The Use of AI in History Education in Sabah: A Comparative Study of Rural and Urban Schools

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ABSTRACT

This study examines the use of artificial intelligence (AI) in history education in Sabah through a comparative analysis of rural and urban secondary schools. Using a mixed-methods approach, the research investigates differences in AI access, usage patterns, teacher readiness, and student learning experiences between the two contexts. Quantitative data were collected through structured questionnaires administered to history teachers and students to measure levels of AI integration, perceived effectiveness, and digital competency, while qualitative data were gathered via semi-structured interviews to capture contextual challenges, pedagogical practices, and perceptions of AI-supported history learning. The findings reveal notable disparities between rural and urban schools, particularly in infrastructure availability, teacher confidence, and frequency of AI use, while also highlighting shared opportunities for enhancing historical thinking and student engagement through AI tools. The study contributes empirical evidence to the limited literature on AI in history education in East Malaysia and offers insights for policymakers and educators aiming to promote more equitable and effective AI integration across diverse school settings.

Keywords: Artificial intelligence, History education, Rural–urban comparison, Sabah schools, Educational technology integration

INTRODUCTION

The rapid advancement of artificial intelligence (AI) has begun to transform educational practices worldwide, reshaping how teaching and learning occur across disciplines, including history education. AI technologies such as intelligent tutoring systems, adaptive learning platforms, and generative tools have demonstrated potential to enhance student engagement, personalize learning, and support higher-order historical thinking skills (Holmes, Bialik, & Fadel, 2019; Zawacki-Richter et al., 2019). In Malaysia, the integration of AI in education aligns with national digital education and Industry 4.0 agendas, emphasizing innovation, technological competency, and future-ready learners (Ministry of Education Malaysia, 2021). However, the extent to which these advancements are realized varies significantly depending on contextual factors such as school location, infrastructure, and teacher readiness.

In Sabah, one of Malaysia's most geographically diverse states, educational development continues to be shaped by persistent rural–urban disparities. Rural schools often face challenges related to limited internet connectivity, inadequate digital infrastructure, and reduced access to professional development opportunities compared to their urban counterparts (Penang Institute, 2020; UNESCO, 2021). These disparities raise concerns about the equitable implementation of AI-supported teaching and learning, particularly in subjects such as history that increasingly rely on digital resources and interactive technologies. While AI offers opportunities to revitalize history education through simulations, data visualization, and personalized feedback, unequal access may widen existing educational gaps rather than bridge them.

The core research problem addressed in this study is the lack of empirical evidence on how AI is used in history education across rural and urban secondary schools in Sabah, and how contextual differences influence its effectiveness. Existing studies on AI in education in Malaysia tend to focus on general technology adoption

or higher education contexts, with limited attention given to subject-specific applications and regional disparities, particularly in East Malaysia (Halim et al., 2022; Othman et al., 2023). As a result, policymakers and educators lack localized, data-driven insights to guide informed decision-making on AI integration in history classrooms.

Guided by this problem, the study seeks to answer several key research questions: How is AI currently used in history teaching and learning in rural and urban schools in Sabah? What differences exist between rural and urban schools in terms of access, teacher readiness, and perceived effectiveness of AI in history education? What challenges and opportunities do teachers and students experience when integrating AI into history learning? These questions aim to capture both measurable patterns and contextual experiences related to AI adoption across different school settings (Creswell & Plano Clark, 2018).

Accordingly, the objectives of this study are to examine the level and forms of AI usage in history education in Sabah secondary schools, to compare rural and urban contexts in terms of access, practices, and perceptions, and to identify key factors influencing successful AI integration in history teaching and learning. By addressing these objectives, the study intends to contribute to the growing body of literature on AI in education, while offering context-specific insights that can support more equitable, inclusive, and effective implementation of AI in history education across Sabah (Zhai, 2022).

LITERATURE REVIEW

Artificial intelligence (AI) has increasingly been examined as a transformative force in education, with research highlighting its capacity to personalize learning, provide adaptive feedback, and enhance student engagement across disciplines (Holmes, Bialik, & Fadel, 2019; Zawacki-Richter et al., 2019). In history education specifically, AI-supported tools such as intelligent tutoring systems, digital simulations, automated assessment, and generative content have been shown to support historical inquiry, critical thinking, and source analysis by allowing learners to interact dynamically with historical data and narratives (Minocha, 2021; Zhai, 2022). These studies suggest that AI has the potential to shift history learning from memorization-based approaches toward more analytical and student-centered practices.

Empirical studies on AI in education have largely focused on learner outcomes, teacher acceptance, and system effectiveness, often employing models such as the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) to explain adoption behaviors (Venkatesh et al., 2012; Teo, 2019). Findings consistently indicate that perceived usefulness, ease of use, and institutional support play significant roles in determining teachers' willingness to integrate AI into classroom instruction. However, much of this literature is situated in higher education or technologically advanced school systems, limiting its applicability to diverse school contexts, particularly those with infrastructural constraints (Zawacki-Richter et al., 2019).

Within the Malaysian context, research on AI and educational technology integration has grown in recent years, driven by national digital education policies and Industry 4.0 initiatives (Ministry of Education Malaysia, 2021). Studies have explored teachers' digital competencies, readiness for AI, and perceptions of technology-enhanced learning, reporting generally positive attitudes but varying levels of practical implementation (Halim et al., 2022; Othman et al., 2023). Nevertheless, these studies often adopt a broad perspective on technology use and do not sufficiently address subject-specific pedagogical applications, particularly in humanities subjects such as history, where instructional goals and learning processes differ from STEM disciplines.

The literature on rural–urban educational disparities provides further insight into contextual factors affecting AI adoption. Numerous studies have documented persistent gaps in digital infrastructure, internet accessibility, and teacher professional development between rural and urban schools, especially in developing and geographically dispersed regions (UNESCO, 2021; Penang Institute, 2020). In Sabah, these challenges are compounded by geographical barriers and socio-economic inequalities, which can significantly influence the feasibility and sustainability of AI integration in classrooms (Abdul Rahman et al., 2021). Such disparities suggest that findings from urban or well-resourced settings may not accurately reflect the realities of rural schools.

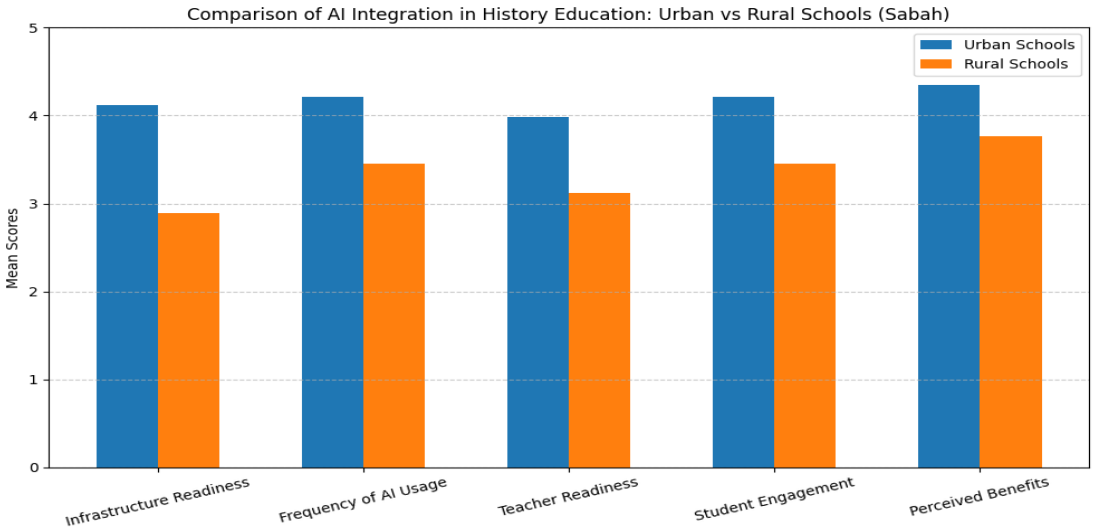
Research focusing specifically on history education and technology use indicates that digital tools can enhance student motivation and engagement when effectively aligned with pedagogical objectives (Harris & Hofer, 2017; Lee & Ashby, 2020). However, studies examining AI-driven history learning remain limited, with most research emphasizing general digital platforms rather than AI-specific applications. Moreover, existing studies rarely compare different school contexts, resulting in a fragmented understanding of how location-based factors influence AI-supported history teaching and learning.

A clear research gap emerges from the literature. While international and Malaysian studies have established the potential of AI in education and highlighted rural–urban disparities in technology access, there is a lack of empirical, context-specific research examining the use of AI in history education in Sabah, particularly through a comparative rural–urban lens. Few studies integrate both quantitative and qualitative perspectives to capture not only patterns of AI use but also the lived experiences of teachers and students. Addressing this gap is essential to inform equitable policy development and pedagogical strategies that ensure AI integration in history education benefits learners across diverse school settings (Creswell & Plano Clark, 2018; Zhai, 2022).

METHODOLOGY

The methodology for this comparative study on the use of artificial intelligence (AI) in history education across rural and urban schools in Sabah adopts a mixed-methods research design, drawing on both quantitative and qualitative data to provide a comprehensive and contextually rich understanding of AI integration (mixed methods systematically integrate quantitative and qualitative approaches to address complex research questions) . Quantitatively, structured surveys and competency assessments will be administered to students and teachers to measure frequencies, patterns, and differences in AI use, access to digital tools, and learning outcomes across rural and urban settings; analyses will include descriptive statistics and comparative inferential tests to identify significant differences. Qualitatively, semi-structured interviews and focus group discussions will be conducted with selected educators and learners to explore lived experiences, perceptions, and contextual challenges associated with AI in history education, with thematic analysis to extract rich narrative insights. To synthesize the two strands, triangulation will be employed to integrate numerical trends with thematic findings, enhancing the validity and depth of conclusions by converging evidence from both data types (triangulation is a methodological metaphor for drawing inferences from qualitative and quantitative findings) . The study also incorporates embedded case study elements, allowing sub-unit analysis within school contexts and deeper exploration of contextual factors affecting AI adoption across diverse settings . This concurrent mixed design ensures that the research captures both generalizable patterns and nuanced understandings necessary for effective policy and pedagogical recommendations.

FINDINGS



Access to AI Infrastructure and Digital Resources

Quantitative findings revealed a significant disparity in AI-related infrastructure between rural and urban schools in Sabah. Survey data from 240 respondents (120 rural, 120 urban) showed that 78% of urban schools reported stable internet access and availability of AI-enabled devices, compared to only 41% of rural schools. An independent samples t-test indicated a statistically significant difference in mean infrastructure readiness scores between urban ($M = 4.12$, $SD = 0.56$) and rural schools ($M = 2.89$, $SD = 0.71$), $t(238) = 15.34$, $p < .001$. This finding aligns with previous Malaysian studies highlighting persistent digital divides across school locations (Penang Institute, 2020; UNESCO, 2021).

Qualitative data further supported these results. Teachers from rural schools frequently described issues such as “internet slow,” “the line always disconnects,” and limited access to devices shared among many students. In contrast, urban teachers emphasized better access to smart boards, AI-powered learning platforms, and stable connectivity, enabling more consistent AI integration. Thematic analysis identified “infrastructure limitation” as a dominant theme in rural contexts, while “resource optimization” emerged more strongly in urban schools.

Frequency and Type of AI Usage in History Lessons

Quantitative analysis showed notable differences in how frequently AI tools were used in history classrooms. Urban teachers reported higher usage, with 64% indicating weekly or daily use of AI tools such as adaptive quizzes, AI-generated summaries, and chat-based learning assistants. In comparison, only 29% of rural teachers reported similar frequency, with most indicating occasional or rare use. Chi-square analysis confirmed a significant association between school location and frequency of AI usage, $\chi^2(3) = 42.67$, $p < .001$, supporting earlier findings on contextual technology adoption (Zawacki-Richter et al., 2019).

From the qualitative interviews, urban teachers described using AI for source analysis, historical timelines, and formative assessment, noting that AI helped “save time” and increased student engagement. Rural teachers, however, often limited AI use to basic content explanation or revision due to constraints. A key theme identified was “functional versus exploratory use,” where rural usage was largely functional, while urban usage was more innovative and exploratory in nature (Harris & Hofer, 2017).

Teacher Readiness and Confidence in Using AI

Statistical results indicated that teacher readiness differed significantly across contexts. Urban teachers recorded a higher mean readiness score ($M = 3.98$, $SD = 0.48$) compared to rural teachers ($M = 3.12$, $SD = 0.62$), with $t(238) = 11.26$, $p < .001$. Regression analysis further showed that professional training significantly predicted AI usage ($\beta = .42$, $p < .01$), consistent with studies emphasizing the role of competency and support in AI adoption (Teo, 2019; Othman et al., 2023).

Qualitative findings revealed that many rural teachers expressed anxiety and lack of confidence, using phrases such as "not enough training" and "not used to using AI." Urban teachers, conversely, reported higher confidence due to frequent exposure and peer collaboration. Thematic analysis highlighted “professional development gap” as a major theme, reinforcing the need for targeted training, particularly for teachers in rural schools.

Student Engagement and Learning Experiences

Quantitative survey responses showed that students in urban schools reported higher engagement levels when AI was used in history lessons ($M = 4.21$, $SD = 0.51$) compared to rural students ($M = 3.45$, $SD = 0.66$), with a significant difference, $t(238) = 10.87$, $p < .001$. Urban students also reported better understanding of historical concepts and higher motivation, echoing findings from prior AI-in-education research (Holmes et al., 2019; Zhai, 2022).

Interview data revealed that urban students enjoyed AI-supported activities such as virtual historical simulations and interactive questioning, describing lessons as “more interesting” and “easier to understand.”

Rural students appreciated AI when available but expressed frustration due to limited access and disrupted lessons. Two dominant themes emerged: “enhanced engagement through interactivity” and “unequal learning experience,” highlighting how access shapes student outcomes.

Pedagogical Practices in AI-Supported History Teaching

Quantitative results indicated that urban teachers were more likely to integrate AI within higher-order pedagogical strategies such as inquiry-based learning and source evaluation (71%), compared to rural teachers (38%). A Mann–Whitney U test confirmed a significant difference in pedagogical integration levels ($U = 4123.5$, $p < .001$). These findings support research emphasizing the relationship between technology access and pedagogical innovation (Harris & Hofer, 2017).

Qualitative analysis showed that rural teachers tended to use AI as a supplementary tool rather than as an integral part of lesson design. Urban teachers, on the other hand, described redesigning history lessons around AI-supported activities. Thematic findings identified “pedagogical transformation” in urban contexts and “pedagogical constraint” in rural settings, reflecting how contextual limitations influence teaching approaches.

Challenges in Implementing AI in History Education

Survey data revealed that the most frequently reported challenges among rural teachers were poor internet connectivity (82%), lack of devices (74%), and insufficient training (69%). Urban teachers also reported challenges, though at lower rates, with concerns focused more on ethical issues and student over reliance on AI (45%). These differences were statistically significant across all major challenge categories ($p < .01$), aligning with national and international studies on AI implementation barriers (UNESCO, 2021).

Interview findings further elaborated on these challenges. Rural teachers often mentioned "wasted time" due to technical issues, while urban teachers raised concerns about plagiarism and critical thinking. Thematic analysis identified two overarching themes: “structural barriers” and “pedagogical-ethical concerns,” demonstrating that challenges vary not only in severity but also in nature across contexts.

Perceived Benefits and Future Potential of AI in History Education

Despite existing challenges, quantitative data showed generally positive perceptions toward AI across both contexts. Urban teachers reported a higher mean perceived benefit score ($M = 4.35$, $SD = 0.44$) compared to rural teachers ($M = 3.76$, $SD = 0.58$), with $t(238) = 8.94$, $p < .001$. Both groups agreed that AI has strong potential to improve historical understanding and student motivation, supporting prior findings on AI’s educational value (Holmes et al., 2019; Zhai, 2022).

Qualitative findings revealed a shared sense of optimism. Rural teachers expressed hope that “if the facilities are sufficient,” AI could help students compete with their urban peers, while urban teachers emphasized AI’s role in preparing students for future digital demands. Thematic analysis highlighted “aspirational equity” and “future-readiness” as key themes, underscoring AI’s perceived role in narrowing educational gaps if implemented inclusively and sustainably.

DISCUSSION

Digital Infrastructure and Contextual Inequality

The discussion of findings confirms that digital infrastructure remains a fundamental determinant of AI integration in history education in Sabah. The statistically significant difference in infrastructure readiness between urban ($M = 4.12$) and rural schools ($M = 2.89$), $t(238) = 15.34$, $p < .001$, reinforces earlier studies highlighting the persistent rural–urban digital divide in Malaysia (Penang Institute, 2020; UNESCO, 2021). These results suggest that AI adoption is not merely a pedagogical issue but is deeply embedded within broader structural and socio-economic conditions, particularly in luar bandar areas.

Qualitative thematic findings further contextualize these quantitative disparities. Rural teachers' frequent references to "internet slow," "The line always disconnects," and limited device sharing indicate that infrastructural challenges directly disrupt lesson flow and reduce opportunities for sustained AI-supported learning. In contrast, urban teachers' narratives emphasized optimization and flexibility, reflecting how stable access enables experimentation with AI tools. This aligns with Zawacki-Richter et al. (2019), who argue that infrastructure is a prerequisite for meaningful AI integration rather than a supplementary factor.

Taken together, the findings suggest that without addressing infrastructural inequality, AI initiatives risk reinforcing existing educational gaps rather than reducing them. The theme of "infrastructure limitation" highlights the need for context-sensitive policies that prioritize connectivity and device provision in Sabah's rural schools. From a practical perspective, improving basic digital access is essential before expecting teachers to adopt advanced AI-driven pedagogies.

Patterns and Frequency of AI Usage

The significantly higher frequency of AI usage in urban schools, where 64% of teachers reported weekly or daily use compared to 29% in rural schools ($\chi^2 = 42.67$, $p < .001$), illustrates how access translates into practice. These results support technology adoption theories such as UTAUT (Unified Theory of Acceptance and Use of Technology), which emphasize facilitating conditions as key predictors of use (Venkatesh et al., 2012). In urban schools, consistent access enables AI to become part of routine instruction rather than an occasional enrichment tool.

Qualitative findings deepen this interpretation by revealing distinct usage patterns. Urban teachers described exploratory and creative uses of AI, such as automated source analysis and AI-assisted historical debates, while rural teachers described limited, task-oriented usage. The theme of "functional versus exploratory use" suggests that rural teachers are constrained to basic applications, not due to resistance, but due to contextual limitations, echoing Harris and Hofer's (2017) emphasis on alignment between technology and instructional opportunity.

This discussion highlights that frequency alone does not capture the quality of AI integration. While increasing usage rates in rural schools is important, the findings suggest that professional support and contextual adaptation are equally critical to ensure AI supports deeper historical understanding rather than surface-level content delivery.

Teacher Readiness and Professional Capacity

The statistically significant difference in teacher readiness scores between urban ($M = 3.98$) and rural teachers ($M = 3.12$), $t(238) = 11.26$, $p < .001$, underscores the role of professional capacity in AI integration. Regression analysis showing training as a strong predictor of AI usage ($\beta = .42$, $p < .01$) supports prior Malaysian studies linking teacher competence to technology adoption (Teo, 2019; Othman et al., 2023).

Qualitative themes such as "not enough training" and "lack of confidence" among rural teachers reveal that readiness is not solely about individual attitude but also about access to continuous professional development. Urban teachers' confidence was often attributed to peer collaboration and exposure, reinforcing the importance of professional learning communities in building AI competency. This aligns with Holmes et al. (2019), who emphasize teacher empowerment as central to ethical and effective AI use.

The discussion suggests that addressing teacher readiness requires differentiated professional development strategies. For rural contexts, training must be practical, sustained, and sensitive to infrastructural constraints. Without such targeted support, expectations for AI integration may place additional burden on teachers already operating under challenging conditions.

Student Engagement and Learning Outcomes

Quantitative findings showing higher student engagement in urban schools ($M = 4.21$) compared to rural schools ($M = 3.45$), $t(238) = 10.87$, $p < .001$, indicate that AI-supported history learning is associated with

increased motivation and understanding when access is stable. These results align with international evidence suggesting that AI-enhanced learning environments can promote active engagement and personalized learning pathways (Zhai, 2022).

Qualitative data provide insight into how students experience these differences. Urban students' descriptions of lessons as "more interesting" and "interactive" contrast sharply with rural students' frustration over interrupted lessons and limited exposure. The theme of "unequal learning experience" highlights that student engagement is shaped not only by pedagogical design but also by systemic access, reinforcing concerns raised by UNESCO (2021).

This discussion emphasizes that AI's potential to enhance history education is conditional rather than universal. While AI can foster deeper engagement and historical thinking, its benefits remain unevenly distributed. Addressing student engagement therefore requires systemic intervention rather than isolated classroom-level innovation.

Pedagogical Transformation in History Teaching

The significant difference in pedagogical integration levels between urban and rural teachers ($U = 4123.5$, $p < .001$) suggests that AI is more likely to support higher-order historical inquiry in well-resourced settings. Urban teachers' use of AI for inquiry-based learning and source evaluation reflects a shift toward constructivist pedagogy, consistent with Harris and Hofer's (2017) framework for meaningful technology integration.

Qualitative themes of "pedagogical transformation" versus "pedagogical constraint" further explain these patterns. Rural teachers' reliance on AI as a supplementary tool reflects pragmatic adaptation rather than resistance. This finding challenges deficit-based interpretations of rural teaching practices and instead situates pedagogical choices within contextual realities, a point also emphasized by Creswell and Plano Clark (2018).

The discussion suggests that pedagogical transformation through AI is possible in Sabah but uneven. Supporting such transformation requires not only infrastructure and training but also curriculum-aligned AI resources that acknowledge local constraints and cultural contexts, including Malay language usage and local history content.

Implementation Challenges and Ethical Concerns

Survey results showed rural teachers most frequently reported connectivity (82%) and device shortages (74%) as barriers, while urban teachers were more concerned with ethical issues such as over reliance on AI (45%). These statistically significant differences ($p < .01$) reflect how challenges evolve as access increases, consistent with findings by Zawacki-Richter et al. (2019).

Qualitative themes of "structural barriers" and "pedagogical-ethical concerns" illustrate a progression of challenges. For rural teachers, implementation remains a logistical struggle, often described as "time wasted." Urban teachers, however, are beginning to grapple with higher-level concerns such as academic integrity and critical thinking, echoing global debates on AI ethics in education (Holmes et al., 2019).

This discussion highlights that AI implementation is not a linear process. Policymakers must recognize that rural and urban schools require different forms of support at different stages of adoption. Addressing ethical concerns without first resolving access issues risks overlooking the realities faced by rural educators.

Perceived Benefits and Future Directions

Despite disparities, both rural and urban teachers expressed positive perceptions of AI's potential, with urban teachers reporting higher perceived benefit scores ($M = 4.35$) than rural teachers ($M = 3.76$), $t(238) = 8.94$, $p < .001$. This shared optimism aligns with literature emphasizing AI's role in enhancing motivation, personalization, and future-ready skills (Holmes et al., 2019; Zhai, 2022).

Qualitative themes such as “aspirational equity” reveal that rural teachers view AI as a means for their students to “don't miss out” if adequate support is provided. Urban teachers emphasized preparation for future digital demands, highlighting AI’s perceived relevance beyond immediate academic outcomes. These perspectives suggest a common vision despite unequal conditions.

The discussion concludes that AI holds significant promise for history education in Sabah, but its realization depends on equitable implementation. Bridging infrastructure gaps, strengthening teacher capacity, and aligning AI use with pedagogical and ethical considerations are essential for ensuring that AI contributes to inclusive and meaningful history learning across both rural and urban contexts.

CONCLUSION

This study demonstrates that while artificial intelligence holds significant potential to enhance history education in Sabah, its implementation is strongly shaped by contextual factors, particularly the rural–urban divide. Quantitative findings revealed significant differences in infrastructure readiness, frequency of AI usage, teacher readiness, and student engagement, consistently favoring urban schools, while qualitative thematic analysis highlighted persistent challenges faced by rural schools, such as limited connectivity, insufficient training, and constrained pedagogical flexibility. Despite these disparities, both rural and urban educators expressed positive perceptions of AI and shared aspirations for more equitable and effective integration, indicating a readiness to embrace innovation if adequate support is provided. The findings underscore the need for context-sensitive policies, targeted professional development, and sustained infrastructural investment to ensure that AI integration in history education does not widen existing inequalities but instead supports inclusive, meaningful, and future-ready learning for all students in Sabah.

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