

The Use of Artificial Intelligence (AI) In Teaching the Malay Language to Students with Hearing Impairments in Malaysia

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ABSTRACT

This study investigates the potential of Artificial Intelligence (AI) in enhancing Malay language learning among students with hearing impairments, focusing on how AI facilitates the transition from Malaysian Sign Language (Bahasa Isyarat Malaysia, BIM) to grammatically correct written Malay. A qualitative case study design was employed involving seven students with severe hearing loss (above 120 decibels) from three secondary schools under the Special Education Integration Programme in Perak, Malaysia. All participants used BIM as their primary mode of communication and were learning Malay as a second language. Two special education teachers also contributed perspectives to triangulate the findings. Data were collected through semi-structured interviews, classroom observations, and document analysis of students' written work before and after AI integration. The analysis followed Braun and Clarke's six-phase thematic framework, ensuring rigor through peer review by qualitative research experts. Findings revealed that AI served as a linguistic bridge between sign language and written Malay, provided scaffolding for sentence restructuring, and enhanced self-correction, motivation, and writing autonomy. Students demonstrated significant improvements in grammatical accuracy, morphological awareness, vocabulary, and the use of affixes, conjunctions, and discourse markers, which were reflected in improved performance in school-based and semester assessments. Overall, the study highlights that AI integration can transform Malay language instruction for deaf learners by bridging linguistic gaps and promoting equitable literacy development. The findings underscore the need for the Ministry of Education to support the adoption of AI-assisted pedagogical innovations to enhance inclusive Malay language education and expand academic and professional opportunities for students with hearing impairments.

Keywords: Artificial Intelligence, Malay Language, Hearing Impairment, Special Education, Sign Language

INTRODUCTION

Background of the Study

According to the Chong (2018), formal education for students with hearing impairments in Malaysia began in 1954 with the establishment of the Federation School in Penang, the nation's first fully residential institution for the deaf, which was relatively late compared to other countries. To expand educational access, special integrated classes and units were introduced in 1963. Subsequently, in 1978, the Ministry of Education established the National Committee on Total Communication to develop more effective approaches for educating students with hearing impairments. Inspired by developments in the United States, the committee introduced the total communication approach, which integrates elements of signing, lip reading, facial expression, body language, and speech. The committee also took the initiative to standardize a national sign language system, resulting in the creation of Bahasa Malaysia Kod Tangan (BMKT) in 1980, used in schools for deaf students (Chong, 2018).

Students with hearing impairments rely on language to convey and receive information, both orally and in writing. As Grash and colleagues (2021) note, language is central to communication, while Colston (2019) emphasizes its role as the foundation for social interaction. For these students, acquiring language is just as critical as it is for their typically hearing peers (Mateus-Gómez et al., 2024). However, learning Malay as a

second language can be particularly challenging, not only in formal classrooms but also in everyday social contexts (Razalli et al., 2018). These challenges often appear in their writing, pointing to the need for effective support. In response, this study investigates how Artificial Intelligence (AI) can assist students with hearing impairments in producing grammatically correct Malay sentences, transforming structures derived from Malaysian Sign Language (BIM) into standard Malay. It also examines the effectiveness of AI-based learning tools in improving their writing proficiency, with the aim of enhancing both their language skills and overall academic achievement.

Malay Language Learning in the Malaysian Education Context

Malay language serves as the medium of instruction in the Malaysian education system and is vital for all students to access knowledge across subjects. According to the Curriculum Development Division (2017) language learning is built upon six core pillars: communication, spirituality, attitudes and values, humanity, scientific and technological literacy, physical and aesthetic development, and personal competence. These domains are interrelated and infused with critical, creative, and innovative thinking skills to develop a balanced and competent individual.

At the primary level, Malay language instruction emphasizes literacy and language application. During the early years, students must master the basic skills of listening, speaking, reading, and writing. A fun and engaging learning approach is encouraged through activity-based instruction (Anwer, 2019). In later stages, the focus shifts to the strengthening and application of language skills. Mastery of grammar plays a key role in producing creative and quality writing (Helmiati et al., 2019). As Abatbaevna (2025) asserts, language is not merely a tool of communication but a crucial component in shaping individual identity and fostering national development.

For students with hearing impairments, writing is an especially critical skill as it allows them to communicate effectively with peers who may not understand sign language (Dostal & Wolbers, 2014; Gärdenfors et al., 2019). However, writing requires understanding of linguistic structure, which many deaf students struggle to acquire due to limited exposure to spoken sounds (Alothman, 2021). Since writing in Malay is based on Roman alphabets and syllable blending, difficulties in auditory perception directly affect the development of written language proficiency among students with hearing impairments (Chong & Mohd Hussain, 2021).

Problem Statement

Students with hearing impairments demonstrate weak proficiency in their second language, Malay, primarily due to challenges in language acquisition (Kamarudin, D., Kamarudin, D., & Hussain, 2021). Although these students are placed in special education schools to receive structured language instruction, many continue to face difficulties mastering Malay, particularly in writing. Their primary mode of communication is Malaysian Sign Language (BIM), while Malay is only taught for five hours per week. Other subjects are often delivered using a mix of *Kod Tangan Bahasa Melayu (KTBM)* and BIM, contributing to inconsistent language exposure and weaker proficiency in written Malay (Nur Syafiza Shafee et al., 2022).

Although the government introduced the KTBM in 1978 to standardize communication and improve learning outcomes, Malay language remains a second language for many students with hearing impairments, and their mastery levels continue to be low (Kamarudin, D., Kamarudin, D., & Hussain, 2021). Even after several years of schooling, a significant number of deaf students still face difficulties in reading and writing, largely because Malay language often serves as their second or even third language (Lee et al., 2022). These ongoing challenges can negatively affect their future academic performance and career opportunities. To illustrate this, Table 1 presents the Malay language academic achievement of students with hearing impairments from 2022 to 2024 at a selected special education school, highlighting the persistent difficulties they face in mastering the language.

Table i examination results (2022–2024) for students with hearing impairments in malay language subjects

Year	Subject	A	B	C	D	E	Total Students
2022	Malay Language Comprehension	0	0	2	11	20	33
2022	Malay Language Writing	0	0	0	10	23	33
2023	Malay Language Comprehension	0	0	3	5	5	13
2023	Malay Language Writing	2	1	1	0	9	13
2024	Malay Language Comprehension	0	0	0	0	13	13
2024	Malay Language Writing	0	0	0	0	13	13

The results show that most of these students performed poorly, particularly in the *Malay Writing* component compared to the *Malay Comprehension* paper. Most candidates obtained grades D and E, indicating limited mastery of written Malay structures and vocabulary. This trend suggests that students with hearing impairments face considerable difficulties in constructing grammatically correct sentences and expressing ideas in written form (Ramakrishnan et al., 2020).

These findings reinforce the need for innovative instructional strategies, including the integration of Artificial Intelligence (AI), to support and improve the writing skills of deaf students. Recent studies from Muhammed Farsin et al. (2025) showed that through AI-driven tools, language input can be adapted, analysed, and refined to better align with students' linguistic patterns, potentially bridging the gap between sign language and written Malay.

The findings above reveal notable weaknesses in sentence and essay writing among students with hearing impairments, which consequently affect their academic performance in language-based subjects. This issue is deeply rooted in the structural characteristics of Malaysian Sign Language (*Bahasa Isyarat Malaysia, BIM*), as summarized in Table 2.

Table 2 Sentence Patterns In Malaysian Sign Language (Bim)

Pattern	Example (BIM Sentence)	Meaning in Malay Language
Subject + Verb	KUCING MASIH TIDUR	Kucing itu sedang tidur
Subject + Verb + Object	KUCING KEJAR TIKUS	Kucing itu mengejar tikus
Object + Subject + Verb	TIKUS KUCING KEJAR. DAPAT LEPASKAN-DIRI	Kucing itu mengejar tikus. Tikus itu dapat melepaskan diri.
Verb Only	KERJA, KERJA, LETIH, REHAT, TIDUR	Banyak bekerja sehingga rasa letih.
Verb + Object	MAKAN BUAH-BUAH	Memakan buah-buahan.
Object + Verb	BUKU BACA. SEDAP. SERONOK.	Membaca buku ini. Buku ini bagus dan seronok dibaca.

The unique syntactic structure of BIM, which differs substantially from the written form of the Malay language, contributes to frequent grammatical and syntactic errors when students attempt to express ideas in written Malay (Rahim & Ayob, 2024). Since BIM operates as a visual-gestural language emphasizing meaning over grammatical precision, students often transfer BIM sentence patterns directly into writing (Nur Syafiza

Shafee et al., 2022). As a result, their compositions tend to lack proper word order, verb inflection, and sentence cohesion that are essential in standard Malay writing.

With the rapid advancement of educational technology, Artificial Intelligence (AI) presents new opportunities to bridge this linguistic gap (Saddhono et al., 2024). AI-powered language learning tools can automatically detect and correct sentence structure, suggest accurate word sequencing, and provide interactive visual feedback aligned with Malay grammar rules (Yaqin et al., 2025). Integrating AI in the teaching and learning of writing could therefore address both linguistic and cognitive barriers experienced by students with hearing impairments. Accordingly, this study is guided by two main objectives:

- i. To explore how Artificial Intelligence (AI) can assist in transforming sentences written in BIM structures into grammatically accurate Malay language sentences.
- ii. To examine the effectiveness of AI-based learning tools in enhancing the Malay writing proficiency of students with hearing impairments.

LITERITURE REVIEW

AI in Supporting Malay Language Learning for Students with Hearing Impairments

Recent studies indicate that Artificial Intelligence (AI) has significant potential to enhance language education for students with hearing impairments (Papastratis et al., 2021; Qassrawi & Karasneh, 2025). Deaf learners, whose first language is Malaysian Sign Language (*Bahasa Isyarat Malaysia, BIM*), often encounter difficulties in acquiring written Malay due to structural differences between the languages (Chong & Mohd Hussain, 2021; Chong, 2014). AI-based tools provide adaptive and multimodal learning environments that offer immediate feedback, personalized learning pathways, and interactive engagement, which collectively improve motivation, comprehension, and participation (Asri et al., 2019; Berrezueta-Guzman et al., 2025; Parveen et al., 2025).

Evidence suggests that game-based platforms, such as Kahoot, and AI-powered sign-to-text translation systems have been effective in enhancing learners' grammar, vocabulary, and sentence structuring in other languages (Ali et al., 2025; Navinkumar & Sivakami, 2024; Pastushenkov et al., 2025). These findings provide a useful foundation for exploring similar applications in the context of the Malay language. These tools not only reinforce language accuracy but also serve as inclusive pedagogical instruments that promote self-directed learning. Moreover, AI integration aligns with equitable education goals by bridging the linguistic gap between students' visual-gestural communication and written expression, thereby fostering accessibility in literacy development (Leong, 2025; So & Lo, 2025).

A strong foundation in *Bahasa Isyarat Malaysia* (BIM) has been shown to support both cognitive and linguistic development among deaf learners (Chong & Mohd Hussain, 2021; Chong, 2018). Studies have demonstrated that early exposure to sign language contributes to enhanced literacy outcomes, improved reading comprehension, and greater mastery of written syntax (Allen et al., 2014; Gärdenfors, 2023). The theory of cross-linguistic transfer explains how knowledge gained through BIM can facilitate the acquisition of Malay, suggesting that linguistic competence in one modality can positively influence another. In addition, translanguaging approaches that allow learners to move fluidly between sign and written language foster deeper comprehension and promote reflective awareness of language use (Gorter et al., 2021; Wei, 2018). Artificial intelligence (AI) tools that integrate these translanguaging principles serve as an innovative pedagogical bridge that connects learners' visual communication with written Malay in a structured, interactive, and meaningful way.

Educational Impacts, Challenges, and Implications

Although Artificial Intelligence (AI) offers strong potential in language learning for deaf students, its implementation faces persistent challenges. Studies across various sign languages report similar issues, including limited AI resources, small and imbalanced training datasets, and regional variations in sign usage involving phonology, lexicon, and grammar (Bragg et al., 2021; De Sisto et al., 2022; Ringor et al., 2024;

Sindhu et al., 2024). These linguistic diversities make it difficult to design models that can accurately interpret and translate signs across contexts (Sincan et al., 2023). Such limitations are also relevant to *Bahasa Isyarat Malaysia* (BIM), where regional and cultural differences further hinder AI standardization.

Despite these constraints, research consistently shows that AI-assisted technologies enhance literacy and writing development among students with hearing impairments (Alkahtani, 2024; Moustafa et al., 2025; Sarkar et al., 2025; Zhang et al., 2024). Through intelligent functions such as grammatical correction, semantic recognition, and adaptive feedback, AI supports the mastery of complex linguistic structures, promotes longer and more coherent writing, and strengthens learner autonomy while fostering equitable and inclusive learning environments (Alijoyo et al., 2025; Gómez Cano & Colala Troya, 2023; Lai, 2025; Parwani & Devnani, 2024; Yaqin et al., 2025).

While prior studies underscore notable gains, the literature identifies several challenges in implementing AI-based interventions. Limitations include insufficient AI resources, inadequate training datasets, regional BIM variations, and a lack of culturally and linguistically appropriate AI models (Aljanada et al., 2025; Tao et al., 2024). Ethical considerations, such as student privacy, and the importance of maintaining meaningful human interaction, are also emphasized (Asrifan et al., 2025; Torrisi-Steele, 2025). Consequently, effective pedagogical strategies must balance AI-supported automation with human-centered teaching approaches that nurture creativity, social skills, and emotional intelligence (Kolhatin, 2025; Shashwat & Pundhir, 2025).

Overall, the literature demonstrates that AI has transformative potential in supporting Malay language acquisition for deaf students. By enhancing grammar, vocabulary, and engagement, AI serves as both a cognitive and pedagogical tool. Successful adoption in Malaysia requires sustained investment in localized AI development, professional capacity-building for educators, and inclusive policy frameworks that prioritize accessibility and sustainability. Within the bilingual context of BIM and Malay, AI emerges as a key enabler of linguistic accessibility, equitable education, and improved literacy outcomes for students with hearing impairments.

METHODOLOGY

This study employed a qualitative research design to explore how Artificial Intelligence (AI) supports the improvement of Malay language writing skills among students with hearing impairments. The qualitative approach was chosen to provide an in-depth understanding of how these students construct and refine meaning when translating Malaysian Sign Language (*Bahasa Isyarat Malaysia, BIM*) into written Malay with the assistance of AI.

Research Design

The qualitative case study design enabled an in-depth exploration of both learning processes and outcomes, offering nuanced and context-rich insights into how students engaged with AI tools in authentic classroom environments. Following the perspectives of Yin (2009), the study was structured to capture the phenomenon within its real-life educational setting, allowing close examination of naturally occurring interactions. Consistent with Merriam and Tisdell (2015) multiple sources of evidence including classroom observations, interviews, and students' written work, were integrated to build a credible and holistic understanding of the case. In line with Stake's (1995) interpretive stance, this approach emphasized meaning-making from participants' experiences, providing a comprehensive view of how AI shaped their writing development.

Participants

The participants comprised seven students with severe hearing loss (above 120 decibels) from three secondary schools under the Special Education Integration Programme (*Program Pendidikan Khas Integrasi*) in the state of Perak, Malaysia. All participants used BIM as their primary mode of communication and were learning Malay as a second language for academic assessment purposes. Two special education teachers also participated to provide triangulated perspectives.

Data Collection

Data were collected through three complementary methods:

- i. Semi-structured interviews: Conducted with both students and teachers to explore their experiences, challenges, and perceptions of using AI in learning Malay writing.
- ii. Classroom observation: Focused on how students interacted with AI-based correction tools during writing tasks, paying attention to sentence restructuring, vocabulary use, and feedback responses.
- iii. Document analysis: Involved reviewing students' written work before and after using AI tools to identify linguistic improvements, such as changes in sentence structure, morphology, and cohesion.

Data Analysis

The data collected from interviews, classroom observations, and students' written work were analyzed using thematic analysis. This approach was selected to identify patterns, meanings, and relationships within the data related to the use of Artificial Intelligence (AI) in supporting Malay language writing among students with hearing impairments. The analysis followed Braun and Clarke's (2006) six-phase framework, which included familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the final report.

During the familiarization phase, all interview transcripts and observation notes were read repeatedly to gain an overall understanding of students' learning experiences and language difficulties. Initial codes were then generated to capture significant features of the data, such as grammatical correction, sentence restructuring, and the role of AI feedback. These codes were grouped into broader themes that reflected the impact of AI on linguistic development, writing accuracy, and student motivation.

To ensure analytical rigor, all coding and theme development were verified through peer review with two qualitative research experts. The findings were then synthesized to illustrate how AI contributed to the transformation of written Malay structures derived from Malaysian Sign Language patterns.

Ethical Considerations

All participants were informed of the study's purpose, and consent was obtained from their parents or guardians and school administrators. Pseudonyms were used to maintain confidentiality, and all data were securely stored.

RESULT AND DISCUSSION

Objective 1: To explore how Artificial Intelligence (AI) can assist in transforming sentences written in BIM structures into grammatically accurate Malay language sentences

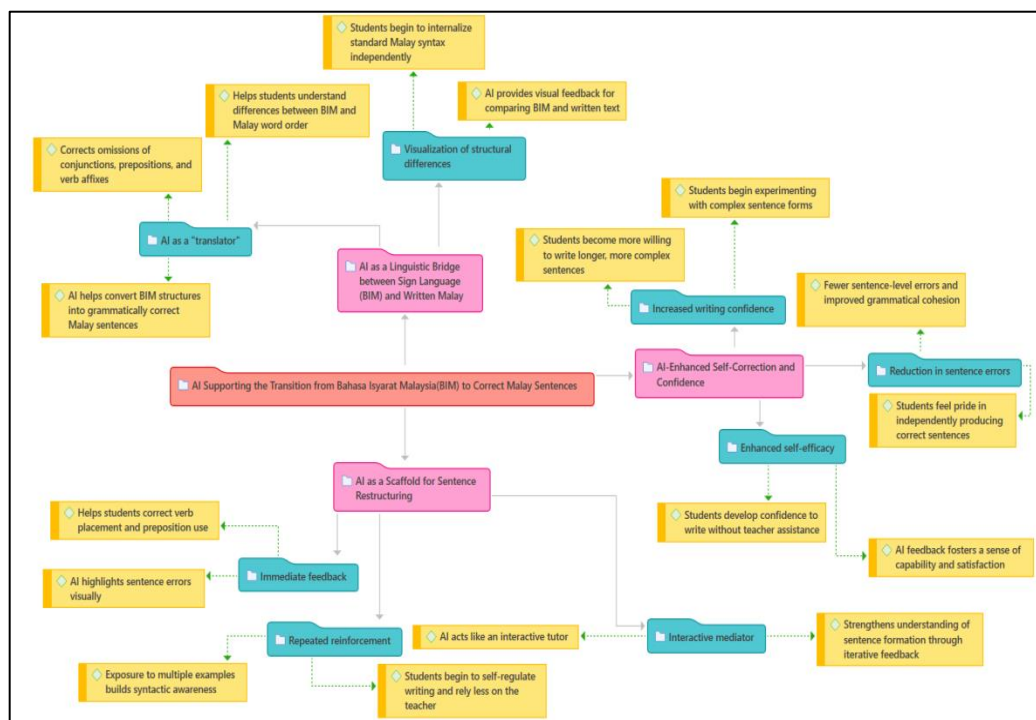
Analysis of interview data, classroom observations, and students' written work revealed that the integration of Artificial Intelligence (AI) tools played a crucial role in supporting students' transition from *Bahasa Isyarat Malaysia (BIM)* structure to grammatically correct Malay sentences. Three dominant themes emerged from the data:

- (1) AI as a linguistic bridge between sign language and written Malay,
- (2) AI as a scaffold for sentence restructuring, and
- (3) AI-enhanced self-correction and confidence.

These themes were further visualized and supported through coding and network mapping in ATLAS.ti, which allowed for a clear representation of the relationships between codes, subthemes, and overarching themes, as

shown in Figure 1.

Figure 1 Ai In Transitioning *Bahasa Isyarat Malaysia (Bim)* To Malay Sentences



AI as a Linguistic Bridge between Sign Language and Written Malay

Teachers and students consistently described AI as a “translator” that helped restructure the non-linear form of BIM into grammatically acceptable Malay sentences. The AI system corrected common linguistic omissions such as missing conjunctions, prepositions, and verb affixes that often occurred when students transferred BIM structures directly into text.

“At first, the students followed the sign language structure directly, but when the AI showed the correct sentence, they began to understand the difference in word order in proper Malay.” (T2)

“When I type my sign words, AI shows the right Malay sentence. I can see the difference between how I sign and how to write it.” (S3)

Observation data revealed that through AI-generated corrections, students began to internalize standard Malay syntax and improved their sentence structure independently. The visual nature of AI feedback was particularly beneficial for hearing-impaired learners, offering an accessible and immediate reference for comparison between sign-based and written forms.

AI as a Scaffold for Sentence Restructuring

AI feedback provided immediate linguistic scaffolding like a teacher’s corrective instruction. Students visually identified grammatical errors, particularly in verb placement and preposition usage, allowing them to reorganize sentences accurately.

“The AI showed that my sentence was wrong... I corrected it myself, and it became right.” (S5)

Teachers observed that the repeated use of AI correction prompts reinforced students’ understanding of Malay grammatical rules, transforming passive correction into active learning. As students gained exposure to multiple examples, they developed syntactic awareness and began to self-regulate their writing. Overall, the AI functioned as an interactive mediator that strengthened students’ understanding of sentence formation through iterative feedback, reducing their dependency on teacher assistance, and promoting independent grammatical

restructuring.

AI-Enhanced Self-Correction and Confidence

The findings also revealed increased student confidence and willingness to take risks in writing. With continuous exposure to AI feedback, students began experimenting with longer and more complex sentence forms. Teachers reported that students who initially struggled to produce coherent sentences gradually improved in fluency and accuracy.

Observation records showed noticeable reductions in sentence-level errors and greater grammatical cohesion. The AI-driven corrections not only provided mechanical accuracy but also nurtured self-efficacy, as students expressed satisfaction and pride in their ability to produce correct sentences independently.

In summary, AI acted as both a linguistic bridge and a cognitive scaffold that supported the restructuring of BIM-based sentences into standard Malay forms. Through visual prompts and real-time corrections, students demonstrated enhanced syntactic awareness, grammatical accuracy, and confidence in independent writing.

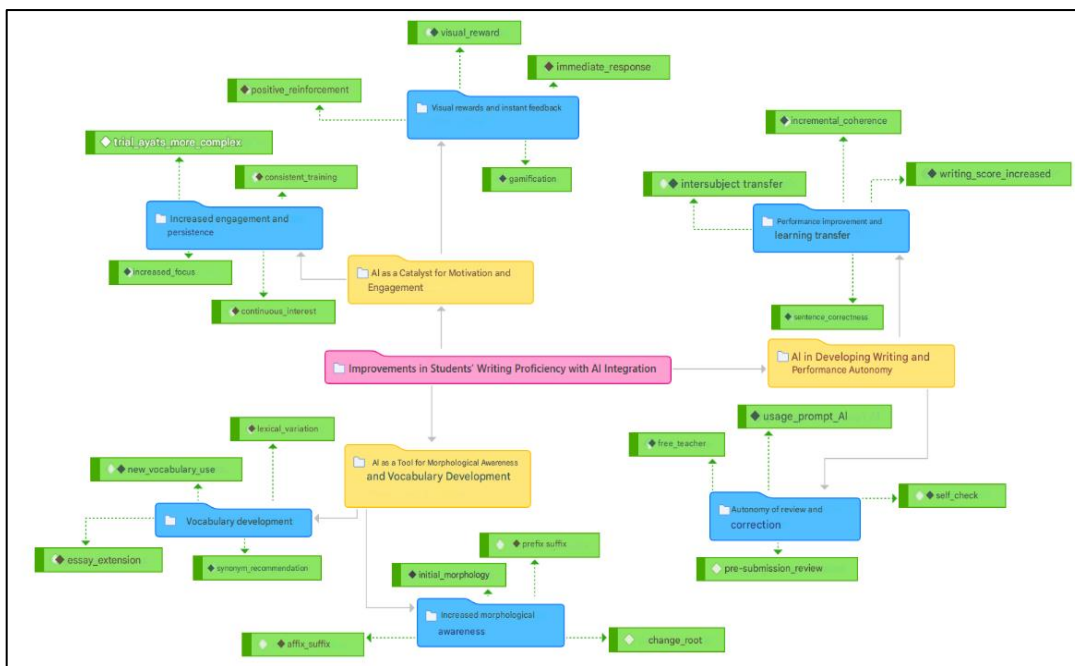
Objective 2: To examine the effectiveness of AI-based learning tools in enhancing the Malay writing proficiency of students with hearing impairments

Triangulated data from interviews, classroom observations, and document analysis revealed significant improvements in students' overall writing proficiency following the integration of AI-based learning tools. Three major themes emerged:

- (1) AI as a tool for morphological awareness and vocabulary expansion,
- (2) AI as a motivational and engagement enhancer, and
- (3) AI in developing writing autonomy and performance.

Figure 2 presents the themes that illustrate the key findings of the study.

Figure 2 Enhanced Writing Proficiency Through Ai-Based Learning



AI as a Tool for Morphological Awareness and Vocabulary Expansion

Teachers and students noted that AI-assisted writing activities exposed learners to new morphological and

lexical patterns. For hearing-impaired students, mastering Malay affixes and function words is particularly challenging, as these elements have no direct visual equivalent in sign language.

“AI tells me why the word ‘tulis’ can become ‘menulis’ or ‘ditulis.’ I start to understand why we add the front part.” (S6)

Through AI-generated explanations and examples, students became more aware of how affixes modified root meanings and grammatical functions. Teachers observed that after several AI-supported writing sessions, students used a wider range of *imbuhan* (affixes) and conjunctions such as “*kerana, walaupun, and supaya*,” demonstrating deeper morphological understanding and richer vocabulary use.

“My students used to repeat the same words. Now, when the AI suggests other words, they try to use them, and their essays become longer.” (T1)

This thematic finding indicates that AI did not merely correct grammar but functioned as a digital linguistic tutor that expanded students’ exposure to authentic language forms, supporting vocabulary development and morphological comprehension.

AI as a Motivational and Engagement Enhancer

Data from interviews and observations also indicated that AI integration significantly increased student motivation and engagement. The visual and gamified features of the platform, such as progress indicators, reward icons, and real-time positive feedback, made learning more interactive and rewarding.

“The AI gives stars when the sentence is correct... it’s fun and makes me want to keep writing.” (S5)

“Before, my students only wrote short sentences. Now, they want to check with AI and make their sentences longer. They feel proud when AI says ‘Good sentence!’.” (T2)

This motivational aspect encouraged more consistent practice and sustained attention among students who typically displayed limited persistence in writing tasks. The immediate feedback loop fostered intrinsic motivation, leading to longer and more complex written outputs.

AI in Developing Writing Autonomy and Performance

Teachers highlighted that AI tools encouraged students to take ownership of their writing process. Rather than relying solely on teacher correction, students began independently reviewing and revising their work using AI prompts before submission.

“Now the students check their work using AI before submitting their essays. They no longer wait for me to correct them.” (T1)

Analysis of students’ writing samples before and after AI integration showed notable improvements in sentence accuracy, coherence, and structure. School-based assessment data further confirmed gains in writing scores across three sequential writing tasks. Moreover, the acquired skills were transferable, students started applying corrected sentence structures in other subjects, reflecting genuine linguistic growth.

Collectively, these findings demonstrate that AI-based learning tools not only improved grammatical accuracy but also cultivated independent learning behaviors and increased students’ confidence in written expression. The technology served both corrective and developmental functions, fostering inclusive and engaging language learning experiences for students with hearing impairments.

In conclusion, the findings reveal that AI-assisted learning significantly contributed to improving the writing skills of hearing-impaired students by functioning as both a linguistic bridge and instructional scaffold. The technology enhanced grammatical understanding, vocabulary acquisition, and writing confidence while fostering motivation and autonomy.

Through triangulated data from interviews, observations, and students' written work, this study provides strong evidence that AI integration can effectively transform sentence construction, morphological awareness, and overall writing proficiency among deaf learners in inclusive Malay language education.

The findings of this study reveal that AI-assisted writing tools played a crucial role in transforming sentences derived from *Bahasa Isyarat Malaysia (BIM)* into grammatically accurate Malay sentences while enhancing the writing proficiency and autonomy of students with hearing impairments. Initially, students tended to follow the structure of sign language directly, resulting in sentences that reflected the visual and spatial grammar of BIM rather than the syntactic norms of Malay. However, when AI tools provided corrected sentence suggestions, the students began to recognise the differences in word order and structure between the two languages. This process reflects how AI can act as a form of scaffolding within Vygotsky's sociocultural theory, enabling learners to internalise new linguistic patterns through guided interaction (Vygotsky, 1978). This finding aligns with Barrios-Beltran (2025), who demonstrated that AI-generated feedback, through repeated exposure and correction, effectively supported second language learners in improving grammatical accuracy and writing fluency. Similarly, in the present study, the AI feedback functioned as a "more capable peer," helping students move from dependence on sign-language syntax toward greater mastery of Malay written grammar.

The data also indicate that AI tools promoted deeper morphological awareness and lexical expansion among students. Teachers reported that learners who previously used repetitive vocabulary began to adopt new words suggested by the AI, producing longer and more coherent compositions. This finding supports earlier research showing that AI-based language tools enhance vocabulary acquisition and grammatical competence by providing contextualised and adaptive feedback (Fathi et al., 2024; Yang, 2025). Students also demonstrated improved understanding of Malay affixes, conjunctions, and discourse markers, which are often challenging for deaf learners due to their limited auditory exposure to morphological patterns (Trussell & Easterbrooks, 2017). The incorporation of AI therefore bridged linguistic gaps by translating visual language structures into text-based linguistic norms, consistent with prior studies on AI-supported bilingual or bimodal language learning (Zawacki-Richter et al., 2019).

Furthermore, the motivational impact of AI was evident in the students' engagement during writing activities. Several participants expressed excitement when the AI system rewarded correct sentences with stars or encouraging comments, stating that such feedback motivated them to continue writing. This aligns with studies suggesting that AI-assisted learning platforms enhance intrinsic motivation through gamified feedback mechanisms and self-paced progression (Kumar et al., 2023; Mohamed et al., 2025). The students' increased willingness to revise and improve their own sentences before teacher review indicates the emergence of self-regulated learning, a critical outcome for learners with special educational needs. This transformation from teacher dependence to learner autonomy suggests that AI tools not only assist with linguistic correction but also foster metacognitive awareness and independent learning behaviours (Mazari, 2025).

The results further underscore the importance of inclusive and technology-enhanced pedagogy in special education. AI serves as an adaptive and assistive learning tool that personalises instruction according to students' cognitive and linguistic profiles, reflecting the principles of Universal Design for Learning (Saborío-Taylor & Rojas-Ramírez, 2024). The study found that students independently used AI to check their writing before submission, demonstrating ownership of the learning process. Such findings are consistent with research advocating for AI integration in language education to promote accessibility and equity for learners with disabilities (Ahmed, 2024; Fitas, 2025). Teachers, therefore, play a pivotal role in guiding ethical and effective AI use in classrooms, ensuring that technology complements human instruction rather than replacing it. As suggested by UNESCO (2023) the professional development of educators in AI literacy is essential to sustain inclusive digital pedagogies that align with educational goals.

Further Research

Future studies should adopt longitudinal designs to examine the long-term linguistic and cognitive impacts of AI-assisted writing among deaf students. Mixed-methods research could also strengthen empirical evidence by combining quantitative measures of writing improvement with qualitative exploration of learner experiences.

Comparative cross-cultural studies are recommended to understand how AI supports bimodal bilingualism among deaf learners in different linguistic contexts. Finally, future research should focus on developing adaptive AI systems capable of translating visual sign input directly into written text through the integration of natural language processing and computer vision technologies.

CONCLUSION

In conclusion, this study demonstrates that AI integration substantially enhances the Malay writing proficiency of students with hearing impairments by functioning as both a linguistic bridge and an instructional scaffold. AI-assisted feedback improved grammatical accuracy, morphological awareness, and learner autonomy while fostering intrinsic motivation and engagement. Beyond a technological intervention, AI represents a pedagogical innovation that promotes equity and linguistic empowerment for deaf learners. With sustained teacher training and inclusive digital policy support, AI can serve as a transformative tool that humanizes and democratizes language learning in special education.

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