI), Blockchain, and Crypto. The effectiveness of the programme was assessed by comparing participants' knowledge levels before and after attending the training sessions on AI, Blockchain, and Cryptocurrency (Crypto). A structured questionnaire consisting of multiple evaluation items was administered using a five-point Likert scale. The mean scores obtained from the pre-programme and post-programme assessments were analysed to determine the extent of learning improvement as depicted in Tables 1- 3.

Figures 1–3 present the comparison of average scores for each topic. An increase in the post-programme mean scores indicates improved knowledge and understanding among participants. The analysis provides evidence of the programme's effectiveness in enhancing participants' awareness of emerging digital technologies and their applications in the digital economy.

Table 1: Evaluation Analysis for Topic 1: Artificial Intelligence (AI)

No.	Questionnaire Item	Average Score (Before)	Average Score (After)
A1	I understand the basic concepts of Artificial Intelligence (AI).	2.46	4.41
A2	I know how AI is used in everyday life.	2.95	4.57
A3	I can explain the advantages and disadvantages of AI.	2.24	4.13
A4	I know that AI can enhance knowledge about the environment.	3.58	4.48
A5	I believe AI will have a significant impact on the future.	3.53	4.56
A6	I understand the concept of machine learning in AI.	2.04	4.40
A7	I am aware of the potential risks associated with irresponsible use of AI.	2.98	4.59
A8	I understand the role of data in training AI systems.	1.97	4.19
A9	I know how AI can be used to support learning.	2.75	4.74
A10	I know how to use AI applications (e.g., ChatGPT, Google Lens, AI Image Generator).	3.46	4.82

Table 1 demonstrates a consistent improvement across all ten evaluation items. The average post-programme scores ranged from 4.13 to 4.82, compared with 1.97 to 3.58 before the programme, indicating that participants' knowledge and understanding of AI concepts, applications, machine learning, data usage, and AI tools increased substantially following the intervention.

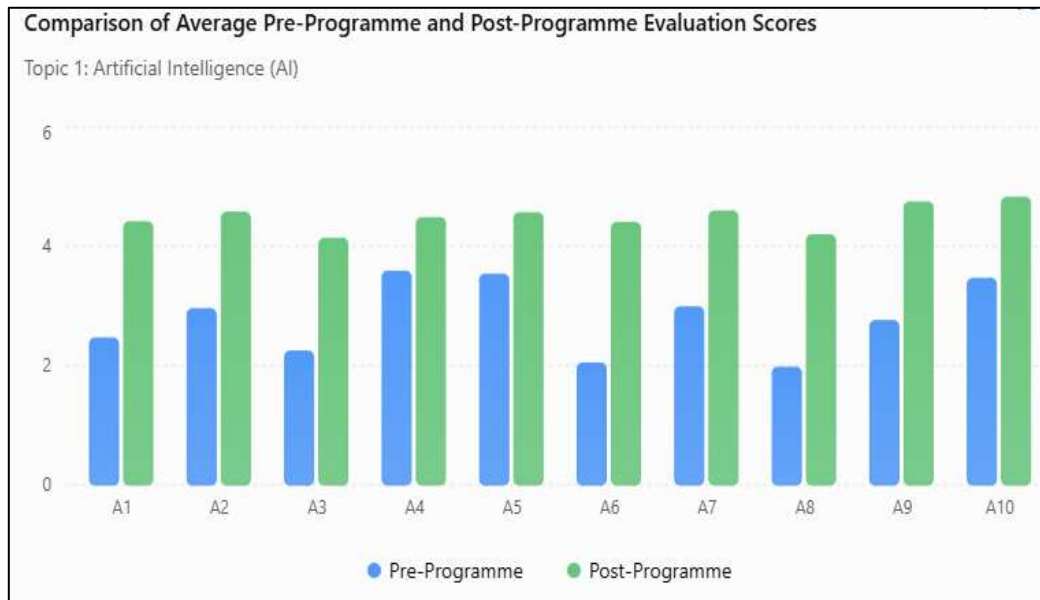


Figure 1: Comparison of the average scores obtained before and after the Artificial Intelligence (AI) programme.

The analysis reveals a significant improvement in participants' understanding of Artificial Intelligence (AI), as shown in Figure 1. Before the program, average ratings were in the low-to-moderate range (1.97 to 3.58), whereas post-program scores consistently rose to a high level, ranging from 4.13 to 4.82. The most notable gains were observed in the understanding of the role of data in training AI systems (rising from 1.97 to 4.19) and the comprehension of basic machine learning concepts within AI (rising from 2.04 to 4.40). Furthermore, participants demonstrated increased confidence in using basic AI applications such as ChatGPT and Google Lens, achieving the highest post-program average score of 4.82. Overall, participants not only gained a better understanding of AI concepts and applications but also developed a greater interest in and confidence regarding the role of AI in the future.

Table 2: Evaluation Analysis for Topic 2: Blockchain

No.	Questionnaire Item	Average Score (Before)	Average Score (After)
B11	I understand the basic concepts of blockchain technology.	1.67	4.42
B12	I know the applications of blockchain in various industries.	1.69	4.09
B13	I can explain the advantages of using blockchain technology.	1.69	4.10
B14	I am interested in learning more about blockchain.	2.86	4.52

No.	Questionnaire Item	Average Score (Before)	Average Score (After)
B15	I believe blockchain will bring positive changes to technology.	2.40	4.56
B17	I can explain the disadvantages of using blockchain technology.	1.71	3.85
B18	I know how blockchain technology can improve cybersecurity.	1.80	4.19
B19	I believe blockchain can enhance the security of data and transactions.	2.19	4.66

Table 2 shows a substantial improvement across all evaluation items after the programme. Participants demonstrated increased understanding of blockchain concepts, applications, cybersecurity, and data security. Post-programme average scores ranged from 3.85 to 4.66, compared with 1.67 to 2.86 before the programme, indicating that the programme effectively enhanced participants' knowledge and awareness of blockchain technology.

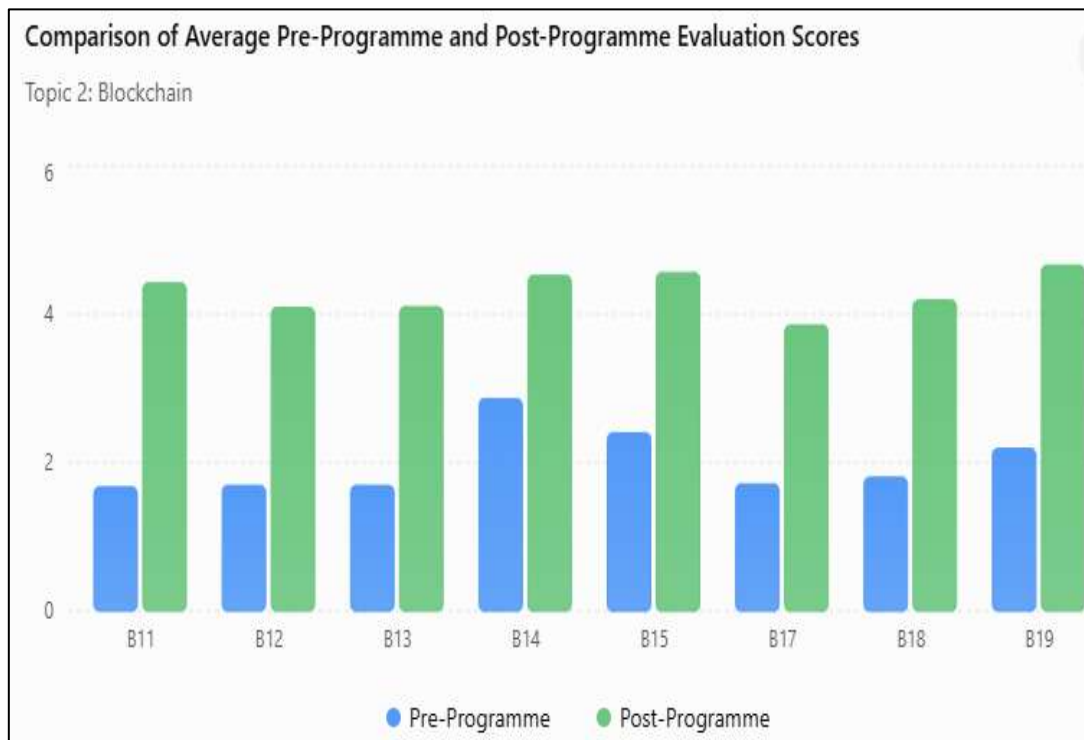


Figure 2: Comparison of the average pre-programme and post-programme evaluation scores for Topic 2: Blockchain.

Meanwhile, Figure 2 shows that the participants' knowledge of blockchain before the programme was very low, with average scores ranging from only 1.67 to 2.86. However, post-program assessments revealed a significant surge to between 3.85 and 4.66. The most substantial improvement was observed in the fundamental understanding of blockchain technology, rising from 1.67 before the program to 4.42 afterwards. Participants also gained confidence in blockchain's potential to enhance data and transaction security, achieving the highest score of 4.66 in this area. Although there remains some room for improvement

regarding the understanding of blockchain's limitations (3.85), most participants now have a clear grasp of the technology's applications, advantages, and its role in education and the future of digital technology.

Table 3: Evaluation Analysis for Topic 3: Cryptocurrency (Crypto)

No.	Questionnaire Item	Average Score (Before)	Average Score (After)
C20	I understand the purpose of cryptocurrency.	1.51	4.51
C21	I know examples of popular cryptocurrencies.	1.71	4.32
C22	I can explain the advantages of cryptocurrency.	1.49	4.16
C23	I can explain the disadvantages of cryptocurrency.	1.51	3.88
C24	I am interested in learning more about cryptocurrency.	2.80	4.56
C25	I believe cryptocurrency will play an important role in the digital economy.	2.27	4.54
C26	I understand how cryptocurrency can function as a digital payment system.	1.75	4.40
C20*	I understand the meaning of cryptocurrency.	1.51	4.51

Table 3 indicates a marked improvement in participants' understanding of cryptocurrency following the programme. Average post-programme scores increased across all assessment items, ranging from 3.88 to 4.56, compared with 1.49 to 2.80 before the programme. These findings suggest that the programme successfully enhanced participants' knowledge of cryptocurrency concepts, applications, benefits, limitations, and its role in digital financial systems.

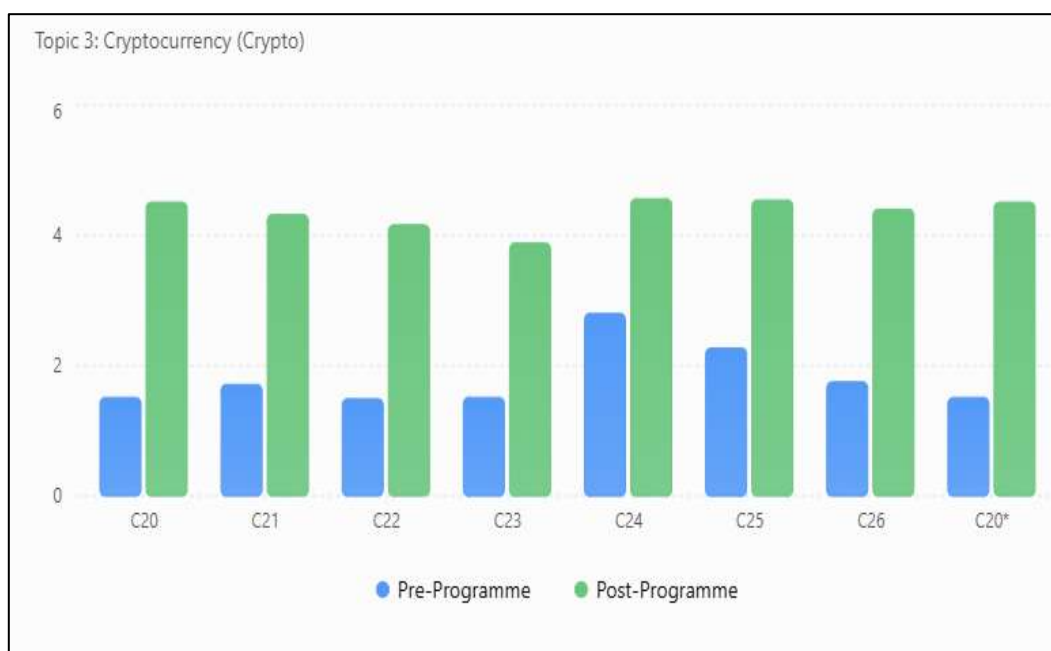


Figure 3: Comparison of the average pre-programme and post-programme evaluation scores for Topic 3: Cryptocurrency (Crypto).

Based on Figure 3, the findings indicate that, initially, participants' knowledge regarding cryptocurrency was the lowest compared to other topics, with average scores ranging from only 1.49 to 2.80. Following the program, all assessment scores improved significantly, reaching a range of 3.88 to 4.56. The most notable improvement was in the understanding of what cryptocurrency is, rising from 1.51 before the program to 4.51 after. Participant interest in learning more about cryptocurrency also increased substantially, from 2.80 to 4.56. Although knowledge regarding the downsides of cryptocurrency remained at a slightly lower level (3.88), overall, participants now have a better understanding of the fundamental concepts, advantages, and role of cryptocurrency in the digital economy.

Overall, the three figures demonstrate that the programme had a significant positive impact on participants' knowledge and understanding of the three emerging digital technology topics: Artificial Intelligence (AI), Blockchain, and Cryptocurrency (Crypto). In every topic, the average post-programme scores were substantially higher than the corresponding pre-programme scores, indicating that the programme effectively achieved its learning objectives. For Topic 1: Artificial Intelligence (AI) (Figure 1), participants showed considerable improvement across all ten evaluation items. Average pre-programme scores ranged from 1.97 to 3.58, while post-programme scores increased to between 4.13 and 4.82. The greatest improvement was observed in participants' understanding of AI applications, machine learning, and the use of AI tools such as ChatGPT and Google Lens, reflecting enhanced awareness and practical knowledge following the programme.

For Topic 2: Blockchain (Figure 2), participants also demonstrated marked improvement in their understanding of blockchain technology. Average scores increased from 1.67–2.86 before the programme to 3.85–4.66 after the programme. The highest post-programme score was recorded for participants' understanding of blockchain's role in enhancing data and transaction security, suggesting that the programme successfully increased awareness of blockchain applications in cybersecurity and digital systems.

Similarly, Topic 3: Cryptocurrency (Crypto) (Figure 3) showed substantial gains in participants' knowledge. Average pre-programme scores ranged from 1.49 to 2.80, while post-programme scores improved to between 3.88 and 4.56. Participants demonstrated greater understanding of cryptocurrency concepts, popular cryptocurrencies, digital payment systems, and the role of cryptocurrency in the digital economy after attending the programme.

Collectively, the findings indicate that the educational programme was highly effective in improving participants' understanding of emerging digital technologies. Across all three topics, the consistently high post-programme scores (above 4.0 for most items) suggest that the programme significantly enhanced participants' knowledge, awareness, and confidence in applying concepts related to Artificial Intelligence, Blockchain, and Cryptocurrency. These results provide strong evidence that the programme successfully met its educational objectives and contributed to improving participants' digital literacy and readiness for Industry 4.0 and the digital economy.

Conclusion

The rapid advancement of digital technologies has increased the demand for digital literacy, particularly in emerging fields such as Artificial Intelligence (AI), Blockchain, and Cryptocurrency. To enhance public awareness and understanding of these technologies, an educational programme was conducted to provide participants with fundamental knowledge,

practical applications, and the potential benefits and challenges associated with these digital innovations.

This study evaluates the effectiveness of the programme by comparing participants' knowledge before and after the training sessions. A quantitative research approach was employed using a structured pre-programme and post-programme questionnaire based on a five-point Likert scale. The questionnaire assessed participants' understanding of three programme modules: Artificial Intelligence (AI), Blockchain, and Cryptocurrency (Crypto).

The results indicate a substantial improvement in participants' knowledge across all three topics. For the AI module, the average post-programme scores increased from 1.97–3.58 to 4.13–4.82. Similarly, the Blockchain module showed an increase from 1.67–2.86 to 3.85–4.66, while the Cryptocurrency module improved from 1.49–2.80 to 3.88–4.56. These findings demonstrate that the programme effectively enhanced participants' understanding of emerging digital technologies and strengthened their digital literacy.

Overall, the programme successfully achieved its educational objectives and provides evidence that short-term technology awareness initiatives can significantly improve participants' readiness to engage with digital transformation and the evolving digital economy.

Acknowledgement

This study was financed by Universiti Teknologi MARA under grant number UiTM.800-3/2 GOV (033/2025). The authors would like to thank the management of Universiti Teknologi MARA, Cawangan Kelantan, and the Research Management Centre, Universiti Teknologi MARA, for their help. Also, the collaboration with the Kelantan State Council of Religion and Malay Custom (MAIK) and the State Education Department (JPN) will ensure the effectiveness of this program.

References

- Rohani M.M., & Yusoff, A. S. (2015). Tahap Kesiediaan Pelajar Dalam Penggunaan Teknologi, Pedagogi, Dan Kandungan (TPACK). *Proceedings of the 3rd International Conference on Artificial Intelligence and Computer Science*, Pulau Pinang.
- Al-Ragwi, N. A., & Zahary, A. T. (2026). A systematic review on the benefits, challenges, and applications of blockchain technology for e-learning. *Discover Computing*, 29, 379.
- Alwakid, W. N., Dahri, N. A., Humayun, M., & Alwakid, G. N. (2026). Examining adoption intention toward blockchain-enabled AI-based gamification in education: A trust–motivation–value perspective. *Frontiers in Computer Science*, 8.
- Crompton, H., & Burke, D. (2024). Artificial intelligence in higher education: A systematic review of applications, impacts, and future directions. *Computers & Education: Artificial Intelligence*.
- Di Domenico, M., Romano, F., Amendola, G., & Di Tore, P. A. (2025). Education, artificial intelligence and blockchain: A systematic review on the convergence of emerging technologies and learning processes. *Journal of Inclusive Methodology and Technology in Learning and Teaching*.
- Kim, J., Yang, G., Chan, W. S., Lin, X., Song, Y., & Li, N. (2026). Game-based learning for asynchronous AI literacy course: Approach to improve students' cognitive, behavioural, affective, and ethical learning of AI. *European Journal of Education*.
- Kwangmuang, P., Somabut, A., Duangngern, P., Changpetch, S., Dhithjaroen, C., Techapornpong, O., Sarakan, P., Chaijaroen, S., & Samat, C. (2025). Designing an AI-enhanced blockchain and FinTech curriculum for youth: A case study of educational and industrial collaboration. *Education and Information Technologies*.
- Li, L., Yu, F., & Zhang, E. (2024). A systematic review of learning task design for K–12 AI education: Trends, challenges, and opportunities. *Computers and Education: Artificial Intelligence*, 6, 100217.
- Luo, Z., Shao, X., & Ma, X. (2024). Enhancing learners' performance in contests through knowledge mapping algorithm: The roles of artificial intelligence and blockchain in scoring and data integrity. *Journal of Organizational and End User Computing*, 36(1), 1–21.
- Ng, D. T. K. (2024). Artificial intelligence literacy in higher education: Emerging competencies for digital citizens. *Computers and Education: Artificial Intelligence*.
- OECD. (2024). *OECD digital education outlook 2024: Artificial intelligence and the future of learning*. OECD Publishing.
- UNESCO. (2024). *Guidance for generative artificial intelligence in education and research*. UNESCO.
- van der Linde, G., Rodriguez-Montoya, C., & Garrido, L. E. (2025). Landscape of AI literacy in education: Approaches, impacts, and challenges for student preparedness—A narrative review. *Discover Education*, 4, 561.
- White, A., Akkapiin, S., & Darodjat, T. A. (2025). Exploring education students' awareness and knowledge of blockchain technology in education. *International Journal of Social Sciences and Business Research*, 1(3), 1–9.
- Kumar, R., Kumar, P., Sobin, C. C., & Subheesh, N. P. (Eds.). (2025). *Blockchain and AI in shaping the modern education system*. CRC Press.
- Tajuddin, N. I. I., Izni, N. A., Mohd Nor, N., Sudin, M. N., Mohd Anim, N. A. H., Rozi Nor Haizan, Md Noor, N., & Aziz, K. A. (2025). Systematic literature review on blockchain-based knowledge integration models for higher learning institutions. *Journal of Technology Management and Business*, 12(1), 46–58.