Artificial Intelligence in Primary Education: Teacher Perceptions, Instructional Decisions, and Integration Challenges in Urban Malaysia

Thivyasiny Saravanan, Nurul Aisyah Kamrozzaman*

Faculty of Education and Humanities, UNITAR International University, Petaling Jaya, Malaysia

***Corresponding Author**

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ABSTRACT

While Artificial Intelligence (AI) is recognized globally for its potential to transform education, empirical research on its adoption in primary schools within developing nations like Malaysia remains scarce. This study investigates the impact of AI on teaching effectiveness and instructional decision-making among primary school teachers in urban Malaysia, addressing this critical gap. Employing a mixed-methods approach, quantitative and qualitative data were collected via an online survey comprising Likert-scale and open-ended questions from 60 teachers in Klang district. The findings reveal strongly positive teacher perceptions, with a overwhelming majority (96.7%) reporting the use of AI tools. Participants recognized AI's significant utility, particularly in understanding students' learning needs (M=1.97), enhancing teaching quality, and enabling data-driven decisions. However, the study identifies a critical implementation gap, highlighting key challenges such as insufficient professional training, inadequate institutional support, and persistent technical infrastructure limitations. These findings underscore a disparity between AI's perceived potential and its practical application. The study advocates for a coordinated strategy focusing on TPACK-based professional development, robust infrastructure, and supportive policy to bridge this implementation gap. By addressing the lived experiences of educators, this research provides valuable evidence-based insights for teachers, school leaders, and policymakers to design effective and sustainable AI integration strategies in the Malaysian context.

Keywords: Artificial Intelligence (AI), Teaching Effectiveness, Instructional Decision-Making, Primary Education, Teacher Perceptions, Malaysia, Technology Integration, Mixed-Methods Research.

INTRODUCTION

The integration of Artificial Intelligence into education is a defining trend of the 21st century, promising to reshape traditional pedagogical approaches (Anghel et al., 2025; Naseer et al., 2024). Globally, AI is being leveraged to create adaptive learning systems that personalize education, automate administrative tasks, and provide data-driven insights into student performance (Akintayo et al., 2024; Sari et al., 2024; Striełkowski et al., 2024; Yekollu et al., 2024). For instance, China utilizes large-scale adaptive learning platforms for real-time student monitoring, while Finland employs AI for tailored feedback and individualized exercises. In the United States, tools like IBM's Watson assist teachers with lesson planning and formative assessment, freeing up time for student interaction. These international initiatives underscore AI's potential to enhance teaching effectiveness and support instructional decision-making (Akintayo et al., 2024; Karakus et al., 2025; Tammets & Ley, 2023; Zhao et al., 2025), aligning with the United Nations Sustainable Development Goal 4 of ensuring inclusive and equitable quality education.

However, the integration of AI in primary education presents a complex set of challenges alongside its opportunities (Akintayo et al., 2024). At this foundational level, education is not merely knowledge transfer but

also crucial for fostering social-emotional growth and cognitive development (Akintayo et al., 2024; Berson et al., 2025). A primary concern is that an over-reliance on AI could lead to a narrow focus on quantifiable outcomes at the expense of the humanistic, relational aspects of teaching (Nadim & Fuccio, 2025; Ruano-Borbalan, 2025). Furthermore, successful implementation is contingent upon conditions often absent in many contexts, including adequate teacher digital competence, robust school infrastructure, and appropriate pedagogical training for integrating these tools effectively (Aljemely, 2024; Ng et al., 2023; Pisica et al., 2023).

The Malaysian context exemplifies this tension between policy ambition and on-the-ground reality. The Malaysia Digital Education Policy (2021-2030) explicitly champions AI integration as a cornerstone of the nation's educational digitalization, aiming to enhance infrastructure, teacher capacity, and digital pedagogy (Goh et al., 2025; Lowa, 2024). Despite this top-down strategic vision, practical adoption at the primary school level remains nascent and uneven (Amdan et al., 2024; Er & Chongo, 2025; Heeg & Avraamidou, 2024). A significant research gap exists; while studies have explored AI in higher education or within Western contexts, there is a scarcity of empirical research focusing on AI's impact on teaching effectiveness and instructional decision-making in primary schools within developing nations like Malaysia (Amdan et al., 2024; Er & Chongo, 2025; Heeg & Avraamidou, 2024). Existing research indicates that while awareness of AI's potential is growing, many primary school teachers lack hands-on experience and feel inadequately trained to integrate AI tools meaningfully into their practice (Amdan et al., 2024; Er & Chongo, 2025). This is compounded by a significant digital divide, where urban schools may have better access to technology and connectivity compared to their semi-urban and rural counterparts, risking the exacerbation of educational inequalities (Amdan et al., 2024; Lowa, 2024).

Crucially, the teacher's voice their perceptions, lived experiences, and the contextual challenges they face is often missing from this discourse (Ayanwale et al., 2022; Bakhadirov et al., 2024). Moreover, little attention has been paid to how AI specifically influences the core professional practice of instructional decision-making, which includes lesson planning, content choice, and adapting teaching strategies (Tammets & Ley, 2023). Understanding these elements is vital for designing sustainable, effective, and equitable implementation strategies that avoid top-down mandates disconnected from classroom realities (FİLİZ et al., 2025; Lin & Brummelen, 2021; Shi et al., 2024).

To address this gap, this study investigates the realities of AI integration in urban Malaysian primary schools. Using the district of Klang as a representative case study, this research moves beyond theoretical potential to capture the actual experiences of educators. Therefore, this study is guided by the following research objectives:

1. To investigate primary school teachers' perceptions of AI tools in enhancing teaching effectiveness.
2. To examine the influence of AI on instructional decision-making and its relationship with classroom teaching practices among primary school educators.
3. To identify the challenges and advantages experienced by teachers when integrating AI in the classroom.

By answering these questions, this research aims to provide evidence-based insights that can inform teachers, school leaders, and policymakers in designing effective, equitable, and sustainable strategies for AI integration in Malaysian primary education.

PROBLEM STATEMENT

Artificial Intelligence is one of the most relevant global projects in the educational context, proposed to raise the quality of instruction, reduce the workload of teachers, and improve the performance of students (FİLİZ et al., 2025; Lampou, 2023; Vorst & Jelicic, 2019; Zhai et al., 2021). However, despite extensive research on the role that AI may play in mainstream education and its various courses at the tertiary level, empirical research on its adoption and evaluation in primary school settings, particularly in the developing world, is lacking (Arriola-Mendoza & Valerio-Ureña, 2024; Hakimi & Shahidzay, 2024; Kölemen & Yıldırım, 2025). AI has the potential to facilitate individualized learning, instant feedback, and dynamic instructions (Akintayo et al., 2024; Guan, 2023; Jian, 2023; Mahmoud & Sørensen, 2024; Qushem et al., 2021), but its application in the lower levels of educational institutions has yet to be fully determined, as their needs are extremely differentiated, and the pedagogy is already built (Arriola-Mendoza & Valerio-Ureña, 2024).

The implementation of AI in schools has already been piloted in other countries, including China, the United States, and Finland, showing encouraging results in terms of student interest and learning effectiveness. For instance, China has actively promoted AI in K-12 education (Li et al., 2024), with adaptive learning systems like Yixue demonstrating greater learning gains in math and English compared to traditional methods and AI tools recognized for personalizing primary mathematics education (Li & Manzari, 2025). In the United States, AI has shown positive effects on elementary students' mathematics achievement (Hwang, 2022) and is actively promoted in K-12 education through initiatives like AI4K12 (Dönmez, 2024; Li et al., 2024). Finland has also seen AI-related policies aimed at improving educational quality (Niemi et al., 2022), and generative AI has been used to foster engagement in sustainability topics among 6th-grade students (Silvennoinen et al., 2024). However, such achievements are contextually contingent and cannot necessarily be directly applied to primary schools in Malaysia, whose infrastructure, teacher preparation, and resources are vastly different (Hakimi & Shahidzay, 2024; Rana et al., 2024). Studies indicate that even though AI tools represent the capability to deliver automatable tasks and are applicable in data-driven teaching, their effectiveness relies on how familiar educators are with them, how they perceive them, and the meanings they attribute to their use in daily teaching activities (FİLİZ et al., 2025; Kim & Kim, 2022; Yim & Wegerif, 2024). In cases where teachers are not properly trained and supported, they can underutilize or improperly use such technologies (Aljemely, 2024; Er & Chongo, 2025; Kim & Kim, 2022; Yim & Wegerif, 2024).

In the Malaysian case, AI has been recognized as one of the major elements of the Malaysian digital transformation in education, evolving from the Malaysia Digital Education Policy (2021-2030) (Goh et al., 2025). This policy explicitly champions AI integration and aims to integrate AI into the national curriculum at all levels, from primary schools to universities (Lowa, 2024). Despite this top-down strategic vision, full implementation, especially at the primary school level, has not yet occurred. Research indicates that a large number of Malaysian teachers either do not know about AI tools or do not feel confident with their meaningful use (Mustafa et al., 2018; Roshan et al., 2024; Uğraş et al., 2024), with studies highlighting low integration of digital technology among Malaysian educators due to lack of training and skills (Abdullah et al., 2016; Zeehan et al., 2020). This is further compounded by uneven development of digital infrastructure in different regions, leading to a prevalent digital divide, particularly among rural communities and lower socio-economic backgrounds, which contributes to problems in the effective application of AI technologies in the classroom (Darus, 2021; Devisakti et al., 2023; Jafar et al., 2022; Kamrozzaman et al., 2025).The challenges are acute in mixed educational districts like Klang, where schools can vary in their maturity in the use of technologies and access to resources.

In addition, little attention has been accredited to the power of AI on instructional decision-making, which is another main task of teachers. Instructional decisions, encompassing what teachers attend to, how they interpret observations, and the pedagogical choices they make (Lee, 2021), include planning, content choice, classroom management, and adjusting teaching strategies to student requirements (Dexter, 2023; Holstein et al., 2020). The absence of explanation of these issues generates the urgent necessity for focused research that addresses how AI can influence everyday primary teachers and their professional standing.

Making the situation even more complicated is the fact that there could be too little knowledge about how the usage of AI correlates with effective teaching in a real-life classroom context (Azzam & Charles, 2024; Holmes & Tuomi, 2022). Though AI has some theoretically potent benefits for enhanced engagement, differentiation, and assessment (Ayeni et al., 2024; Onesi-Ozigagun et al., 2024; Ram, 2025; Swargiary, 2024), classroom outcomes depend on an array of human and situational factors that can be affected by AI. The lack of sufficient evidence and unexamined adoption may lead school leaders or policymakers to apply AI without a detailed roadmap, which risks reinforcing existing inequalities, promoting algorithmic bias, increasing digital disparities, or developing teacher resistance (Al-Zahrani, 2024; Nadim & Fuccio, 2025; Roshanaei et al., 2023).

Thus, this study aims to help fill these research gaps by studying the effect of AI on teaching effectiveness and instructional decision-making by primary school teachers in Klang, Malaysia. Not only does the study capture teachers' perceptions, experiences, issues, and implementation practices with the objective of bringing forth meaningful insights concerning both school-level strategies as well as national education policies, but what the study also achieves is the attainment of insights commonly held through a field of supreme knowledge of the challenge of being a teacher today. This research is informed by a single overarching objective and four specific

objectives to find out how Artificial Intelligence can be introduced in primary school practices in Klang, Malaysia.

METHODOLOGY

Research Design

A mixed-methods descriptive research design was employed to capture both quantitative trends and qualitative depth regarding teachers' experiences with AI. This approach allowed for a comprehensive understanding of the prevalence of certain perceptions and the rich, contextual reasons behind them.

Population and Sampling

The study targeted primary school teachers from government schools in Klang, an urban district in the state of Selangor, Malaysia. A purposive sampling technique was used to recruit 60 participants. This non-probability sampling method was selected to specifically target teachers who had some prior experience or exposure to AI-based educational tools, ensuring that their responses were grounded in practical application and could provide meaningful insights into the realities of integration, rather than being based on theoretical awareness alone.

Instrument and Data Collection

Data were collected using a structured questionnaire, adapted from previous studies on technology integration (Backfisch et al., 2021) to fit the specific context of AI in education.

The instrument comprised five sections:

- **Section A:** Demographic information.
- **Sections B-D:** These sections utilized a five-point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree) to measure perceptions of AI effectiveness, its influence on instructional decision-making, and challenges/advantages of integration. These scores were later reverse-coded for analysis so that higher mean scores consistently indicated higher levels of agreement, aligning with standard interpretative practice.
- **Section E:** Open-ended questions to gather qualitative insights into teachers' personal experiences.

The questionnaire was validated for content relevance by two experts in educational technology. A pilot study with 10 teachers (not included in the main sample) was conducted to ensure clarity, relevance, and reliability. Feedback from the pilot led to minor refinements in the wording of several questions to eliminate ambiguity and ensure they were easily understood by the target respondents. The internal consistency of the scales in the final instrument was excellent, with a Cronbach's Alpha coefficient of .92. Data were collected both electronically and in person, ensuring anonymity and voluntary participation.

Data Analysis

Quantitative data from the closed-ended questions were analyzed using SPSS software. Descriptive statistics including frequencies, percentages, means, and standard deviations were computed to summarize the data. Inferential statistics, specifically independent samples t-tests and one-way Analysis of Variance, were employed to determine if perceptions of AI differed significantly based on key demographic factors.

Qualitative data from the open-ended questions were analyzed using thematic analysis following the six-phase iterative process outlined by Braun & Clarke, (2006) familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. To enhance the validity of the qualitative findings and provide a measure of prevalence, the frequency of responses contributing to each major theme was also quantified.

FINDINGS AND RESULTS

Demographic Profile

The demographic profile of the 60 participating primary school teachers provides essential context for interpreting the study's findings. The data, summarized in Table 1, reveals a sample characterized by a significant gender imbalance, a predominantly young and early-career teaching force, and near-universal adoption.

Table 1 Demographic Characteristics of Participants

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Female	54	90.0
	Male	6	10.0
Age	20-25 years	16	26.7
	26-30 years	18	30.0
	31-35 years	12	20.0
	36-40 years	2	3.3
	41-45 years	2	3.3
	46-50 years	6	10.0
	51 and above	4	6.7
Years of Teaching Experience	1-5 years	28	46.7
	6-10 years	12	20.0
	11-15 years	6	10.0
	16-20 years	4	6.7
	21-25 years	4	6.7
	26-30 years	4	6.7
	31-35 years	2	3.3
Use of AI Tools	Yes	58	96.7
	No	2	3.3

The sample was overwhelmingly female (90%), reflecting a common gender distribution within the primary education sector in Malaysia. Analysis of age and experience indicates a relatively young and novice teaching cohort. A combined 76.7% of participants were 35 years of age or younger, and nearly half (46.7%) had between 1 and 5 years of teaching experience. This suggests that the findings are particularly representative of the perceptions and practices of newer-generation educators.

Teachers' Perceptions of AI Effectiveness

Analysis revealed a strong, positive consensus on AI's role in enhancing teaching effectiveness (Table 2). Educators demonstrated the highest level of agreement that AI helps them better understand students' learning needs (M=1.97), highlighting its valued diagnostic capability. This was powerfully illustrated by one teacher's comment: "The AI platform flags students who are struggling with a specific concept immediately. I can then form a small group for remediation the very next day without waiting for a test result." Furthermore, teachers affirmed AI's utility in providing feedback for instructional improvement (M=2.03) and enhancing overall teaching quality (M=2.07). The slightly more reserved agreement on AI's effectiveness in managing mixed-ability classes (M=2.10), which also showed the greatest response variation, suggests its utility in this complex area is perceived as more context-dependent.

Table 2 Teachers' Perceptions of AI Effectiveness

Item	Mean	Standard Deviation
I believe AI can enhance the quality of my teaching.	2.07	1.015
AI helps me better understand my students' learning needs.	1.97	1.066
AI tools provide useful feedback that supports my instructional improvement.	2.03	1.066
AI enables me to manage large mixed-ability classes more effectively.	2.10	1.094

AI's Influence on Instructional Decision-Making

Teachers reported a high degree of trust in the recommendations provided by AI tools (Table 3), indicating strong confidence in the technology's insights. One participant's statement, "I find the suggestions for extra exercises based on a student's mistakes to be very accurate and helpful," exemplifies this trust. This trust translates into practice, as educators agreed that AI helps them adapt their teaching strategies (M=2.00) and significantly reduces time spent on routine tasks (M=2.00). The use of AI-generated data for decisions on student progress was also viewed positively, though with slightly more reservation and the greatest variability in responses (M=2.10, SD=1.16).

Table 3 AI's Influence on Instructional Decision-Making

Item	Mean	Standard Deviation
I use AI-generated data to make decisions about student progress.	2.10	1.155
AI helps me decide how to adapt my teaching strategies.	2.00	0.983
I trust the recommendations or insights provided by AI tools.	1.60	0.770
AI reduces the time I spend on routine instructional tasks.	2.00	1.050

Challenges and Advantages of Integration

As shown in Table 4, teachers reported a high degree of personal readiness, feeling adequately trained (M=1.90) and finding the tools easy to incorporate into daily routines (M=1.73), with one teacher noting, "The basic functions are quite intuitive to pick up." However, this personal competence is starkly contrasted by significant systemic challenges. Participants identified insufficient access to institutional resources and support (M=2.13) as the primary barrier, compounded by frequent technical problems (M=2.00), which were a major source of frustration: "The internet connection in my school is too weak to run the applications smoothly. It crashes constantly, making the lesson inefficient."

Table 4 Challenges and Advantages of Integration

Item	Mean	Standard Deviation
I find it easy to integrate AI tools into my daily teaching routines.	1.73	1.112
I feel adequately trained to use AI tools in my teaching.	1.90	1.155
Access to AI-related resources and support in my school is sufficient.	2.13	1.224
I often face technical problems like slow internet or system errors when using AI tools.	2.00	1.145

Relationship between AI Use and Classroom Practices

Correlation analysis revealed very strong, statistically significant positive relationships between all variables studied (Table 5). The strongest correlation ($r = .930$, $p < .001$) was between using AI for feedback/management and its perceived ability to save time. This indicates that teachers who use AI for practical tasks perceive it as a significant efficiency booster, which in turn is strongly linked to improved teaching quality and student engagement.

Table 5 Correlation Matrix of Key Variables

Variables	1	2	3	4	5	6	7
1. Teaching Quality	1						
2. Feedback & Mgmt	.905**	1					
3. Student Engagement	.876**	.860**	1				
4. Adaptive Teaching	.791**	.816**	.752**	1			
5. Trust in AI	.837**	.870**	.799**	.823**	1		
6. Saves Time	.881**	.930**	.829**	.765**	.842**	1	
7. Ease of Use	.781**	.816**	.732**	.714**	.767**	.829**	1

*Note: ** p < .001*

Qualitative Findings

Thematic analysis of open-ended responses was conducted to triangulate and enrich the quantitative findings, yielding profound insights into the lived experiences of teachers. The analysis crystallized into three core themes regarding its perceived benefits and three central challenges.

Perceived Benefits of AI Integration

Teachers consistently reported several key advantages that aligned strongly with the positive quantitative trends.

- Enhanced Pedagogical Efficiency and Time-Saving: This was the most prominent advantage, cited by 43 out of 60 respondents (71.7%). Educators emphasized how AI streamlined lesson preparation, directly supporting the strong quantitative correlation between AI use and time reduction. One teacher noted, "AI helps me generate worksheets and activity ideas in minutes, which used to take me hours. This frees up my time to actually focus on my students."
- Facilitation of Data-Driven Differentiation: This theme was identified in the responses of 35 teachers (58.3%). Participants highly valued AI's ability to provide immediate insights into student performance, corroborating the high mean scores for understanding student needs. A respondent explained, "The AI platform flags students who are struggling with a specific concept immediately. I can then form a small group for remediation the very next day without waiting for a test result."
- Increased Student Motivation and Engagement: A total of 29 teachers (48.3%) observed that AI-driven platforms heightened student interest. This qualitative finding provides context for the strong quantitative relationship between AI use and student engagement. One teacher commented, "My students are more eager to complete exercises on the AI platform because it feels like a game. They get instant badges and points, which motivates them."

Key Challenges and Concerns

Despite the benefits, the analysis revealed significant systemic and pedagogical hurdles.

- Inadequate Professional Development and Support: This was the most common challenge, reported by 38 participants (63.3%), affirming the quantitative result indicating insufficient institutional support (M=2.13). A predominant concern was the lack of pedagogical training. "We were shown how to use the software, but not how to effectively integrate it into my lessons for better teaching. I need strategies, not just instructions,"a participant stated.
- Persistent Technical and Infrastructural Barriers: This issue was raised by 46 teachers (76.7%), making it the most frequently reported challenge and quantitively manifested as a high mean score for technical problems (M=2.00). Unreliable technology was a major point of frustration. Responses like, "The internet connection in my school is too weak to run the applications smoothly. It crashes constantly, making the lesson inefficient,"were common.

- Apprehension Regarding the Erosion of the Human Element: This nuanced concern emerged in 22 responses (36.7%). Teachers expressed a conscious desire to maintain their central role in fostering relationships, echoing global calls for a human-centric approach to AI. One teacher reflected, "AI is a tool, not a replacement. I worry that we might lose the personal touch, the empathy, and the spontaneous teachable moments that define teaching."

Inferential Analysis by Demographics

To explore whether demographic variables influenced perceptions, independent samples t-tests and ANOVA tests were conducted. Teachers were grouped by experience: novice teachers (1-5 years' experience, n=28) and experienced teachers (6+ years' experience, n=32). Age groups were consolidated into 20-30 years (n=34) and 31 years and above (n=26) for robust analysis.

An independent samples t-test revealed no statistically significant difference in the perception of AI's effectiveness between novice teachers (M=2.02, SD=0.76) and experienced teachers (M=2.04, SD=0.89); t(58) = -0.105, p = .917. Similarly, no significant difference was found between teachers aged 20-30 (M=2.01, SD=0.80) and teachers aged 31 and above (M=2.05, SD=0.86); t(58) = -0.198, p = .844.

A one-way ANOVA confirmed that perceptions did not significantly differ across the various sub-categories of age (F (6, 53) = 0.301, p = .932) or years of teaching experience (F(6, 53) = 0.459, p = .835).

Table 6 T-test Comparison of AI Perception by Teaching Experience

Group	n	Mean	Std. Deviation	t	p-value
Novice (1-5 yrs)	28	2.02	0.76	-0.105	.917
Experienced (6+ yrs)	32	2.04	0.89		

DISCUSSION

This study set out to capture the realities of AI integration in urban Malaysian primary schools, moving beyond policy rhetoric to the lived experiences of teachers. The findings paint a picture of widespread optimism and adoption, yet one that is sharply constrained by significant systemic barriers, revealing a critical implementation gap.

The strongly positive perceptions of AI's utility, particularly in diagnosing learning needs (M=1.97) and saving instructional time (M=2.00), align with global narratives on AI's transformative potential in education (Baker, 2016; Wang et al., 2020). The high level of trust in AI recommendations (M=1.60) and the very strong correlations between AI use and enhanced teaching quality (r = .905, p<.001$) suggest a teaching workforce that is not only receptive to but also actively experiencing the benefits of data-driven decision-making. This reinforces the OECD's findings that AI can effectively support pedagogical efficiency. However, our qualitative data crucially adds nuance to this quantitative optimism. The overwhelming reporting of technical barriers (76.7%) and inadequate support (63.3%) demonstrates that this positive perception exists despite a challenging environment, not because of a seamless one. This aligns with the assertion that technological adoption is seldom just about the tool itself, but is deeply entangled with the surrounding ecosystem of support, training, and infrastructure (Dexter & Richardson, 2019).

A particularly fascinating finding, which appears to contradict some established literature on technology adoption, is the lack of significant difference in perceptions based on age or teaching experience. Previous studies, such as those by Backfisch et al., (2021), often suggest that younger, less experienced "digital native" teachers may be more amenable to new technologies. Our results, however, indicate that enthusiasm for AI's pedagogical potential is a uniform phenomenon across the demographic spectrum in this urban Malaysian context. This could be a unique effect of the pervasive national policy push (Malaysia Digital Education Policy, 2021-2030), which has potentially normalized AI as a core expectation for all educators, regardless of seniority.

The remarkably high adoption rate (96.7%) warrants careful discussion. This figure likely reflects a combination of factors: the study's purposive sampling of teachers with some AI exposure, the urban context of Klang with presumably better infrastructure, and the successful top-down promotion of the national digital education agenda. However, qualitative responses suggest a spectrum of "use," ranging from sophisticated integration for differentiation to more basic utilization for worksheet generation. This indicates that while adoption is high, the depth and pedagogical sophistication of use may vary greatly, a crucial distinction for understanding the true state of integration. It suggests that teachers are willing to engage with AI, but the quality of that engagement is limited by the challenges they face.

Furthermore, the study uncovers a profound and nuanced concern that goes beyond technical issues: the apprehension regarding the erosion of the human element in teaching, voiced by over a third of participants (36.7%). This concern is not merely a practical hesitation but echoes a central debate in the academic literature. It directly reflects the warnings of scholars like Zawacki-Richter et al., (2019) about the potential for AI to de-emphasize the relational and empathetic core of education. More importantly, it provides empirical support from a developing nation context for the theoretical and ethical framework of human-centered AI in education, as strongly advocated by UNESCO (Fu & Weng, 2024). This framework posits that AI should augment, not replace, human teachers, ensuring that educational technology serves to enhance human relationships and uphold fundamental educational values. Our findings show that Malaysian teachers are intuitively and professionally aligned with this global call, seeking to leverage AI (Jie & Kamrozzaman, 2024; Kamrozzaman et al., 2025) as a supportive tool while vigilantly protecting the irreplaceable human interactions that define effective teaching.

In conclusion, the teachers in this study are caught between a wave of policy-driven optimism and a reality of infrastructural and pedagogical constraints. They are not resistant to change; on the contrary, they are highly optimistic and have adopted AI tools at an impressive rate. The challenge, therefore, is not one of convincing teachers of AI's value, but one of building a robust, supportive, and ethically grounded ecosystem that allows them to translate their positive perceptions into effective, sustainable, and human-centered practice.

CONCLUSION AND IMPLICATIONS

This study unequivocally demonstrates that Artificial Intelligence holds substantial promise for enhancing teaching and learning within urban Malaysian primary schools. Despite widespread optimism and a high reported adoption rate among educators, a critical implementation gap persists, primarily driven by systemic barriers rather than a lack of teacher willingness. Realizing AI's full potential necessitates a strategic, multi-stakeholder approach that transcends mere technology provision and instead cultivates a truly enabling and supportive ecosystem.

The findings underscore that teacher are not resistant to AI; rather, they are keen to leverage its benefits for improved diagnostic insights into student learning, enhanced pedagogical efficiency, and reduced instructional workload. However, their enthusiasm and adoption are currently navigating significant challenges related to inadequate professional development, insufficient institutional support, and persistent technical infrastructure limitations. The qualitative insights further highlight a crucial concern regarding the potential erosion of the human element in teaching, aligning with the global call for human-centered AI integration.

The implications of this research are multi-faceted, offering actionable insights for various stakeholders:

- **For Teachers:** Continuous professional development is paramount. Training must move beyond basic tool operation to emphasize a TPACK-based approach, equipping educators with the pedagogical content knowledge to effectively integrate AI into their teaching practices, fostering critical thinking, and ensuring a human-centric approach.
- **For School Leaders:** A culture of innovation and robust support must be championed. This includes not only advocating for and securing necessary technological resources but also providing consistent technical assistance, fostering collaborative learning environments, and offering moral support to teachers navigating the complexities of AI integration.
- **For Policymakers:** The Malaysia Digital Education Policy's strategic vision must be operationalized with a comprehensive national AI-in-education framework. This framework should prioritize addressing

infrastructure equity across all regions, establishing clear ethical guidelines for AI use in primary education, and investing in scalable, sustainable teacher training programs that are responsive to educators' expressed needs and concerns.

- **For Technology Developers:** A co-design methodology with educators is essential. Developing AI tools that are intuitive, curriculum-aligned, flexible, and directly address real classroom challenges will significantly enhance their utility and adoption. Emphasizing solutions that augment, rather than replace, human interaction and pedagogical expertise is crucial for ensuring ethically sound and effective educational technologies.

LIMITATIONS AND FUTURE RESEARCH

This study's findings, while robust within its scope, are subject to certain limitations, including its confinement to one urban district in Malaysia, a relatively small sample size, and a reliance on self-reported data. Future research should expand to encompass diverse geographical settings, particularly rural and semi-urban areas, to capture a broader spectrum of experiences regarding the digital divide and infrastructural challenges. Incorporating longitudinal designs would provide valuable insights into the long-term impacts of AI integration on teaching practices and student outcomes. Furthermore, including the perspectives of students, parents, and administrators would offer a more holistic understanding of AI's integration into the primary education ecosystem. Such expanded research will be vital in informing comprehensive, equitable, and sustainable strategies for AI integration in Malaysian primary education and beyond.

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