INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 15, Issue 2, (2026) E-ISSN: 2226-6348

The Role of Generative Artificial Intelligence (GEN-AI) in Bridging the Post-PPSMI Gap with Malay Language Assessment

Siti Haryanti Osaman, Mohd Effendi Ewan Mohd Matore

Faculty of Education, Universiti Kebangsaan Malaysia (UKM), Malaysia

Corresponding Author Email: effendi@ukm.edu.my

DOI Link: http://dx.doi.org/10.6007/IJARPED/v15-i2/28146

Published Online: 17 May 2026

Abstract

Generative Artificial Intelligence (Gen-AI) has emerged as a transformative tool in enhancing educational practices, particularly in Malay language assessment following the Policy for the Teaching and Learning of Science and Mathematics in English (PPSMI). The ongoing discourse surrounding PPSMI highlights concerns regarding the effectiveness of Malay language assessment, yet the role of Gen-AI in addressing these gaps remains underexplored. This conceptual paper adopts a qualitative approach through a structured review of relevant literature to examine how Gen-AI can support assessment practices in the post-PPSMI context. The findings reveal several key applications, including the translation of technical terminology into *Bahasa Melayu*, the facilitation of personalized learning through adaptive materials, the provision of real-time linguistic feedback, the generation of multimedia resources for oral assessments, and the rapid development of diverse question banks. Despite these benefits, concerns related to academic integrity, authenticity of students' work and over-reliance on technology must be addressed. Additionally, issues of infrastructure, digital access, and teacher readiness remain critical. This study provides insights for educators and policymakers in integrating Gen-AI to support more adaptive, inclusive, and sustainable Malay language assessment practices in the digital education landscape.

Keywords: Educational Technology, Generative Artificial Intelligence (Gen-AI), Malay Language Assessment, Personalized Learning, PPSMI

Introduction

The Policy for the Teaching and Learning of Science and Mathematics in English (PPSMI) was officially implemented in the 2003 school session. It involves Year 1, Form 1, and Form 6 students as pioneers. This is the result of the Special Cabinet Meeting decision on July 19, 2002, which brought drastic changes to the national education system. Throughout its implementation, RM3 billion has been spent covering the purchase of laptops, teaching aids, teacher training and intensives, as well as continuous courses and guidance for teachers. The main objective of PPSMI is to improve English proficiency among students, which is considered the language of knowledge and global communication. The study by Mohammad

Mosiur & Manjet kaur (2021) states that Vision 2020 and the pressures of globalization made the government aware of the need to reinforce English language proficiency. It also aims to facilitate students' access to reference materials and up-to-date knowledge, most of which are available in English.

The main target groups of this policy are Year 1 primary school students and Form 1 secondary school students, while science and mathematics teachers are also directly involved in the implementation of this policy. In the context of current education, PPSMI is seen as a strategic effort to prepare students to face the challenges of the Fourth Industrial Revolution, which demands communication skills in a global language as well as the ability to access scientific and technological knowledge from various international sources (Rafiq et al., 2024; Kementerian Pendidikan Malaysia, 2017). This policy also reflects the nation's desire to improve the quality of STEM education and strengthen high-quality human capital, in line with the aspirations of Vision 2020 and the Malaysia Education Development Plan 2013–2025 (Nurul Aliah Mustafa et al., 2021).

However, the implementation of this policy sparked considerable controversies and objections from various stakeholders, particularly concerning the widening achievement gap between urban and rural students, as well as teachers' limited proficiency in delivering instruction in English. Empirical evidence indicates that rural students tend to experience lower English language proficiency and reduced access to educational resources compared to their urban counterparts, which further exacerbates learning inequalities (Muhamad et al., 2024; Farah Zulkefly & Abu Bakar Razali, 2019). In addition, the effectiveness of PPSMI was constrained by inadequate teacher preparedness and challenges in adapting to English-medium instruction, particularly among teachers in less-resourced schools (Hussan Sahib & Stapa, 2022). Consequently, on 8 July 2009, the Malaysian government announced the reversal of PPSMI following sustained opposition and multiple implementation challenges. The policy was not abolished abruptly but was gradually replaced by the *Memartabatkan Bahasa Melayu dan Memperkukuh Bahasa Inggeris* (MBMMBI) policy, with the complete phase-out of PPSMI in primary schools by 2015 (Ahmad et al., 2012). Therefore, the implementation of the MBMMBI policy is expected to be carried out systematically, with a strong emphasis on improving English language proficiency. Although PPSMI was officially abolished in 2012, it remains a significant subject in educational policy debates due to its long-term impact on the national education system, students' competencies, and the status of the Malay language as the national language.

Despite growing research on artificial intelligence in education, existing studies predominantly focus on general applications of AI in learning and teaching, with limited emphasis on its role in language-specific assessment contexts, particularly in Malay language education. Furthermore, there is a lack of conceptual frameworks that integrate post-policy educational challenges, such as those arising from PPSMI, with emerging Gen-AI capabilities. Recent studies highlight that while AI technologies have shown significant potential in enhancing personalized learning and assessment, their application in language-specific educational contexts remains limited (UNESCO, 2023;Holmes et al., 2023b). This indicates a clear research gap in understanding how Gen-AI can be systematically leveraged to address linguistic transition issues and assessment practices in the Malaysian context.

In the current era of digital education and the rapid advancement of Generative Artificial Intelligence (Gen-AI), there is an increasing need to re-examine language assessment practices, particularly in post-policy contexts such as PPSMI. While previous studies have extensively discussed the impact of PPSMI on language proficiency and educational inequality, limited attention has been given to how emerging technologies such as Gen-AI can be strategically utilized to address these challenges. This is particularly relevant in the Malaysian context, where the integration of digital technologies in education is emphasized under national policies such as the Malaysia Education Blueprint and the Digital Education Policy (Shuhaimi et al., 2023;UNESCO, 2023). Therefore, this study is significant in exploring how Gen-AI can function as an innovative mechanism to bridge linguistic, pedagogical, and assessment gaps in Malay language education. Accordingly, the objective of this conceptual paper is to examine the role of Generative Artificial Intelligence (Gen-AI) in Malay language assessment in the post-PPSMI context, particularly in bridging the gap in existing assessment practices. The findings of this study are expected to provide practical insights for teachers in designing more adaptive assessment strategies, as well as inform policymakers in developing guidelines for ethical and effective integration of Gen-AI in language education.

Implementation and Educational Implications of PPSMI

The implementation of the Teaching and Learning of Science and Mathematics in English (PPSMI) policy began in 2003 as a radical approach introduced by the Malaysian government to enhance students' global competitiveness (Rahman & Singh, 2021). From an implementation perspective, PPSMI involved multiple stakeholders, including the Ministry of Education Malaysia, Science and Mathematics teachers, school administrators, students, and parents. Among the key strategies of this policy were the provision of intensive training for teachers to improve their English language proficiency, as well as the integration of educational technologies such as interactive learning software and ICT tools in schools (K. Abu Bakar et al., 2012). The government also allocated substantial resources to support the implementation of the policy, including the provision of ICT infrastructure such as laptops and LCD projectors to facilitate teaching and learning processes. (Luck & Peng, 2010) The implementation of the policy was monitored by relevant educational authorities, including State Education Departments and District Education Offices, to ensure compliance and effectiveness across school (Kementerian Pendidikan Malaysia, 2013).

Nevertheless, the implementation of PPSMI did not proceed smoothly. In the short term, the policy generated various implications for the education system, particularly causing confusion and increased pressure among primary school students with limited English proficiency, especially those in rural areas. This situation contributed to a decline in students' motivation to learn Science and Mathematics. Empirical evidence indicates that PPSMI did not achieve its intended objectives and, in some cases, hindered students' learning performance, particularly among those with limited English proficiency. Students were found to perform better and demonstrate clearer understanding when learning in *Bahasa Melayu*, which supports more effective comprehension of subject content (Alias & Shuaib, 2015).From a long-term perspective, PPSMI has had a significant impact on the national education system, particularly in contributing to disparities in academic achievement and influencing the position of *Bahasa Melayu* as a language of knowledge in education (Othman et al., 2023).

The policy also raised concerns among advocates of the national language, who viewed PPSMI as a threat to the status and dignity of *Bahasa Melayu*. It is undeniable that the implementation of PPSMI led to several unintended consequences. Recent studies indicate that educators, including trainee teachers, tend to demonstrate a stronger preference for the use of *Bahasa Melayu* in the teaching of Mathematics and Science, as it enhances instructional effectiveness and students' understanding (Alias & Shuaib, 2015). In addition, feelings of marginalization emerged among rural students who were unable to effectively follow classroom instruction due to language barriers. Academic achievement gaps also widened based on socioeconomic background and school location. Empirical evidence shows that the use of a non-native language as the medium of instruction negatively affected students' performance in Mathematics and Science, particularly after the transition to English (Soh et al., 2021). Rural students generally exhibited lower English language proficiency due to limited exposure and difficulties in understanding technical terminology, which reduced their interest in learning these subjects in English (Melor & Saiful Islam, 2017). Parents also faced dilemmas as they were unable to support their children's learning at home due to similar language constraints (Latiff Azmi, 2013). Mounting pressure from various stakeholders eventually led to the abolition of PPSMI and its replacement with the MBMMBI policy (Kementerian Pendidikan Malaysia, 2013).

Strengths and Weaknesses of the PPSMI Policy

The Teaching and Learning of Science and Mathematics in English (PPSMI) policy is widely regarded as one of the most controversial education policies in the history of Malaysia's education system. From a critical standpoint, the policy possesses notable strengths, particularly in its vision and aspirations to position Malaysian students within a globally competitive landscape. However, weaknesses in its implementation, coupled with realities at the grassroots level, have hindered the policy from fully achieving its intended objectives.

One of the primary strengths of PPSMI lies in its long-term vision, which aligns with the demands of globalization. In the era of the Fourth Industrial Revolution and the rapid expansion of the digital economy, English proficiency is widely recognized as a crucial prerequisite for accessing global knowledge, particularly in Science, Technology, Engineering, and Mathematics (STEM). Recent studies emphasize that mastery of English enhances students' ability to engage with global academic resources and technological advancements, thereby strengthening national competitiveness (Dwivedi et al., 2023). In this context, the PPSMI policy reflects a forward-looking effort to equip students with linguistic and cognitive tools necessary for participation in a knowledge-based economy.

In addition, PPSMI contributes to early exposure to scientific and mathematical terminology in English, which may provide long-term advantages in higher education and the international labor market. This aligns with the broader role of English as a second language in Malaysia's education system, where it serves as an essential medium for academic and professional communication (A. L. Abu Bakar et al., 2021). Empirical evidence further suggests that students from urban and higher socioeconomic backgrounds tend to benefit more from English-medium instruction due to stronger language proficiency and access to supportive learning environments (García & Wei, 2018). Furthermore, the policy has been associated with the development of a cohort of students who demonstrate competitiveness in STEM and

English language proficiency, which are essential attributes in a globalized workforce. Consequently, PPSMI can be seen as a strategic initiative aimed at enhancing human capital and fostering innovation.

Despite these strengths, PPSMI has been widely criticized for its implementation shortcomings. One of the most significant weaknesses lies in its failure to account for disparities in English language proficiency between urban and rural students, as well as variations in teachers' competency. Recent studies highlight a persistent mismatch between policy aspirations and classroom realities, particularly due to uneven language proficiency among teachers and students, which contributes to inconsistent pedagogical practices and widening educational inequalities (Dinh & Dang, 2026). This issue is further compounded by broader structural inequalities in education, as highlighted by UNESCO (2026), which emphasizes that despite global progress in educational access, significant disparities persist, particularly among students from rural and disadvantaged socioeconomic backgrounds. Many teachers were also insufficiently prepared to teach technical subjects in a second language, leading to reduced instructional quality and reliance on code-switching or reverting to *Bahasa Melayu* during lessons. This situation ultimately affected students' comprehension and academic performance, thereby undermining the overall effectiveness of the policy.

Moreover, PPSMI did not fully achieve its intended objectives, particularly in improving students' performance in Science and Mathematics. Research indicates that language barriers negatively impacted students' understanding of subject content, especially among those from lower and middle socioeconomic backgrounds (Dearden, 2016;UNESCO, 2026). In many cases, students opted to learn these subjects in *Bahasa Melayu*, as they perceived limited benefits from English-medium instruction. Additionally, the policy's goal of strengthening bilingual proficiency was not fully realized, as some teachers were unable to serve as effective language models in the classroom. This highlights a critical mismatch between policy expectations and actual classroom realities.

Another notable weakness is the lack of stakeholder involvement in the policy formulation process. PPSMI was largely implemented through a top-down approach, with limited consultation involving teachers, parents, and language experts. This led to resistance from various groups, including academics, non-governmental organizations, and language advocacy bodies (Windle et al., 2020). Contemporary policy studies emphasize that inclusive and participatory approaches are essential for ensuring successful educational reform and long-term sustainability (Michael, 2020). The absence of such engagement in PPSMI contributed to its eventual rejection and policy reversal.

The abrupt implementation and subsequent abolition of PPSMI further highlight issues related to policy inconsistency and sustainability. Introduced in 2003 and abolished in 2009, the policy was replaced by the MBMMBI policy within a relatively short period. Such rapid policy shifts created instability within the education system and raised concerns regarding long-term planning and coherence in national education strategies (Kementerian Pendidikan Malaysia, 2013;Kementerian Pendidikan, 2026). A comparison with other countries offers valuable insights. For instance, in Singapore, the use of English as a medium of instruction has been successfully implemented due to systematic planning, strong teacher training, and a multilingual societal context. English functions as a unifying language across

ethnic groups, contributing to more effective policy outcomes (Khine & Liu, 2022). In contrast, countries such as Finland maintain their national language as the primary medium of instruction while still achieving high levels of English proficiency. This approach underscores the importance of balancing global competencies with national linguistic identity (Sahlgren, 2015) .

Overall, while PPSMI represents a policy grounded in future-oriented aspirations, its lack of strategic planning, insufficient preparation, and limited stakeholder engagement constrained its effectiveness. A critical evaluation of the policy demonstrates that successful educational reforms require careful alignment between policy design, implementation capacity, and sociocultural context. PPSMI serves as a significant example of how well-intentioned policies may produce unintended consequences when implementation realities are not adequately addressed. In light of these persistent educational and linguistic challenges, there is a growing need to explore innovative technological approaches, such as Generative Artificial Intelligence (Gen-AI), to support more adaptive and inclusive assessment practices.

The Role of Gen-AI in Bridging the Post-PPSMI Practice Gaps for the Context of Malay Language Assessment

The role of Generative Artificial Intelligence (Gen-AI) can be elaborated in bridging the existing practice gap in the post-PPSMI context, particularly in Malay language assessment. Firstly, Gen-AI assists in translating technical terms in Science and Mathematics into *Bahasa Melayu*. In assessment contexts, AI tools such as large language models (e.g., ChatGPT and Google Gemini) are capable of transforming complex problem-solving questions into language that is more accessible without compromising their scientific integrity. This supports students who experience confusion with terminology due to policy transitions, enabling them to better understand the requirements of Malay language assessment tasks, which is consistent with the role of AI in enhancing comprehension through simplified and accessible information (OECD, 2023).

Furthermore, Gen-AI facilitates blended and personalized learning through the generation of practice materials tailored to students' levels of vocabulary mastery. For students accustomed to English references in the post-PPSMI context, AI systems can automatically generate bilingual glossaries and explanatory notes for difficult terms in Malay comprehension texts. The integration of technology in the elevation of the Malay language helps students bridge the gap between conceptual understanding and the appropriate use of standardized *Bahasa Melayu* as guided by Dewan Bahasa dan Pustaka, in line with findings that generative AI supports adaptive and personalized learning environments (UNESCO, 2026).

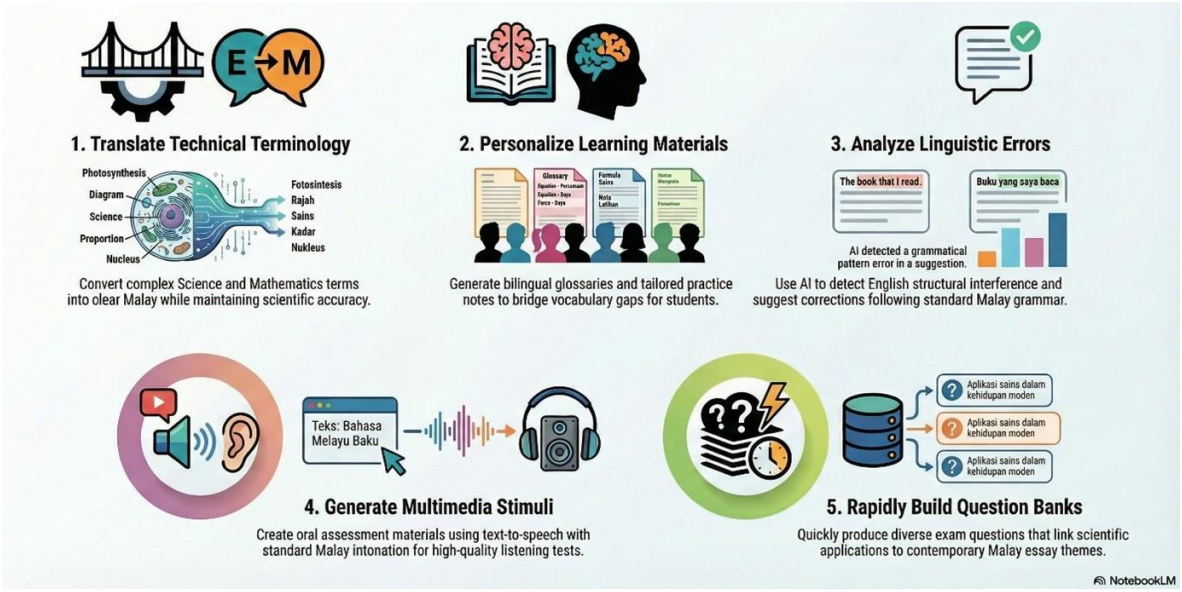

Figure 1: The role of Gen-AI in bridging the gap in Post-PPSMI practice for the Malay Language assessment context

From an assessment perspective, Generative Artificial Intelligence (Gen-AI) functions as a linguistic error analysis that provides real-time feedback on students' writing. In formative assessment contexts, AI is capable of detecting the influence of English sentence structures (interference), which is commonly observed among students in the post-PPSMI context, and subsequently suggesting syntactic corrections in accordance with *Tatabahasa Dewan*. This process not only supports more efficient feedback processes but also directly educates students on the differences in morphological and syntactic structures between the two languages, consistent with studies highlighting the effectiveness of AI-driven feedback in improving writing quality and language learning outcomes (Zawacki-Richter et al., 2019;Holmes et al., 2023).

In addition, Gen-AI serves as a generator of inclusive multimedia stimuli for speaking and listening assessments. By utilizing text-to-speech technology with native-like Malay intonation, students are exposed to accurate standard pronunciation, thereby addressing issues related to "academic accent" that may arise from prior learning of Science and Mathematics in a foreign language. This aligns with evidence that AI-based technologies, including text-to-speech and speech recognition, can enhance pronunciation accuracy and support speaking skill development in language learning contexts (Fitria, 2021).

Finally, this technology has the potential to bridge digital resource gaps by generating a diverse range of question banks within a short period of time. Educators can utilize Gen-AI to develop simulated assessment items that integrate applications of Science and Mathematics into essay writing tasks centered on contemporary issues in the Malay language. This indirectly elevates the status of the national language as a dynamic language of knowledge, in line with the aspirations of Ministry of Education Malaysia to produce students who are proficient in cross-disciplinary communication. In conclusion, the integration of Gen-AI in Malay language assessment serves as a strategic bridge in restoring students' linguistic sustainability, particularly those affected by the transitional phase of educational policy changes. With informed human oversight, this technology can ensure that mastery of the

national language remains strong without compromising the advancement of scientific literacy that has been previously developed

Conclusion

Overall, the PPSMI policy represented a bold initiative by the government to enhance the competitiveness of Malaysian students in the context of globalization and the Fourth Industrial Revolution. In terms of vision and objectives, the policy was clearly future-oriented, aiming to produce a generation capable of mastering scientific and technological knowledge in an international language, namely English. In contrast, its implementation revealed several significant challenges, particularly in terms of achievement gaps between urban and rural students, varying levels of language proficiency among teachers and students, and the lack of comprehensive consultation with key stakeholders. PPSMI generated mixed impacts. While it provided positive outcomes in terms of access to global knowledge resources, it also resulted in negative consequences for student performance, especially among those with limited English proficiency. Weaknesses in teacher training, a predominantly top-down implementation approach without inclusive consultation, and insufficient community support were among the key factors contributing to the policy's shortcomings. Therefore, the implementation of any educational policy should be grounded in principles of inclusivity, supported by empirical evidence, and aligned with the socio-cultural context and capacity of its implementers. PPSMI should serve as a lesson that even well-intentioned policies may fail if implementation aspects are neglected. With the introduction of the MBMMBI policy, new hope has emerged to strengthen bilingual proficiency among students through a more systematic, holistic, and phased approach. Moving forward, any educational policy must be carefully designed and involve multiple stakeholders to ensure its effectiveness and sustainability within the national education system. Future studies should further explore the practical implementation, ethical considerations, and effectiveness of Gen-AI integration in Malay language assessment across diverse educational settings.

Acknowledgment

I would like to express my sincere gratitude to my supervisor, Associate Professor Ts. Dr. Mohd Effendi @ Ewan Mohd Matore, for his guidance and support throughout this study. I am also thankful to my husband, Mohd Nazri Abdullah, my beloved son, my three daughters, my parents, family, and friends for their continuous encouragement and support throughout this academic journey.

References

Abu Bakar, A. L., Mohd. Esa, S., Ationg, R., & Jawing, E. (2021). the English Language in the Malaysian Education System. *International Journal of Education, Psychology and Counseling*, *6*(43), 122–130. https://doi.org/10.35631/ijepc.643011

Abu Bakar, K., Mohd Ayub, A. F., & Wong, S. L. (2012). Malaysian teachers' professional development in ICT. *Workshop Proceedings of the 20th International Conference on Computers in Education, ICCE 2012*, 157–163.

Ahmad, R. @ R., Majid, N., Mamat, N. J. Z., Rambely, A. S., Muda, N., Jaaman, S. H. H., Suradi, N. R. M., Ismail, W. R., Shahabuddin, F. A., Nazar, R. M., Samsudin, H. B., Zin, W. Z. W., Zahari, M., & Rafee, N. M. (2012). Transformation of Language in Teaching and Learning Policy. *Procedia - Social and Behavioral Sciences*, *59*, 685–691. https://doi.org/10.1016/j.sbspro.2012.09.331

Alias, N., & Shuaib, F. S. (2015). Position, status and role of Malay language in Malaysia = Kedudukan, status, dan peranan Bahasa Melayu di Malaysia. *Perspektif: Jurnal Sains Sosial Dan Kemanusiaan*, *7*(1), 1–11. http://irep.iium.edu.my/47564/

Dearden, J. (2016). *English medium Instruction: A Growing Global Phenomenon* (pp. 1–40). https://doi.org/10.13140/RG.2.2.12079.94888

Dinh, T., & Dang, M. (2026). A j a l. *The Asian Journal of Applied Linguistics*, *10*(1), 1–16. https://doi.org/https://doi.org/10.25442/hku.31384231

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., … Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *71*(March), 1–63. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Farah Zulkefly, & Abu Bakar Razali. (2019). Malaysian Rural Secondary School Students' Attitudes towards Learning English as a Second Language. *International Journal of Instruction*, *12*(1), 1141–1156. www.e-iji.net

Fitria, T. N. (2021). The Use Technology Based on Artificial Intelligence in English Teaching and Learning. *ELT Echo : The Journal of English Language Teaching in Foreign Language Context*, *6*(2), 213–223. https://doi.org/10.24235/eltecho.v6i2.9299

García, O., & Wei, L. (2018). Book Review Translanguaging : Language, Bilingualism and Education. *Bellaterra Journal of Teaching & Learning Language & Literature*, *11*(1), 85–95.

Holmes, W., Bialik, M., & Fadel, C. (2023a). Artificial Intelligence in Education. In *Lecture Notes in Networks and Systems* (Vol. 478). https://doi.org/10.1007/978-981-19-2940-3_16

Holmes, W., Bialik, M., & Fadel, C. (2023b). Globethics Repository. In *Artificial intelligence in education* (pp. 622–653). Globethics Publications. https://doi.org/10.58863/20.500.12424/4276068

Hussan Sahib, F., & Stapa, M. (2022). A Review of the Issues and Challenges to the English Language Reform at Malaysian Primary Education. *Malaysian Journal of ELT Research*, *19*(1), 16–33. https://doi.org/10.52696/rlzu4912

Kementerian Pendidikan. (2026). *Ringkasan Eksekutif Rancangan Pendidikan Malaysia 2026-2035*.

Kementerian Pendidikan Malaysia. (2013). Pelan Pembangunan Pendidikan Malaysia 2013-2025. In *Kementerian Pendidikan Malaysia*.

Kementerian Pendidikan Malaysia. (2017). *Dasar Pendikan Kebangsaan* (Issue Edisi keempat). Firdaus Press Sdn Bhd.

Khine, M. S., & Liu, Y. (2022). Handbook of Research on Teacher Education: Innovations and Practices in Asia. In *Handbook of Research on Teacher Education: Innovations and Practices in Asia*. https://doi.org/10.1007/978-981-16-9785-2

Latiff Azmi, M. N. (2013). National Language Policy and its impacts on second language reading culture. *Journal of International Education and Leadership*, *3*(1), 1–11.

Luck, L. T., & Peng, C. F. (2010). Maximizing the Usage of Technology-Enhanced Teaching and Learning of Science and Mathematics in English Program in the Malaysian Secondary Schools System. *Online Submission USChina Education Review*, *7*(10), 87–97. http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED514814

Melor, M. Y., & Saiful Islam, A. S. (2017). The Use of English in Teaching Mathematics and Science: The PPSMI Policy vis-à-vis The DLP. *Advances in Language and Literary Studies*, *8*(1), 133–142. https://doi.org/10.7575/aiac.alls.v.8n.1p.133

Michael, F. (2020). *Leading in a Culture of Change* (second).

Mohammad Mosiur, R., & Manjet kaur, M. S. (2021). English and Malay language policy and planning in Malaysia. *Training, Language and Culture*, *5*(4), 36–46. https://doi.org/10.22363/2521-442X-2021-5-4-36-46

Muhamad, M., Seng, G. H., Khaja, F. N. M., Tahir, M. H. M., & Saputra, S. (2024). Malaysian Rural ESL Learners' Perceived English Language Proficiency. *Arab World English Journal*, *15*(2), 274–287. https://doi.org/10.24093/awej/vol15no2.17

Nurul Aliah Mustafa, Norela Mohamed Shah, Nabilla Waheda Hashim &, & Mahsuri Md Desa. (2021). an Overview of Stem Education and Industry 4.0 for Early Childhood Education in Malaysia. *Journal of Positive School Psychology*, *2022*(4), 53–62. http://journalppw.com

OECD. (2023). OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem. In *OECD Digital Education Outlook*. https://www.oecd-ilibrary.org/education/oecd-digital-education-outlook-2023_c74f03de-en

Othman, I. W., Moharam, M. M., Ambo, H., Maizurah, S., Salam, A., Khairi, M., Ahmad, L., & Yusoff, M. S. (2023). Hospitality and Enhancing The Role of The Malay Language (MBM) In Knowledge Augmentation , Practical Application , Skill Development , and Attitudinal Growth. *Journal of Tourism, Hospitality and Environment Management*, *8*(34), 113–142. https://doi.org/10.35631/JTHEM.834008.This

Rafiq, K. R. M., Hashim, H., & Yunus, M. M. (2024). Roles of English for Specific Purposes (ESP) in STEM Education to Leverage Sustainable Education. *Asian Journal of University Education*, *20*(3), 741–751. https://doi.org/10.24191/ajue.v20i3.27857

Rahman, M. M., & Singh, M. K. M. (2021). English and Malay language policy and planning in Malaysia. *Training, Language and Culture*, *5*(4), 36–46. https://doi.org/10.22363/2521-442X-2021-5-4-36-46

Sahlgren, G. H. (2015). *Real Finnish Lessons*.

Shuhaimi, H. binti, Ramli, R. bin M., Mohd Faizul Azmin bin Zamin, Hamid, S. H. bin A., & Zainudin, F. binti. (2023). *Dasar Pendidikan Digital* (Dr. Kamarul Azman bin Abd Salam (ed.)). Kementerian Pendidikan Malaysia. https://www.moe.gov.my/storage/files/shares/Dasar/Dasar Pendidikan Digital/Dasar Pendidikan Digital.pdf

Soh, Y. C., Carpio, X. V. Del, & Wang, L. C. (2021). *The Impact of Language of Instruction in Schools on Student Achievement* (Issue January). https://openknowledge.worldbank.org/bitstream/handle/10986/35031/The-Impact-of-Language-of-Instruction-in-Schools-on-Student-Achievement-Evidence-from-Malaysia-Using-the-Synthetic-Control-Method.pdf?sequence=6&isAllowed=y

UNESCO. (2023). Guidance for generative AI in education and research. In *United Nations Educational, Scientific and Cultural Organization*. https://doi.org/10.54675/ewzm9535

UNESCO. (2026). Access and Equity. In *Global Healthcare and the Supply Chain* (first edit). https://doi.org/10.54676/JLKL3223

Windle, J. A., Jesus, D. de, & Lesley, B. (2020). The Dynamics of Language and Inequality in Education. In *The Dynamics of Language and Inequality in Education*. https://doi.org/10.21832/windle6942

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 1–27. https://doi.org/10.1186/s41239-019-0171-0