

Artificial Intelligence (AI) Technology in Learning Malay Language Literacy Skills among Students

Simon Jiack Anak Aaron*, Zamri Mahamod

Faculty of Education, Universiti Kebangsaan Malaysia, Selangor, Malaysia

*Corresponding Author

DOI: <https://dx.doi.org/10.47772/IJRISS.2025.909000486>

Received: 10 September 2025; Accepted: 16 September 2025; Published: 15 October 2025

ABSTRACT

This concept paper examines the integration of Artificial Intelligence (AI) in enhancing Malay language literacy education, with a particular focus on reading, writing, speaking, and listening skills. Literacy remains a pressing issue in Malaysia, especially in rural schools where students continue to struggle with foundational skills despite government initiatives. Drawing on past and recent studies, the paper highlights that AI technologies—particularly Natural Language Processing (NLP) and Automatic Speech Recognition (ASR)—offer opportunities to create personalized, adaptive, and engaging learning experiences. Research indicates that AI applications can provide real-time feedback, support vocabulary and grammar development, and enable autonomous practice in pronunciation and listening. These affordances make AI an important complement to traditional pedagogy, especially in contexts where teachers face constraints in time, resources, or training.

However, the adoption of AI in literacy education also faces several challenges. Infrastructural limitations, such as poor internet connectivity and lack of devices in rural areas, remain major barriers. Teacher readiness is another critical factor, as many educators lack training in digital pedagogy and confidence in applying AI tools. In addition, the linguistic complexity of Malay—its morphology, affixation, and dialectal diversity—complicates the use of global AI tools that are primarily designed for English or Mandarin. Ethical concerns, including data privacy and algorithmic bias, further underscore the need for responsible AI integration.

The paper proposes solutions such as developing localized Malay NLP and ASR systems, expanding teacher professional development, and investing in infrastructure to ensure equitable access. It concludes that AI, if localized and carefully implemented, has the potential to reduce literacy gaps and contribute to Malaysia's broader educational goals.

Keywords: Artificial Intelligence, Malay Language, Literacy Skills, NLP, Educational Technology

INTRODUCTION

Literacy is widely acknowledged as the foundation of academic success and lifelong learning. In Malaysia, however, literacy gaps remain a pressing concern, particularly among rural students who struggle with reading and writing in Malay. These challenges not only limit individual learning but also pose wider implications for the nation's aspirations in human capital development. Government initiatives such as the LINUS programme have made efforts to improve literacy levels, yet persistent issues continue to affect the most disadvantaged groups [5,9].

The rapid growth of Artificial Intelligence (AI) provides new opportunities to reimagine literacy instruction. Unlike traditional pedagogical tools, AI offers adaptive, interactive, and data-driven methods that can personalize learning to students' needs [1,4]. By leveraging Natural Language Processing (NLP) and

Automatic Speech Recognition (ASR), AI has the potential to support the development of reading, writing, listening, and speaking skills in more dynamic ways than conventional teaching alone. International organizations such as UNESCO [10] and OECD [13] also highlight the urgency of embedding AI in literacy policies to ensure that education systems remain relevant in the digital era.

Despite these opportunities, integrating AI into literacy education is not straightforward. Barriers such as infrastructural disparities, teacher readiness, and ethical concerns limit the extent to which AI can be deployed effectively. Moreover, linguistic features unique to Malay, including its morphology and dialectal diversity, complicate the adoption of existing global AI tools [14]. This paper therefore aims to critically examine these challenges and propose solutions for integrating AI into Malay literacy learning, with particular attention to local context and sustainability.

LITERATURE REVIEW

Artificial Intelligence (AI) is increasingly recognized as a transformative tool in education due to its ability to provide adaptive, interactive, and personalized learning experiences. Studies [1,4] demonstrate that AI-based platforms, such as ChatGPT, enhance student engagement and motivation by making learning more interactive and accessible. Similarly, [6] report that AI can facilitate comprehension and communication in higher education, reflecting its potential to address both cognitive and affective aspects of learning.

In the field of literacy, AI applications leveraging Natural Language Processing (NLP) have been shown to improve students' reading and writing abilities. For instance, [3] highlights the role of AI-driven tools in supporting grammar, vocabulary development, and text comprehension. [2] further note that technology-based strategies complement cooperative learning by providing immediate feedback, which is essential for literacy development. These findings are consistent with international research [10,13], which emphasize that AI can democratize access to literacy resources through real-time feedback and adaptive learning environments.

Beyond reading and writing, AI also plays a crucial role in developing speaking and listening skills. Automatic Speech Recognition (ASR) technologies, for example, enable learners to practice pronunciation and listening comprehension autonomously. [4] observe that although ASR performs effectively in widely spoken languages such as English and Mandarin, challenges arise when applied to linguistically complex or less-resourced languages like Malay. [14] confirm this by showing that transformer-based NLP models for Malay still face difficulties in handling morphology, affixation, and dialectal variations, underscoring the need for localized AI solutions.

In the Malaysian context, literacy gaps remain a pressing issue, especially in rural areas. [5,9] highlight how the lack of infrastructure, inadequate teaching resources, and limited teacher training exacerbate literacy challenges. Although government initiatives such as the Malaysia Education Blueprint [7] aim to improve equity in education, rural schools often lag behind in access to digital technologies [11]. These challenges not only hinder the adoption of AI but also widen the digital divide between urban and rural learners.

Taken together, the literature suggests that while AI offers significant opportunities to enhance literacy skills, its success in the Malaysian context requires localized adaptation. Studies converge on the point that Malay literacy education cannot simply adopt global AI tools without addressing linguistic complexity, infrastructural disparities, and teacher readiness. This critical review highlights both the promise and limitations of AI in literacy education and sets the stage for a deeper discussion of issues and challenges.

ISSUES AND CHALLENGES

Infrastructure and Accessibility

The digital divide remains one of the most significant barriers to AI adoption in Malaysian schools. Rural communities often face limited internet connectivity and lack of access to affordable devices, which restrict

students' ability to benefit from AI-driven platforms. Research [11] confirms that these infrastructural gaps exacerbate inequalities between urban and rural learners, despite national initiatives outlined in the Malaysia Education Blueprint [7]. Without addressing infrastructure, the promise of AI in literacy education cannot be realized.

Teacher Readiness

Teachers serve as the mediators between AI technologies and classroom practices. However, many educators lack adequate training and confidence in applying AI to literacy instruction. Studies [8] reveal that while teachers recognize the value of digital tools, they often lack structured professional development that connects technology to pedagogy. As [9] argue, teacher readiness must go beyond technical familiarity to include pedagogical strategies that ensure AI complements, rather than replaces, traditional literacy teaching.

Linguistic Barriers

The Malay language presents unique challenges for AI applications due to its complex morphology, extensive use of affixes, and diverse dialects. NLP systems trained primarily on English and Mandarin often underperform when applied to Malay [14]. Similarly, ASR technologies encounter difficulties in recognizing dialectal variations such as Kelantanese and Sarawak Malay, which are underrepresented in available speech corpora [9]. These linguistic barriers highlight the need for localized AI solutions tailored to the characteristics of Malay literacy.

Ethical and Pedagogical Concerns

Beyond technical issues, ethical questions also shape the debate on AI in education. Concerns include data privacy, algorithmic bias, and the risk of students becoming overly dependent on AI tools. Scholars [12,13] caution that without ethical safeguards, AI integration may perpetuate inequalities rather than reduce them. UNESCO [10] stresses that AI should be aligned with human-centered educational values. In the context of literacy, AI must be designed to complement teachers' expertise and foster authentic learning, not simply automate assessment and feedback.

Taken together, these challenges underline that AI adoption in Malay literacy education requires more than just technological readiness. It involves systemic reforms in infrastructure, teacher development, linguistic adaptation, and ethical governance. Addressing these issues is essential for ensuring that AI serves as an enabler of equitable literacy learning in Malaysia.

PROPOSED SOLUTIONS AND DISCUSSION

To address the issues highlighted, several strategies have been proposed in the literature, many of which emphasize the importance of localized and sustainable integration of AI into Malay literacy education.

Development of Malay NLP Tools

Localized AI literacy applications are critical for addressing the unique linguistic features of Malay. While generic NLP tools perform well in English and Mandarin, they often fail to capture Malay morphology, affixation, and reduplication patterns. Research [1] shows that AI tools can enhance literacy by offering grammar correction, vocabulary expansion, and reading comprehension support. However, [14] demonstrate that transformer-based NLP models for Malay still face challenges in achieving high accuracy. This underscores the need for research collaborations between linguists, technologists, and educators to produce robust Malay-specific NLP models.

Localized Speech Recognition

Pronunciation and listening comprehension remain underexplored in Malay literacy education. ASR systems can provide real-time feedback to learners, making language practice more engaging and autonomous. Studies

[4] indicate that ASR improves oral skills in major languages, but its performance in Malay is constrained by dialectal diversity. Current ASR systems underrepresent Kelantanese, Sarawak, and Sabah Malay, leading to recognition errors. To overcome this, large-scale speech corpora must be developed and diversified [14]. Without such datasets, ASR will remain unreliable for literacy instruction in Malaysia.

Teacher Professional Development

The role of teachers is central in ensuring effective AI integration. Although AI tools offer automation and personalization, their success depends on teachers' ability to design lessons that balance technology with pedagogy. Research [8] reveals that many teachers lack confidence in using digital platforms. This aligns with [9], who highlight the importance of equipping teachers with not just technical training but also pedagogical frameworks to integrate AI effectively. Ongoing professional development should therefore include digital pedagogy modules, training in AI ethics, and hands-on practice with AI tools in real classroom contexts.

Infrastructure Investment

Access to reliable internet and digital devices is a prerequisite for AI integration. Studies [11] indicate that rural schools face significant barriers due to poor connectivity and insufficient resources, creating a digital divide that hinders equitable access. Both government and private sector partnerships are needed to expand broadband access and subsidize device procurement. The Malaysia Education Blueprint [7] already outlines infrastructure goals, but their implementation must prioritize rural communities. Without closing the digital gap, AI innovations will disproportionately benefit urban learners while marginalizing rural students.

Ethical and Pedagogical Safeguards

Finally, AI integration must be guided by ethical considerations. Concerns about data privacy, algorithmic bias, and overreliance on AI tools are well documented [12,13]. While UNESCO [10] emphasizes AI's potential to democratize education, it also warns of risks when local contexts are ignored. In literacy education, AI should be framed as a complementary tool that enhances—not replaces—teachers' roles. Strong regulatory frameworks, transparent data policies, and clear pedagogical guidelines are essential to ensure that AI supports inclusive and equitable literacy development.

Taken together, these solutions suggest that AI has the potential to transform Malay literacy education. Yet, this transformation requires a holistic approach: developing localized technologies, empowering teachers, strengthening infrastructure, and embedding ethical safeguards. Only through this multi-pronged strategy can AI meaningfully reduce literacy gaps in Malaysia.

Table 1: Summary of Challenges and Proposed Solutions in AI-Based Malay Literacy Learning

Challenges	Proposed Solutions	References
Infrastructure gaps	Expand broadband access, subsidize devices	[7], [11]
Teacher readiness	Professional development, digital pedagogy training	[8], [9]
Linguistic complexity	Develop Malay-specific NLP and ASR corpora	[14]
Ethical concerns	Data privacy safeguards, AI ethics frameworks	[12], [13]

CONCLUSION

This paper has examined the potential and challenges of integrating Artificial Intelligence (AI) into Malay literacy education. The review demonstrates that AI, through Natural Language Processing (NLP) and Automatic Speech Recognition (ASR), can provide adaptive, interactive, and personalized learning support that complements traditional pedagogy. Such technologies are particularly relevant for improving reading, writing, listening, and speaking skills, as they offer immediate feedback and create opportunities for autonomous learning.

Nevertheless, significant challenges must be addressed before these benefits can be fully realized. Infrastructural barriers, particularly in rural areas, teacher readiness, and the linguistic complexity of Malay limit the effectiveness of existing AI solutions. Ethical concerns such as privacy, bias, and over-reliance on technology also require careful attention.

The findings suggest that localized and sustainable strategies are essential. Investment in infrastructure, professional development, and Malay-specific NLP and ASR tools will be key to successful implementation. Future research should further explore context-sensitive AI applications that promote inclusive and equitable literacy education in Malaysia.

REFERENCES

1. Ab, E., Maskur, H., & Mutalib, R. A. (2023). The use of ChatGPT in learning: Impact on student engagement. *Malaysian Journal of ICT*, 8(2), 78–87.
2. Adibah, N., & Zulkifli, H. (2020). Cooperative learning in Islamic education. *Malaysian Online Journal of Education*, 4(2), 61–69.
3. Aizatul. (2024). Assessment and evaluation in education. *Journal of Educational Studies*, 12(1), 55–66.
4. Chan, C., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, 20(43).
5. Ghazali, N., & Hassan, R. (2021). Issues in literacy acquisition among rural Malaysian students. *Journal of Language and Education Studies*, 14(2), 33–47.
6. Mahmoud Elkhodr, Gide, E., Wu, R., & Darwish, O. (2023). ICT students' perceptions towards ChatGPT: An experimental study. *Education and Information Technologies*, 28, 8799–8820.
7. Ministry of Education Malaysia. (2021). *Malaysia Education Blueprint 2013–2025 (Annual Report)*. Putrajaya: MOE.
8. Mohd Salleh, S., & Ibrahim, N. (2020). Teachers' readiness in integrating digital technologies for literacy learning. *Malaysian Journal of Learning and Instruction*, 17(2), 45–62.
9. Siti Hajar, A., & Mahamod, Z. (2021). The role of educational technology in enhancing Malay literacy skills. *Jurnal Pendidikan Bahasa Melayu*, 11(2), 23–34.
10. UNESCO. (2022). *AI and the Future of Literacy Education*. Paris: UNESCO Publishing.
11. Yusof, N., & Ahmad, R. (2020). Digital divide in Malaysia: Implications for rural education. *Asian Journal of Distance Education*, 15(1), 112–127.
12. Zhang, Y., & Chen, X. (2021). Ethical issues of AI in education: Data privacy and bias. *Journal of Learning Analytics*, 8(3), 45–59.
13. OECD. (2022). *Artificial Intelligence in Education: Challenges and Opportunities*. Paris: OECD Publishing.
14. Lim, S., & Tan, J. (2023). Transformer-based language models for Malay NLP. *Journal of Computational Linguistics*, 49(2), 211–230.