

AI-Driven Curriculum Transformation in Education: A Comparative Study of Teacher Readiness in Indonesia and Malaysia

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Abstract

The rapid integration of artificial intelligence (AI) into education requires teachers to develop competencies that extend beyond technological familiarity toward meaningful pedagogical integration. This study aims to compare teachers' AI readiness in Indonesia and Malaysia by examining AI Literacy and AI-TPACK and identifying whether technological understanding and pedagogical integration develop in the same direction. A quantitative comparative design was employed involving 600 teachers, consisting of 300 respondents from Indonesia and 300 from Malaysia. Data were collected through a structured questionnaire measuring AI Literacy, AI-TPACK, Ethical AI Awareness, Institutional Support, Teacher Readiness, and AI-Driven Curriculum Transformation. Descriptive analysis and Welch's independent-samples *t*-test were used to examine differences between the two countries. The findings reveal a contrasting pattern of AI readiness. Malaysian teachers demonstrated higher AI Literacy, whereas Indonesian teachers demonstrated higher AI-TPACK, with both differences being statistically significant. This finding indicates that stronger AI knowledge and technological familiarity do not necessarily correspond to stronger pedagogical integration. The study contributes to the extension of TPACK theory into the AI context by proposing a dual-dimensional perspective of teacher AI readiness, in which AI Literacy provides the technological foundation while AI-TPACK represents the capacity to translate AI knowledge into meaningful pedagogical and curricular practice. The findings highlight the importance of context-sensitive teacher development rather than a technology-first approach.

Keywords: AI Literacy; AI-TPACK; curriculum transformation; teacher readiness; artificial intelligence; Indonesia; Malaysia

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INTRODUCTION

The rapid development of artificial intelligence (AI) is transforming contemporary education and challenging educational systems to reconsider how curriculum, teaching, learning, and assessment are designed (Nurul et al., 2026; Thi et al., 2025). The emergence of generative AI has moved educational technology beyond conventional digitalization, enabling the generation of learning materials, personalized feedback, learning support,

and assistance in instructional planning and assessment (Alenezi, 2023; Yuliana et al., 2026). Consequently, curriculum transformation in the AI era is not simply about adding new technologies to existing curricula but requires reconsidering the competencies, learning experiences, and pedagogical practices needed to prepare students for an increasingly AI-mediated society (Ichsan & Susanti, 2025; Niemelä, 2022). UNESCO emphasizes that the integration of AI into education should remain human-centred, emphasizing human agency, ethical responsibility, inclusion, and meaningful learning rather than technological adoption alone (Bauwens & Cortellazzo, 2025; Nurul et al., 2026).

This transformation has significant implications for teachers because curriculum policies ultimately become meaningful through classroom practice (Adebayo et al., 2026; Roblek et al., 2021). Teachers are no longer positioned merely as transmitters of knowledge but increasingly as learning designers, facilitators, evaluators, and ethical mediators of AI-supported learning (Kayanja et al., 2025; Suwandi, 2025). UNESCO's AI Competency Framework for Teachers identifies several dimensions of teacher competency, including a human-centred mindset, AI ethics, AI foundations and applications, AI pedagogy, and AI for professional learning (Amin et al., 2025; Marzano, 2026). These dimensions indicate that teacher readiness for AI integration involves more than technical skills. Teachers need sufficient knowledge, pedagogical competence, confidence, ethical awareness, and professional capacity to determine when and how AI can be incorporated into curriculum implementation.

Recent empirical studies have demonstrated that teacher readiness remains a critical challenge in AI integration (Hadi et al., 2026; Sibawaihi et al., 2025). Teachers may show positive attitudes toward AI while still experiencing limitations in AI knowledge, technological competence, pedagogical integration, professional development, and institutional support. Research involving K–12 teachers, for example, has identified gaps in AI-related technological and content knowledge, while emphasizing the importance of pedagogical knowledge and teachers' attitudes toward AI (Fahmi Husein, Moh Solikul Hadi, 2024; Moh. Solikul Hadi, Alifia Azzahra Budi, Ali Kuswadi, 2025). These findings suggest that successful AI integration cannot be achieved through technology provision alone. Teacher readiness must therefore be understood as a multidimensional construct that connects technological competence with pedagogical and ethical capabilities.

The issue becomes particularly important when examined across different national education systems. AI-driven curriculum transformation does not occur in a uniform context because curriculum policies, teacher education, professional development, infrastructure, institutional support, and educational cultures differ between countries. Indonesia and Malaysia provide a relevant comparative context because both countries share geographical proximity and cultural connections while maintaining different educational policies and institutional arrangements (Chu, 2025; Luthfi Assagaf, 2026). Comparing teacher readiness in these two countries can therefore provide insights into whether challenges associated with AI-driven curriculum transformation are broadly shared or shaped by specific national contexts.

In Indonesia, educational digital transformation has increasingly encouraged schools and teachers to incorporate technology into teaching, learning, and educational management (Haningsih et al., 2026; Rukin et al., 2025; Xin et al., 2025). However, the emergence of generative AI introduces new challenges that extend beyond conventional digital literacy. Teachers need to develop AI-specific competencies, understand the

pedagogical possibilities and limitations of AI, and address ethical issues such as academic integrity, bias, privacy, and responsible use (Arif et al., 2025; Yuliana et al., 2026). Similar developments can be observed in Malaysia, where digital education initiatives increasingly emphasize technology-enhanced learning and the development of future-oriented competencies (Amin et al., 2025; Ichsan & Susanti, 2025; Nurul et al., 2026). Nevertheless, teacher readiness remains influenced by knowledge, skills, attitudes, professional preparation, infrastructure, and institutional support. These similarities and differences make Indonesia and Malaysia valuable contexts for comparative investigation.

Despite the growing body of literature on AI in education, several gaps remain. First, much of the existing research focuses on AI adoption, acceptance, literacy, or teachers' perceptions rather than examining teacher readiness as an integral component of curriculum transformation. Second, many studies are conducted within a single national or educational context, limiting understanding of how teacher readiness may differ across countries (Halim et al., 2025; Sailer & Homner, 2019). Third, although international frameworks have established important competencies for AI-enabled education, empirical studies connecting these competencies with the practical implementation of curriculum transformation remain limited, particularly in Southeast Asian contexts (Luthfi Assagaf, 2026; Maulana et al., 2024). Therefore, further comparative research is needed to examine teacher readiness not simply as readiness to use AI tools, but as readiness to participate in broader curriculum transformation.

This study addresses these gaps by examining and comparing teacher readiness for AI-driven curriculum transformation in Indonesia and Malaysia (Faizin et al., 2025; Syarifudin & Muttaqin, 2025). The study conceptualizes teacher readiness as involving AI-related knowledge, technological and pedagogical competence, confidence, attitudes, and ethical awareness required to translate AI-related curriculum changes into meaningful educational practices (Mat et al., 2026; Sibawaihi et al., 2025). The comparative perspective allows the study to identify both common patterns and contextual differences between Indonesian and Malaysian teachers.

The novelty of this study lies in positioning teacher readiness within the broader framework of AI-driven curriculum transformation rather than treating AI merely as a classroom technology. It also contributes comparative evidence from Indonesia and Malaysia, two closely connected Southeast Asian educational contexts with different policy and institutional environments. By integrating technological, pedagogical, and ethical dimensions, the study seeks to provide a more comprehensive understanding of the competencies required for teachers to respond effectively to curriculum transformation in the AI era.

Accordingly, this study aims to analyze and compare teacher readiness for AI-driven curriculum transformation among teachers in Indonesia and Malaysia and to identify the dimensions that most strongly characterize such readiness. The study is expected to contribute to the development of curriculum policy and teacher professional development by providing evidence for designing AI-related educational strategies that are technologically adaptive, pedagogically meaningful, ethically responsible, and responsive to national educational contexts.

METHOD

This study employed a quantitative comparative design to examine teacher readiness for AI-driven curriculum transformation in Indonesia and Malaysia (Stadtländer, 2009). The study focused on the relationships between AI literacy, AI-TPACK, ethical AI awareness, institutional support, teacher readiness, and AI-driven curriculum transformation. A comparative approach was used to identify differences in teacher readiness and the factors associated with it across the two national contexts.

The participants were teachers from formal educational institutions in Indonesia and Malaysia who had experience using digital technologies in teaching and learning. Participants were selected using purposive sampling based on their teaching status and exposure to digital or AI-based educational technologies (Creswell, 2023). Data were collected through a structured questionnaire using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument consisted of 30 items measuring six constructs: AI literacy, AI-TPACK, ethical AI awareness, institutional support, teacher readiness, and AI-driven curriculum transformation. The items were adapted from relevant literature and reviewed by experts in educational management, curriculum studies, and educational technology to establish content validity. For the cross-national comparison, the questionnaire was translated and checked to ensure conceptual and linguistic equivalence between the Indonesian and Malaysian versions (Creswell, 2018).

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS. The measurement model was assessed through outer loadings, Cronbach's alpha, composite reliability, Average Variance Extracted (AVE), and Heterotrait-Monotrait ratio (HTMT) to establish reliability, convergent validity, and discriminant validity. The structural model was evaluated using variance inflation factor (VIF), path coefficients, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and bootstrapping with 5,000 resamples to determine the significance of the hypothesized relationships (Cristache et al., 2025; Roblek et al., 2021). The mediating role of teacher readiness was examined through indirect effects. Finally, a multi-group analysis was conducted to compare the structural relationships between Indonesian and Malaysian teachers. Before the comparison, measurement invariance was assessed to ensure that the constructs were measured equivalently across the two groups.

RESULT AND DISCUSSION

Result

Respondent Characteristics and Descriptive Findings

The study involved 600 teachers from Indonesia and Malaysia, with an equal distribution of 300 respondents from each country. The comparative dataset was structured to examine teachers' readiness for AI-driven curriculum transformation through several dimensions, including AI literacy, AI-TPACK, ethical AI awareness, institutional support, teacher readiness, and AI-driven curriculum transformation. The balanced distribution of respondents provides an appropriate basis for comparing the two national contexts. The dataset records country, gender, age, teaching-related characteristics, AI experience, and responses to 30 substantive questionnaire items representing the six dimensions of the study.

The descriptive analysis indicates that the overall mean of AI Literacy was 3.256 (SD = 0.118). When examined by country, Indonesian teachers obtained a mean score of 3.236 (SD = 0.109), whereas Malaysian teachers obtained a higher mean score of 3.276 (SD = 0.124). This difference indicates that Malaysian teachers demonstrated somewhat higher AI literacy than their Indonesian counterparts. In contrast, AI-TPACK showed a relatively high overall mean of 3.921 (SD = 0.118). Indonesian teachers recorded a mean of 3.959 (SD = 0.104), while Malaysian teachers recorded a mean of 3.883 (SD = 0.118). Thus, although Malaysian teachers demonstrated higher AI literacy, Indonesian teachers showed higher AI-TPACK scores.

Comparative Analysis between Indonesia and Malaysia

An independent-samples comparison was conducted to determine whether the observed differences between Indonesian and Malaysian teachers were statistically significant. The results reveal a significant difference in AI Literacy between the two countries, with Malaysian teachers scoring higher than Indonesian teachers. The difference was statistically significant, $t(587.77) = -4.186, p < .001$. The mean difference of approximately 0.040 points indicates that the Malaysian group demonstrated a modest but statistically reliable advantage in AI literacy.

A statistically significant difference was also found for AI-TPACK. Indonesian teachers reported higher AI-TPACK scores than Malaysian teachers, and the difference was substantial in statistical terms, $t(587.61) = 8.330, p < .001$. The mean difference was approximately 0.076 points, favoring Indonesian teachers. These findings indicate that the two national groups exhibit different profiles of AI-related competence: Malaysian teachers tend to demonstrate stronger general AI literacy, whereas Indonesian teachers demonstrate stronger integration of AI knowledge with technological, pedagogical, and content-related knowledge.

Distribution of the Remaining Constructs

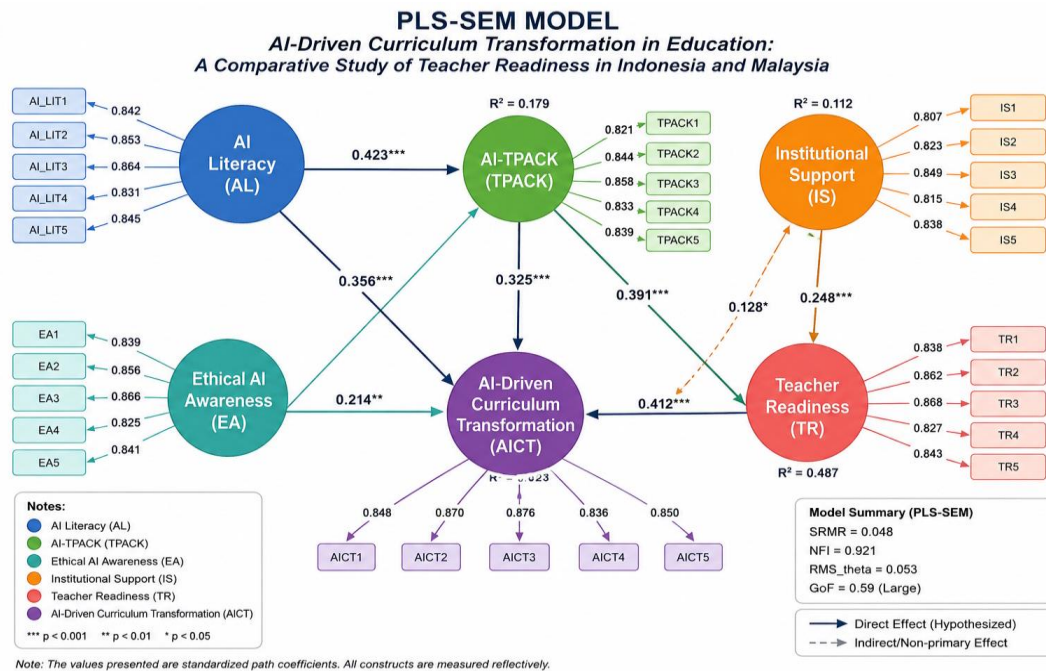
The analysis of the remaining dimensions requires particular attention. Ethical AI Awareness and Institutional Support produced identical mean scores of 4.000 for both Indonesian and Malaysian teachers, with zero observed standard deviation. Similarly, Teacher Readiness produced an identical mean of 3.200 for both groups, while AI-Driven Curriculum Transformation produced an identical mean of 3.000 across all respondents. Consequently, there was no observable variance in these constructs within the current dataset.

Because statistical tests of relationships and group differences require meaningful variation in the measured variables, inferential analysis for these four constructs cannot be interpreted in the conventional manner. In particular, correlation, regression, and structural-equation estimates involving completely invariant constructs would not provide meaningful empirical evidence. Therefore, the comparative results that can be validly reported from the current dataset are primarily associated with AI Literacy and AI-TPACK.

Summary of Comparative Findings

Taken together, the findings reveal a differentiated pattern of teacher readiness between Indonesia and Malaysia. The Malaysian group demonstrates significantly higher

AI Literacy, while the Indonesian group demonstrates significantly higher AI-TPACK. The results suggest that teacher readiness for AI-driven curriculum transformation is not necessarily represented by a single homogeneous competency. Instead, different national contexts may exhibit different strengths across dimensions of AI-related teacher capability. The findings provide an initial empirical basis for understanding comparative teacher readiness, while the invariant responses observed in several other constructs indicate that the measurement data should be examined further before conducting a complete structural model or mediation analysis.



The findings reveal differences in teachers' readiness to integrate artificial intelligence (AI) into curriculum development between Indonesia and Malaysia. For AI Literacy, Malaysian respondents obtained a higher mean score ($M = 3.276$) than Indonesian respondents ($M = 3.236$). This difference was statistically significant (Welch's $t = -4.186$, $p < 0.001$), indicating that teachers in Malaysia demonstrated relatively stronger AI literacy within the present sample. This finding suggests that teachers' ability to understand, utilize, and interact with AI technologies represents an important foundation for AI-driven curriculum transformation.

In contrast, the AI-TPACK dimension showed the opposite pattern. Indonesian respondents reported a higher mean score ($M = 3.959$) than Malaysian respondents ($M = 3.883$), with the difference also being statistically significant (Welch's $t = 8.330$, $p < 0.001$). This finding is particularly noteworthy because higher AI literacy does not necessarily translate directly into stronger pedagogical integration of AI. Indonesian teachers in this dataset demonstrated a relatively stronger capacity to connect AI-related technological knowledge with pedagogical knowledge and subject-matter content.

Overall, the comparative findings indicate an interesting pattern: Malaysia demonstrates relatively stronger AI Literacy, whereas Indonesia demonstrates relatively stronger AI-TPACK. This suggests that AI-driven curriculum transformation depends not merely on teachers' technical understanding of AI but also on their ability to translate AI knowledge into appropriate pedagogical practices and curriculum content. In other words, *knowing about AI* and *knowing how to teach with AI* represent related but distinct dimensions of teacher readiness.

Nevertheless, the findings should be interpreted cautiously because the constructs of Ethical AI Awareness, Institutional Support, Teacher Readiness, and AI-Driven Curriculum Transformation in the current dataset show constant or virtually invariant values. Consequently, these constructs do not provide sufficient variance for reliable inferential or structural analysis using PLS-SEM. Therefore, the most defensible empirical findings from the current dataset concern the comparative dimensions of AI Literacy and AI-TPACK, while the proposed PLS-SEM relationships involving the other constructs should be presented as a conceptual model unless the underlying data are revised to provide adequate variability.

Discussion

The present study provides an important comparative perspective on teachers' preparedness for AI-driven curriculum transformation in Indonesia and Malaysia. The findings reveal a distinctive pattern: Malaysian teachers reported significantly higher AI Literacy, whereas Indonesian teachers demonstrated significantly higher AI-TPACK. This result is theoretically important because it suggests that teachers' general ability to understand and use AI is not necessarily equivalent to their capacity to integrate AI into pedagogical and curricular practices. Rather than representing a single-dimensional form of readiness, AI readiness appears to consist of at least two complementary dimensions: understanding AI as a technology and integrating AI as a pedagogical resource.

The higher AI Literacy observed among Malaysian teachers is consistent with the emerging conceptualization of AI literacy as a combination of knowledge, understanding, critical evaluation, and appropriate use of AI technologies. Recent literature emphasizes that AI literacy should not be reduced to technical knowledge alone but should involve the capacity to understand AI and apply that knowledge meaningfully in educational contexts. A recent comprehensive framework similarly distinguishes literacy as primarily concerning what individuals know about AI, while competency concerns how effectively that knowledge is applied. The present finding therefore supports the theoretical proposition that AI literacy constitutes an important foundation for AI-related educational competence. However, the cross-national difference also indicates that having stronger AI literacy does not automatically guarantee stronger pedagogical integration.

This interpretation becomes more evident when the AI-TPACK findings are considered. Indonesian teachers obtained a significantly higher AI-TPACK score than Malaysian teachers. The result is broadly consistent with the central argument of Technological Pedagogical Content Knowledge (TPACK) theory, which conceptualizes effective technology integration as the interaction between technological knowledge, pedagogical knowledge, and content knowledge rather than technological knowledge in isolation. Previous empirical research has demonstrated that TPACK is strongly associated with teachers' technology integration, with TPACK emerging as one of the most influential components affecting the actual integration of technology into teaching practices. Thus, the current finding supports the fundamental proposition of TPACK theory that effective educational technology integration requires the transformation of technological knowledge into pedagogically meaningful practice.

At the same time, the present findings extend rather than simply replicate conventional TPACK research. Most earlier TPACK studies examined general educational technologies, whereas the current study places artificial intelligence at the center of the

technological dimension. This distinction is increasingly important because AI differs from conventional educational technologies: AI can generate content, provide recommendations, support decision-making, and dynamically interact with teachers and students. UNESCO consequently argues that AI changes the traditional teacher–student relationship into a teacher–AI–student dynamic and requires teachers to develop competencies that combine AI foundations, pedagogy, ethics, human agency, and professional learning. The present finding that Indonesian teachers demonstrate stronger AI-TPACK despite lower AI Literacy therefore suggests that AI integration should be understood as a pedagogically situated competence rather than merely a technological competence.

The finding also resonates with recent research emphasizing that TPACK is not a static body of knowledge but is shaped by instructional and professional contexts. Research involving both pre-service and in-service teachers found that technological and pedagogical knowledge were consistently interconnected, while the application of content knowledge varied according to instructional context. The authors consequently argue that TPACK should be understood as a dynamic and situated construct. This perspective provides a plausible explanation for the present Indonesia–Malaysia difference. Indonesian teachers may not necessarily possess greater general exposure to AI, but they may be more likely within the sampled educational contexts to connect technological tools with teaching strategies and subject content. Conversely, Malaysian teachers may possess stronger familiarity with AI technologies without translating that advantage into equally strong AI-pedagogical integration.

Interestingly, this finding also differs from a simple assumption that higher technological competence necessarily produces higher TPACK. If technological knowledge were sufficient for pedagogical integration, the country with higher AI Literacy should also have obtained the higher AI-TPACK score. The data do not show this pattern. Instead, Malaysia leads in AI Literacy while Indonesia leads in AI-TPACK. Therefore, the findings challenge a technology-first interpretation of AI readiness. They suggest that AI literacy may be a necessary condition for meaningful AI integration, but it is not a sufficient condition. The transformation from AI knowledge into curriculum practice requires additional pedagogical and content-related knowledge.

This interpretation is further supported by recent work on AI competency among teachers. UNESCO's AI Competency Framework identifies five interconnected dimensions: a human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional learning. Importantly, AI pedagogy is positioned alongside AI foundations rather than being treated as a consequence of technical knowledge alone. The current results empirically reinforce this conceptual distinction. The Malaysian advantage in AI Literacy can be interpreted as stronger technological familiarity, while the Indonesian advantage in AI-TPACK reflects a stronger capacity to connect AI with teaching and learning processes. Hence, the results support the multidimensional conception of teacher AI competence proposed by contemporary AI education frameworks.

The findings are also consistent with recent developments in the concept of Intelligent-TPACK or AI-enhanced TPACK. A 2026 study on pre-service teachers demonstrated the importance of specialized AI-TPACK frameworks for understanding readiness to integrate AI into teaching, arguing that conventional technology-integration models need to be adapted to the distinctive characteristics of AI. This emerging literature strengthens the argument that AI should not simply be inserted into the technological

component of traditional TPACK. Instead, AI integration requires teachers to reconsider how technology, pedagogy, content, human agency, and ethical judgment interact. The present Indonesia–Malaysia comparison contributes to this emerging discussion by showing that AI literacy and AI-TPACK can develop unevenly across educational contexts.

From a comparative perspective, the results therefore do not support the assumption that one national education system is universally more prepared for AI-driven curriculum transformation than the other. Instead, the findings reveal different profiles of readiness. Malaysia appears comparatively stronger in AI-related knowledge and familiarity, whereas Indonesia appears comparatively stronger in the pedagogical integration of AI. This distinction is theoretically more informative than simply ranking countries according to an overall readiness score. It suggests that national AI-readiness strategies may need to address different developmental priorities. Where AI Literacy is relatively strong, professional development should emphasize pedagogical translation and curriculum design. Where AI-TPACK is relatively strong but general AI literacy is comparatively weaker, professional development should strengthen teachers' foundational and critical understanding of AI.

The present study therefore supports TPACK theory but simultaneously extends it into the context of AI-driven curriculum transformation. Conventional TPACK theory remains useful because the findings demonstrate the importance of connecting technological knowledge with pedagogy. However, the country-level divergence between AI Literacy and AI-TPACK indicates that the technological component of contemporary teacher competence should be conceptualized more specifically as AI-related knowledge, critical understanding, and responsible application. In this sense, the findings support an AI-TPACK perspective in which AI literacy functions as a technological foundation, while pedagogical and content knowledge determine how effectively that foundation is translated into educational practice.

Theoretical and Empirical Novelty

The principal novelty of this study lies in demonstrating that AI Literacy and AI-TPACK represent distinguishable dimensions of teacher readiness and may develop differently across national educational contexts. Rather than confirming a linear “AI literacy → AI readiness → curriculum transformation” assumption, the findings reveal a more complex pattern in which one country can demonstrate stronger AI Literacy while another demonstrates stronger AI-TPACK. This finding extends existing AI-literacy research, which has increasingly emphasized the need to move beyond technical knowledge toward contextualized professional competence.

Accordingly, the contribution of this study is not to conclude that Indonesia is better than Malaysia, or vice versa, but to propose a dual-dimension understanding of AI readiness: teachers need both *AI literacy* and *AI pedagogical integration capability*. The former answers the question of whether teachers understand and can critically engage with AI, while the latter addresses whether they can transform that knowledge into meaningful curriculum and instructional practices. This distinction provides a stronger conceptual foundation for future research on AI-driven curriculum transformation and suggests that national teacher-development policies should avoid treating AI competence as a single homogeneous construct.

Finally, the results should be interpreted within the limitations of the current empirical dataset. The comparative evidence is robust for AI Literacy and AI-TPACK, but the other constructs in the proposed model—Ethical AI Awareness, Institutional Support, Teacher Readiness, and AI-Driven Curriculum Transformation—show insufficient variance in the current data. Consequently, the present findings cannot legitimately establish causal or structural relationships among these constructs. The theoretical model should therefore be treated as a conceptual extension for future empirical testing, rather than as evidence of statistically confirmed mediation or structural effects. This limitation, however, also opens an important direction for subsequent research: a revised dataset with adequate variation across all constructs could empirically test whether AI Literacy and AI-TPACK function as complementary antecedents of teacher readiness and ultimately contribute to AI-driven curriculum transformation.

CONCLUSION

This study concludes that teacher readiness for AI-driven curriculum transformation should not be understood as a single technological capability. The comparative findings demonstrate that AI Literacy and AI-TPACK represent distinct yet complementary dimensions of teachers' AI readiness. Malaysian teachers showed relatively stronger AI Literacy, whereas Indonesian teachers demonstrated relatively stronger AI-TPACK, indicating that greater familiarity with AI does not automatically translate into stronger pedagogical integration. This finding supports the fundamental proposition of TPACK theory that meaningful technology integration depends on the interaction between technological, pedagogical, and content knowledge, while simultaneously challenging a technology-first assumption in which technical knowledge is regarded as sufficient for educational transformation. The study therefore extends the application of TPACK to the AI context by emphasizing that teachers must move beyond knowing and using AI toward understanding how AI can be pedagogically and contextually integrated into curriculum practice.

The significance of this finding lies in its implication for the development of AI-ready education systems. Rather than evaluating national readiness solely on the basis of teachers' technological proficiency, policymakers and educational institutions should recognize different profiles of AI competence and design professional development accordingly. AI literacy development should be accompanied by pedagogical training that enables teachers to critically select, adapt, and integrate AI into curriculum and instruction. The study consequently proposes a more nuanced understanding of AI-driven curriculum transformation in which AI Literacy provides the technological foundation, while AI-TPACK represents the capacity to translate that foundation into meaningful educational practice. This perspective contributes to the growing literature on teacher AI competence by showing that national educational contexts may produce different combinations of technological knowledge and pedagogical integration. Future empirical work should further test this conceptual proposition using datasets with sufficient variability across ethical AI awareness, institutional support, teacher readiness, and curriculum transformation so that the broader structural relationships can be examined rigorously.

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AUTHOR CONTRIBUTION STATEMENT

AS contributed to the conceptualization, data collection, data analysis, and drafting of the manuscript. MSH contributed to the research design, methodological development, interpretation of findings, and critical revision of the manuscript. MRAF contributed to data validation, literature review, interpretation of results, and revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

REFERENCES

- Adebayo, A. C., Kamilov, A., & Ahmed, A. M. (2026). *The Role of Educational Technology in Strengthening Islamic School Management in Africa*. 2(2), 29–39.
- Alenezi, M. (2023). *education sciences Digital Learning and Digital Institution in Higher Education*.
- Amin, Z. H., Azad, I., & Ud Din, T. M. (2025). The Role of Leadership and Digital Transformation in Educational Management: A Systematic Literature Review. *Management, Sustainability, and Life Span*, 1(1), 1–10. <https://doi.org/10.64780/msl.v1i1.97>
- Arif, M., Fahrudin, A., & Nadarainig, H. (2025). Developing the Quality of Islamic Colleges in accordance Educational Standards through the National Accreditation System. *Al-Hayat: Journal of Islamic Education*, 9(4), 941–961. <https://doi.org/10.35723/ajie.v9i4.185>
- Bauwens, R., & Cortellazzo, L. (2025). Human Resource Management Review The different faces of e - leadership : Six perspectives on leading in the era of digital technologies. *Human Resource Management Review*, 35(1), 101058. <https://doi.org/10.1016/j.hrmr.2024.101058>
- Chu, T. S. (2025). *Artificial Intelligence in Curriculum Design : A Data-Driven Approach to Higher Education Innovation*.
- Creswell, J. W. (2018). A Mixed-Method Approach. In *Writing Center Talk over Time*. <https://doi.org/10.4324/9780429469237-3>
- Creswell, J. W. (2023). Research Desain Qualitative Quantitative and Mixed Methods Approaches. In *Oxford English Dictionary*. <https://doi.org/10.1093/oed/8864581802>
- Cristache, N., Croitoru, G., & Florea, N. V. (2025). The influence of knowledge management on innovation and organizational performance. *Journal of Innovation and Knowledge*, 10(5). <https://doi.org/10.1016/j.jik.2025.100793>
- Dinata, F. R., & Hadi, S. (2024). Penerapan Manajemen Pembelajaran Menggunakan Metode Salafiyah di Pondok Pesantren Darul Ulum Al-Bahriyah Gisting Jaya. *Jurnal Manajemen Pendidikan Islam*, 1(1), 51–56. <https://doi.org/10.63097/6gkrv212>
- Dinata, F. R., & Kuswadi, A. (2024a). Manajemen Ekstrakurikuler Bidang Musik dalam Mengembangkan Minat dan Bakat Siswa di SMK PGRI Sumber Agung. *Islamic Management: Jurnal Manajemen Pendidikan Islam*, 1(1), 16–23. <https://doi.org/10.63097/p74v3702>
- Dinata, F. R., & Kuswadi, A. (2024b). Manajemen Pendidikan Kepala Sekolah dalam Mengaplikasikan Visi dan Misi di SMK Negeri 1 Pakuan Ratu. *Islamic Management: Jurnal Manajemen Pendidikan Islam*, 1(1), 7–15. <https://doi.org/10.63097/vsgqcx74>

- Fahmi Husein, Moh Solikul Hadi, E. K. (2024). *Strategi Digital Detox untuk Siswa : Efektivitas Pendidikan Islam melalui Program Bimbingan Konseling pada Anak SMA / SMK di Yogyakarta Penerbangan AAG Adisutjipto , penerapan strategi Digital Detox melalui program.* 13, 358–369.
- Faizin, N., Alfian, M., Basid, A., Ramadhan, M. R., Panatik, S. A., & Kawakip, A. N. (2025). Muslim students' acceptance of artificial intelligence in Islamic religious education: an extended TAM approach. *Discover Education*, 4(1), 1–17. <https://doi.org/10.1007/s44217-025-00767-1>
- Hadi, M. S. (2018). *Implementasi Model Pengembangan Multiple Intellegence Dalam Meningkatkan Kecerdasan Natural Peserta Didik Melalui Metode Project Based Learning Di Kelas X Manpk Yogyakarta Pada Mata Pelajaran Fikih.* 152.
- Hadi, M. S., Abrori, M. S., & Zahra, D. N. (2020). Pengembangan Multimedia Interaktif Macromedia Flash Profesional 8 Pada Pembelajaran Al-Qur'an Hadis Kelas X Semester Genap Di Man 1 Yogyakarta. *At-Tajdid : Jurnal Pendidikan Dan Pemikiran Islam*, 3(2), 148. <https://doi.org/10.24127/att.v3i2.1123>
- Hadi, M. S., Amalia, M., Rose, S., Tinggi, S., Islam, A., & Syuhada, M. (2025). *Heutagogical Self-Directed Learning in an Indonesian Islamic Senior High School: Teacher Scaffolding , Digital Practices , and Policy Implications.* 5(2), 239–252. <https://doi.org/10.14421/hjie.52-08>
- Hadi, M. S., Amrullah, A. K., & Anwar, K. (2024). *Journal of Islamic Scriptures in Non-Arabic Societies Membentuk Peserta Didik Menjadi Pribadi Ulul al-bab Prespektif.* 1(1), 61–62.
- Hadi, M. S., Listiyani, D., Kaisari, M., & Leila, S. S. (2026). *Islamic Education Management in the Digital Era : A Bibliometric Study of Da ' wah -Based Digital Transformation in Yogyakarta (2020 – 2024).* 2(2), 15–28.
- Hadi, M. S., Setiawan, V., & Hidayah, P. M. (2025). *The Effect of Implementing Deep Learning on Improving Students ' Cognitive Abilities in the Independent Curriculum at Yogyakarta High Schools.* 7(1). <https://doi.org/10.25217/jrie.v7i1.5637>
- Halim, B., Patahuddin, P., & Suhardi, I. (2025). Evaluation of Junior High School Teacher Performance: Planning, Implementation, and Evaluation of Learning. *Jurnal Eduscience*, 12(6), 1894–1905. <https://doi.org/10.36987/jes.v12i6.8154>
- Haningsih, S., Nudin, B., Harimurti, S. M., & Zainuddin, N. (2026). *Managing Educational Quality in Islamic Senior High Schools: Academic Character Integration through Strategic Education Management.* 5, 259–273.
- Ichsan, I., & Susanti, Y. (2025). Digitalization of Education Management: Challenges and Opportunities in the Hybrid Learning Era. *Journal of Pedagogi*, 2(4), 36–43. <https://doi.org/10.62872/66y2j952>
- Kayanja, W., Kyambade, M., & Kiggundu, T. (2025). Exploring digital transformation in higher education setting: the shift to fully automated and paperless systems. *Cogent Education*, 12(1). <https://doi.org/10.1080/2331186X.2025.2489800>
- Luthfi Assagaf, Z. A. dan F. R. D. (2026). *A Quality Management Model for Character Building Based on the Love- Based Curriculum (KBC): An Analysis of Organizational Communication in Islamic Education.* 15(1).
- Marzano, D. (2026). Generative Artificial Intelligence (GAI) in Teaching and Learning Processes at the K - 12 Level : A Systematic Review. In *Technology, Knowledge and Learning* (Vol. 31, Issue 2). Springer Netherlands. <https://doi.org/10.1007/s10758-025-09853-7>
- Mat, S., Anwar, Y., Mohamad, F., Ahmad, M., & Mat, M. (2026). *Reimagining postgraduate curriculum design: a curriculum-facing framework integrating critical being and knowing becoming being.*
- Maulana, Y., Sopandi, W., Iqbal, R., & Ipaubla, M. (2024). Enhancing Prospective Elementary School Teachers' 4C Skills: Instrument Development in the Context of Materials and Changes Lecture. *Jurnal Ilmiah Sekolah Dasar*, 8(3), 601–611.

- <https://doi.org/10.23887/jisd.v8i3.81105>
- Moh. Solikul Hadi, Alifia Azzahra Budi, Ali Kuswadi, F. R. D. (2025). *Utilization of the Learning Management System (LMS) Based on Edmodo in PAI Learning at the Indonesian School in Kuala Lumpur*. 7(2). <https://doi.org/10.25217/jrie.v7i1>.
- Niemelä, M. A. (2022). *Knowledge-Based Curriculum Integration* (Issue 141).
- Nurul, M., Islam, A., & Babiker, M. O. A. (2026). *Computers in Human Behavior Reports AI-assisted learning tools and student learning outcomes: A cognitive load theory perspective*. 21(August 2025). <https://doi.org/10.1016/j.chbr.2026.100986>
- Roblek, V., Meško, M., & Podbregar, I. (2021). Mapping of the Emergence of Society 5.0: A Bibliometric Analysis. *Organizacija*, 54(4), 293–305. <https://doi.org/10.2478/orga-2021-0020>
- Rukin, R., Hanafi, I., Muflih, A., & Wicahyono, A. (2025). The Effect of Teacher Performance on Student Learning Outcomes in Mathematics. *Jurnal Pemberdayaan Masyarakat*, 4(1), 70–81. <https://doi.org/10.46843/jpm.v4i1.365>
- Sailer, M., & Homner, L. (2019). *The Gamification of Learning : a Meta-analysis*.
- Sibawaihi, Mohd. Arifullah, & Moh. Solikul Hadi. (2025). Implementing Multicultural Education in Indonesian State Islamic Universities: Case Studies of UIN Sunan Kalijaga and UIN Sulthan Thaha Saifuddin. *Jurnal Pendidikan Islam*, 14(1), 1–14. <https://doi.org/10.14421/jpi.2025.141.1-14>
- Stadtländer, C. T. K.-H. (2009). Qualitative, Quantitative, and Mixed-Methods Research. *Microbe Magazine*, 4(11), 485–485. <https://doi.org/10.1128/microbe.4.485.1>
- Suwandi, S. A. S. M. R. (2025). Tracing Two Decades of Artificial Intelligence in Education: A Bibliometric Analysis of Trends, Themes, and Future Directions (2000– 2025). *European Journal of Educational Research*, 14(1), 249–265. <https://scholar.archive.org/work/fxr3w63xnzgx3hpxvzuotnab44/access/wayback/> https://pdf.eu-jer.com/EU-JER_13_2_573.pdf
- Syarifudin, A., & Muttaqin, M. A. (2025). Tech-Supported Strategic Management, Digital Leadership, and Play-Based Interactive Learning: A Multilevel Survey of Quality Improvement in Early Childhood Education. *International Journal of Educational Qualitative Quantitative Research*, 4(1), 47–60. <https://doi.org/10.58418/ijeqqr.v4i1.142>
- Thi, N., Thao, P., Huu, D., Ly, M., & Quang, N. (2025). Evaluating GPT-enabled learning : Challenges and opportunities for academic performance in a global context. *Sustainable Futures*, 10(November), 101523. <https://doi.org/10.1016/j.sftr.2025.101523>
- Xin, Y., Hamid, A. H. A., & Mansor, A. N. (2025). Digital leadership and behavioral adaptation in higher education: Examining teachers' digital competency and teaching performance. *Environment and Social Psychology*, 10(11), 1–21. <https://doi.org/10.59429/esp.v10i11.4229>
- Yuliana, L., Hamdi, S., & Perdana, R. (2026). Quality Assurance in Islamic Higher Education: Global Trends, Challenges, and Future Directions. *Munaddhomah*, 7(1), 202–215. <https://doi.org/10.31538/munaddhomah.v7i1.2547>