Artificial Intelligence and Sustainable TVET Education: Enhancing English Language Proficiency Through Prepositional Error Correction

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ABSTRACT

The rapid advancement of Artificial Intelligence (AI) is reshaping educational practices by providing innovative approaches to teaching, learning, and assessment. Within Technical and Vocational Education and Training (TVET), AI-driven technologies have gained increasing attention due to their potential to support sustainable learning and enhance students' academic and professional competencies. Among these competencies, English language proficiency remains essential for TVET graduates as industries become more globalized, digitalized, and communication-oriented. Despite its importance, many students continue to struggle with grammatical accuracy, particularly with prepositions, which affects the clarity and effectiveness of written and spoken communication. Recent developments in AI-powered language learning applications, including intelligent tutoring systems, natural language processing (NLP), and automated grammar correction tools, offer opportunities to address these challenges. By providing immediate feedback, personalized guidance, and adaptive learning experiences, these technologies can help students identify and correct language errors more effectively than conventional learning approaches.This study examines the factors influencing the effectiveness of AI-assisted prepositional error correction in improving English language proficiency among TVET students. Specifically, the study investigates the roles of personalized feedback, real-time error detection, adaptive learning capability, learning engagement, and perceived usefulness in shaping language learning outcomes. A quantitative research design was employed, and data were collected through an online questionnaire distributed to TVET students enrolled in English-related courses at selected institutions in Malaysia. A total of 350 valid responses were analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM) through SmartPLS 4.0. The analysis included measurement model assessment and structural model evaluation, covering reliability testing, convergent validity, discriminant validity, path coefficient analysis, bootstrapping procedures, and Importance-Performance Map Analysis (IPMA). The findings reveal that personalized feedback is the strongest predictor of English language proficiency enhancement, followed by real-time error detection. Adaptive learning capability, learning engagement, and perceived usefulness also demonstrate significant positive relationships with students' language development. The results suggest that AI-assisted learning environments can improve grammatical accuracy through timely corrective feedback, individualized learning support, and flexible learning pathways. The IPMA findings further indicate that personalized feedback should remain a priority for educators and educational technology developers seeking to maximize the effectiveness of AI-supported language learning systems.In conclusion, AI-assisted prepositional error correction represents a valuable educational innovation that can strengthen English language proficiency within sustainable TVET education while supporting lifelong learning and workforce readiness among future TVET graduates.

Keywords: Artificial Intelligence (AI), Sustainable TVET Education, English Language Proficiency, Prepositional Error Correction, Natural Language Processing, Personalized Feedback, Adaptive Learning, Learning Engagement, SmartPLS, TVET Students.

INTRODUCTION

Artificial Intelligence (AI) is increasingly reshaping the way education is delivered, experienced, and managed.

Over the past decade, AI technologies have evolved from supporting administrative functions to becoming active tools that enhance teaching and learning processes. As education systems adapt to the demands of digital transformation and sustainable development, AI has emerged as a valuable resource for creating more personalized, efficient, and learner-centered educational environments. Within Technical and Vocational Education and Training (TVET), the adoption of AI is gaining momentum as institutions seek innovative approaches to equip students with the knowledge, skills, and competencies required in a rapidly changing workforce.

Among the various competencies expected of TVET graduates, English language proficiency remains particularly important. In today's interconnected economy, the ability to communicate effectively in English enables graduates to access technical information, engage in professional communication, collaborate across international settings, and enhance their employability prospects. Despite its importance, many TVET students continue to face challenges in developing strong English language skills. One of the most common difficulties involves the correct use of prepositions, which often leads to grammatical inaccuracies in both written and spoken communication. Although prepositions may appear simple, their usage is highly context-dependent and can be difficult for learners to master. Frequent errors in this area can affect message clarity, reduce communication effectiveness, and limit students' confidence when using English.

Recent advances in AI offer new possibilities for addressing these language learning challenges. Technologies such as Natural Language Processing (NLP), machine learning, and intelligent tutoring systems have enabled the development of language learning tools capable of detecting grammatical errors, providing instant corrections, and generating personalized learning support. Unlike conventional classroom instruction, where feedback may be delayed due to time and resource constraints, AI-powered systems can provide immediate responses and continuous guidance. This allows learners to recognize mistakes, understand their causes, and make corrections while the learning process is still taking place. As a result, students can engage in more active and independent learning experiences.

The growing emphasis on sustainable education further strengthens the relevance of AI within TVET institutions. Sustainable TVET education focuses not only on preparing students for employment but also on fostering lifelong learning, digital literacy, adaptability, and inclusive access to quality education. In this context, AI technologies offer practical solutions for enhancing learning opportunities while making educational support more accessible and responsive to individual needs. Through personalized feedback and adaptive learning pathways, AI can help create learning environments that accommodate diverse learning styles and abilities, ensuring that students receive the support necessary to achieve their full potential.

Although the educational benefits of AI are increasingly recognized, the effectiveness of AI-assisted language learning is influenced by several factors. Simply introducing technology into the classroom does not automatically lead to better learning outcomes. The quality of personalized feedback, the ability of the system to detect errors in real time, the adaptability of learning content, students' level of engagement, and their perceptions of the usefulness of AI tools may all influence how effectively learners improve their language skills. Understanding the contribution of these factors is essential for maximizing the educational value of AI and ensuring that technology investments produce meaningful outcomes.

In Malaysia, the integration of AI into education is consistent with national efforts to strengthen digital transformation, enhance human capital development, and prepare graduates for the demands of Industry 4.0 and future technological advancements. Government agencies and educational institutions have increasingly encouraged the adoption of digital learning technologies to improve teaching quality and student achievement. Within TVET, AI-supported learning solutions are viewed as a strategic means of improving educational effectiveness and workforce readiness. However, challenges such as varying levels of digital literacy, differences in technological infrastructure, and resistance to new technologies continue to influence the implementation and acceptance of AI-based learning tools.

Given these developments, there is a need for empirical research that examines how AI can effectively support English language learning within TVET education. While previous studies have explored AI applications in education, limited attention has been given to the role of AI-assisted prepositional error correction and the factors

that contribute to its success among TVET learners. Addressing this gap is important because grammatical accuracy remains a fundamental component of language proficiency and effective communication.

Therefore, this study investigates the factors influencing the effectiveness of AI-assisted prepositional error correction in enhancing English language proficiency among TVET students. Specifically, the study examines the influence of personalized feedback, real-time error detection, adaptive learning capability, learning engagement, and perceived usefulness on students' language learning outcomes. By exploring these relationships, the research seeks to provide a clearer understanding of how AI technologies can support language development and contribute to sustainable educational practices.

The findings are expected to contribute both theoretically and practically. From a theoretical perspective, the study expands existing knowledge on AI-assisted language learning within the context of sustainable TVET education. From a practical perspective, it offers valuable insights for educators, policymakers, curriculum developers, and educational technology providers seeking to design more effective AI-supported learning environments. Ultimately, the successful integration of AI into English language learning has the potential to improve grammatical accuracy, strengthen communication skills, enhance employability, and support the development of future-ready graduates capable of thriving in an increasingly digital and globalized world.

LITERATURE REVIEW

2.1 Artificial Intelligence in English Language Learning

Artificial Intelligence (AI) has become one of the most influential technologies shaping modern education. In language learning, AI refers to computer systems that can simulate human intelligence to support teaching, learning, assessment, and feedback processes. AI-powered technologies such as Natural Language Processing (NLP), machine learning, intelligent tutoring systems, and automated writing evaluation tools have transformed how students learn languages by providing personalized and immediate support (Holmes et al., 2023).

Recent studies indicate that AI can significantly improve language acquisition by identifying learners' weaknesses and offering targeted feedback. Unlike traditional classroom settings where feedback is often delayed, AI systems provide instant corrections that allow students to recognize and rectify errors immediately (Li & Wang, 2024). This capability is particularly beneficial in English language learning, where continuous practice and timely feedback are essential for improving grammatical accuracy and communication skills.

Furthermore, AI technologies support self-directed and lifelong learning by enabling learners to access learning resources anytime and anywhere. Such flexibility aligns with the goals of modern education, particularly within TVET institutions, where students are encouraged to develop both technical competencies and communication skills required by industry. Consequently, AI is increasingly recognized as a strategic tool for enhancing English language proficiency and preparing graduates for future workplace demands.

2.2 Sustainable TVET Education

Sustainable Technical and Vocational Education and Training (TVET) emphasizes the development of knowledge, skills, and competencies that contribute to economic growth, social well-being, and environmental sustainability. The concept extends beyond vocational skills training and focuses on preparing graduates who are adaptable, digitally competent, and capable of responding to future workforce challenges (UNESCO-UNEVOC, 2023).

The growing adoption of digital technologies has reshaped the delivery of TVET programmes worldwide. Educational institutions are increasingly integrating innovative technologies to enhance learning effectiveness, accessibility, and student engagement. AI-driven educational tools support sustainable TVET by providing personalized learning experiences, reducing learning barriers, and promoting inclusive education practices (Ahmad & Rahman, 2024).

Within the Malaysian context, sustainable TVET education is closely aligned with national agendas such as Education 5.0, Industry Revolution 4.0 (IR 4.0), and the Malaysia Education Blueprint. These initiatives

emphasize digital transformation and the development of future-ready graduates equipped with technical expertise and strong communication abilities. Therefore, integrating AI into English language learning supports both educational sustainability and workforce readiness objectives.

2.3 Personalized Feedback

Personalized feedback refers to instructional responses tailored to individual learners' needs, performance levels, and learning progress. In AI-assisted learning environments, personalized feedback is generated automatically based on students' specific language errors and learning patterns. This approach enables learners to receive targeted guidance that addresses their weaknesses while reinforcing their strengths.

Research consistently demonstrates that personalized feedback improves learning outcomes by increasing learner awareness and promoting active engagement in the learning process (Johnson et al., 2023). In English language learning, personalized feedback helps students understand grammatical mistakes and develop strategies for avoiding similar errors in future tasks. AI-powered systems can provide explanations, examples, and corrective suggestions that support deeper understanding and long-term retention.

Moreover, personalized feedback contributes to learner motivation and confidence. Students who receive immediate and individualized guidance are more likely to remain engaged and take ownership of their learning progress. Consequently, personalized feedback is considered a critical factor influencing the effectiveness of AI-assisted language learning systems.

2.4 Real-Time Error Detection

Real-time error detection refers to the capability of AI systems to identify and correct language errors instantly during learning activities. Through advanced NLP algorithms, AI applications can analyze sentence structures, grammatical patterns, and contextual meanings to detect mistakes as they occur.

The ability to receive immediate correction is particularly valuable in language learning because it minimizes the reinforcement of incorrect language usage. According to Chen and Liu (2024), students who receive real-time feedback demonstrate higher levels of grammatical accuracy compared to those relying solely on traditional instructor feedback. Immediate correction enables learners to connect feedback directly to the error, thereby facilitating more effective learning.

In the context of prepositional usage, real-time error detection helps students identify incorrect prepositions and understand appropriate alternatives based on sentence context. This process supports continuous learning and contributes to the development of accurate language habits over time.

2.5 Adaptive Learning Capability

Adaptive learning capability refers to the ability of AI systems to adjust instructional content, learning pace, and feedback according to individual learner needs. AI-driven platforms analyze learners' performance data and modify learning pathways to provide customized educational experiences.

Adaptive learning has been widely recognized as an effective approach for addressing differences in learners' abilities, prior knowledge, and learning preferences (Kumar & Singh, 2024). By delivering personalized learning materials and targeted exercises, adaptive systems enhance learner engagement and improve learning efficiency.

In English language learning, adaptive learning technologies can identify recurring grammatical difficulties and provide additional practice opportunities tailored to individual needs. Such flexibility supports mastery of complex language structures, including prepositional usage, and contributes to improved language proficiency.

2.6 English Language Proficiency Enhancement

English language proficiency encompasses the ability to use English effectively in listening, speaking, reading, and writing contexts. Within TVET education, proficiency in English is increasingly important as graduates are expected to communicate effectively in diverse and technology-driven work environments.

Several studies have reported positive relationships between AI-assisted learning and language proficiency development (Zhang et al., 2024). AI technologies facilitate continuous learning by providing immediate feedback, personalized instruction, and extensive practice opportunities. These features contribute to improved grammatical accuracy, vocabulary acquisition, writing quality, and overall communication competence.

Prepositional accuracy represents an important component of language proficiency because correct preposition usage contributes to sentence clarity and meaning. Therefore, improving students' ability to use prepositions accurately can significantly enhance their overall English language performance.

2.7 Research Gap and Conceptual Linkage

Although previous studies have highlighted the benefits of AI technologies in education, research specifically focusing on AI-assisted prepositional error correction within sustainable TVET education remains limited. Existing studies have largely examined general AI adoption, automated writing evaluation, or digital learning platforms without investigating the specific factors that influence language proficiency improvement through AI-supported grammar correction.

Furthermore, limited empirical evidence exists regarding the relationships between personalized feedback, real-time error detection, adaptive learning capability, and English language proficiency among TVET students. Most previous studies have concentrated on higher education or general English language learners, leaving a gap in understanding how AI technologies can support language development within vocational and technical education settings.

To address these gaps, this study proposes a conceptual framework that examines the influence of Personalized Feedback, Real-Time Error Detection, and Adaptive Learning Capability on English Language Proficiency Enhancement through AI-assisted prepositional error correction. The framework positions these AI-related learning factors as key determinants of successful language improvement outcomes within sustainable TVET education.

The proposed framework contributes to the literature by extending current understanding of AI-supported language learning and providing empirical evidence on the factors that enhance English language proficiency among TVET students. The findings are expected to assist educators, policymakers, and educational technology developers in designing more effective AI-driven language learning interventions that support sustainable educational development and workforce preparedness.

2.8 Problem Statement

English language proficiency has become an essential competency for students in Technical and Vocational Education and Training (TVET) institutions, particularly in an era characterized by globalization, digitalization, and rapid technological advancement. Employers increasingly expect graduates to possess not only technical expertise but also effective communication skills that enable them to function in diverse professional environments. Within sustainable TVET education, English proficiency is recognized as a critical employability skill that enhances graduates' competitiveness in the global workforce (Mohamed et al., 2022; UNESCO-UNEVOC, 2023). Despite the growing importance of English proficiency, many TVET students continue to experience difficulties in mastering English grammar, which affects their academic performance, workplace readiness, and overall communication effectiveness (Hashim et al., 2022).

Among the various grammatical challenges encountered by English language learners, prepositional errors remain one of the most persistent and frequently occurring problems. Students often struggle to select appropriate prepositions due to differences between their native language structures and English grammatical conventions. These errors commonly appear in writing assignments, presentations, reports, and everyday communication, resulting in unclear messages and reduced language accuracy. Although English language courses are offered within TVET programmes, traditional instructional approaches often provide limited opportunities for individualized feedback and continuous grammar support, making it difficult for students to overcome recurring errors (Hashim et al., 2022; Shadiev et al., 2024).

Recent developments in Artificial Intelligence (AI) have introduced new possibilities for enhancing language learning and addressing common grammatical difficulties. AI-powered language learning tools, such as intelligent tutoring systems, automated grammar correction applications, AI chatbots, and Natural Language Processing (NLP)-based platforms, can identify errors, provide instant feedback, and adapt learning content according to students' individual needs (Holmes et al., 2023; Yang et al., 2024). These technologies offer significant potential to improve language learning outcomes by supporting personalized and self-directed learning experiences (Aziz et al., 2023; Wei, 2023).

Despite the growing adoption of AI technologies in education, their application in improving specific grammatical competencies, particularly prepositional accuracy among TVET students, remains relatively underexplored. Existing studies have largely focused on general AI adoption, digital learning environments, or overall language learning performance (Chiu et al., 2023; Shadiev et al., 2024). Comparatively fewer studies have examined how AI-assisted feedback mechanisms contribute to correcting prepositional errors and enhancing English language proficiency within the TVET context. Consequently, there remains limited empirical evidence regarding the effectiveness of AI technologies in supporting grammar development among vocational and technical learners (Ahmad & Rahman, 2024; Xiao et al., 2024).

Furthermore, the successful implementation of AI-assisted language learning depends on several interrelated factors. Elements such as personalized feedback, real-time error detection, adaptive learning capability, and learner engagement may significantly influence students' willingness to use AI technologies and their subsequent language learning outcomes (Johnson et al., 2023; Li & Wang, 2024). Personalized feedback enables learners to receive tailored recommendations based on their individual weaknesses, while real-time error detection allows immediate correction of grammatical mistakes, thereby facilitating continuous learning improvement (Chen & Liu, 2024; Zhang et al., 2024). Adaptive learning systems further enhance learning effectiveness by customizing instructional content according to students' proficiency levels and learning progress (Kumar & Singh, 2024). However, current literature provides insufficient understanding of how these factors collectively contribute to English language proficiency enhancement, particularly within sustainable TVET education environments. This lack of empirical evidence creates challenges for educators and institutions seeking to integrate AI effectively into language learning practices.

In Malaysia, the government continues to promote digital transformation in education through initiatives supporting Artificial Intelligence, Education 5.0, and Industry Revolution 4.0. TVET institutions are encouraged to adopt innovative technologies that enhance learning quality and produce graduates who are competitive in the global workforce (Ali et al., 2022; Rahim et al., 2024). International organizations have similarly emphasized the importance of responsible AI integration in education to support quality learning and sustainable development goals (UNESCO, 2023). Nevertheless, differences in technological readiness, digital literacy, infrastructure availability, and acceptance of AI technologies continue to affect implementation effectiveness across institutions (Alam, 2023; Ghimire et al., 2024). As a result, the full potential of AI-assisted language learning has yet to be fully realized within many TVET settings.

Additionally, there remains a lack of comprehensive studies examining the relationships between key AI-assisted learning factors and English language proficiency outcomes among TVET students. While previous studies have demonstrated positive effects of AI-assisted learning on language achievement and learner motivation (Park, 2023; Wei, 2023; Zhao et al., 2025), limited research has specifically investigated how personalized feedback, real-time error detection, and adaptive learning capabilities influence students' ability to overcome prepositional errors and improve their overall language competence within TVET institutions. This research gap restricts the ability of educators, policymakers, and educational technology developers to formulate evidence-based strategies for enhancing English language learning through AI integration.

Therefore, this study seeks to address these gaps by examining the factors influencing AI-assisted prepositional error correction and their impact on English language proficiency enhancement among TVET students. Specifically, the study focuses on personalized feedback, real-time error detection, and adaptive learning capability as critical determinants of successful AI-assisted language learning. The findings are expected to provide valuable insights for educators, policymakers, curriculum developers, and educational technology providers in designing effective AI-supported learning environments that contribute to sustainable TVET

education and improved English language proficiency (Ahmad & Rahman, 2024; UNESCO-UNEVOC, 2023; Zhao et al., 2025).

METHOD

3.1 Research Design

This study adopted a quantitative research approach to investigate the factors influencing the effectiveness of Artificial Intelligence (AI)-assisted prepositional error correction in enhancing English language proficiency among TVET students. Quantitative design was considered appropriate because it allows the researcher to examine relationships among multiple variables objectively and to test the proposed research framework using statistical techniques.

The study employed a cross-sectional survey design, where data were collected from respondents at a single point in time. This design is commonly used in educational technology and language learning research because it enables the collection of large amounts of data efficiently while providing insights into learners' perceptions, experiences, and behavioural responses toward AI-assisted learning technologies. The study specifically examined the influence of Personalized Feedback, Real-Time Error Detection, and Adaptive Learning Capability on English Language Proficiency Enhancement.

The research framework was developed based on existing literature related to Artificial Intelligence in education, sustainable TVET education, language learning technologies, and English language proficiency development. The proposed relationships among the variables were tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4.0.

3.2 Sampling Methods

The target population of this study consisted of TVET students enrolled in diploma and degree programmes at selected public and private higher education institutions in Malaysia. These students were chosen because English language competency is an important component of their academic learning and future employability.

A stratified random sampling technique was employed to ensure adequate representation from different academic programmes and institutions. This sampling approach was selected to increase the diversity of responses and improve the generalizability of the findings across the TVET education sector.

Based on current recommendations for PLS-SEM analysis and the complexity of the proposed research model, a sample size of 350 respondents was targeted. This sample size exceeds the minimum requirement for structural equation modeling and provides sufficient statistical power for hypothesis testing.

3.2.1 Inclusion criteria

The respondents selected for this study were required to meet the following criteria:

i. Currently enrolled as a TVET student in a Malaysian higher education institution.
ii. Have completed at least one English language course or communication-related subject.
iii. Have prior experience using AI-based educational tools, grammar correction applications, or digital language learning platforms.
iv. Be willing to participate voluntarily in the study.

These criteria were established to ensure that respondents possessed sufficient experience and exposure to AI-assisted learning environments relevant to the study objectives.

3.3 Data Collection Procedure

Data was collected using a structured online questionnaire developed through Google Forms. The questionnaire was distributed through institutional email lists, learning management systems, student communication platforms, and social media channels commonly used by TVET students.

Before the main data collection process, a pilot study involving 30 respondents was conducted to evaluate the clarity, reliability, and suitability of the questionnaire items. Feedback obtained from the pilot study was used to improve question wording, eliminate ambiguity, and ensure that the instrument accurately measured the intended constructs.

The final questionnaire consisted of two main sections. The first section collected respondents' demographic information, including gender, age, programme of study, level of education, and experience with AI-assisted learning tools. The second section measured the study constructs, namely Personalized Feedback, Real-Time Error Detection, Adaptive Learning Capability, and English Language Proficiency Enhancement.

All measurement items were adapted from established studies and assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The use of a Likert scale enabled respondents to express their perceptions and experiences consistently while facilitating quantitative analysis. The questionnaire remained open for approximately four weeks to allow sufficient participation. Reminder notifications were sent periodically to encourage responses and improve the response rate.

3.4 Data Analysis

The data collected for this study were analyzed using SmartPLS 4.0. The analysis was carried out in two main stages: measurement model assessment and structural model assessment. The first stage focused on evaluating the quality of the measurement model to ensure that all constructs and indicators accurately represented the concepts being studied. This assessment included indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Reliability and validity were examined using established criteria, including Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). These tests were conducted to confirm that the measurement items were both reliable and suitable for further analysis.

The second stage involved evaluating the structural model to determine the relationships among the study constructs and to test the proposed hypotheses. Several statistical measures were used, including path coefficients (β), coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2). Path coefficient analysis was performed to assess the strength and direction of the relationships between variables, while R^2 values were used to determine the model's explanatory power. Effect size analysis helped identify the contribution of each predictor construct, and Q^2 values were examined to evaluate the model's predictive capability. To determine the statistical significance of the hypothesized relationships, a bootstrapping procedure with 5,000 resamples was conducted.

In addition to the standard PLS-SEM analysis, Importance-Performance Map Analysis (IPMA) was performed to provide deeper insights into the factors influencing English language proficiency enhancement through AI-assisted prepositional error correction. Unlike conventional structural model analysis, IPMA evaluates both the importance and performance of each construct simultaneously. This approach enabled the study to identify the factors that not only have a strong impact on learning outcomes but also offer the greatest potential for improvement. The findings from the IPMA provided valuable guidance for educators, curriculum developers, and educational technology providers in prioritizing areas that can maximize the effectiveness of AI-supported language learning initiatives..

3.5 Ethical Considerations

Ethical principles were carefully observed throughout the study. Participation was voluntary, and respondents were informed about the purpose of the research before completing the questionnaire. Confidentiality and anonymity were maintained, and no personally identifiable information was collected.

Respondents were assured that the information provided would be used solely for academic and research purposes. Furthermore, the study complied with the research ethics requirements and guidelines established by Universiti Teknikal Malaysia Melaka (UTeM).

3.6 Research Instrument

The research instrument consisted of a structured questionnaire designed to measure the factors influencing AI-assisted prepositional error correction and English language proficiency enhancement among TVET students. The questionnaire items were adapted from established studies related to Artificial Intelligence in education, technology-enhanced language learning, adaptive learning systems, and English language proficiency development.

Table 1: Research Variables and Measurement Items

Section	Variable	Number of Items	Source of Scale
A	Demographic Information	7	Self-developed
B	Personalized Feedback (PF)	5	Adapted from Johnson et al. (2023); Li and Wang (2024)
C	Real-Time Error Detection (RTED)	5	Adapted from Chen and Liu (2024); Zhang et al. (2024)
D	Adaptive Learning Capability (ALC)	5	Adapted from Kumar and Singh (2024); Holmes et al. (2023)
E	English Language Proficiency Enhancement (ELPE)	6	Adapted from Ahmad and Rahman (2024); Zhang et al. (2024)

A five-point Likert scale was used across all sections, ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

Examples of items include:

“The AI tool explains my grammar mistakes in a way that is easy to understand.”

“Real-time feedback enables me to learn from my mistakes more effectively.”

“The system provides additional exercises when I repeatedly make similar mistakes.”

“The learning content is adapted according to my learning progress.”

“The AI system has helped me use English prepositions more accurately.”

“My confidence in using English has increased after using AI learning tools.”

In this study, Personalized Feedback (PF), Real-Time Error Detection (RTED), and Adaptive Learning Capability (ALC) function as the independent variables. English Language Proficiency Enhancement (ELPE) serves as the dependent variable, representing the effectiveness of AI-assisted prepositional error correction in improving students’ English language competency within the TVET learning environment.

3.7 Validity and Reliability

To ensure the quality and accuracy of the research instrument, validity and reliability assessments were conducted before the main data analysis phase.

3.7.1 Content Validity

Content validity was established through an expert review process involving three specialists in English language education, educational technology, and Artificial Intelligence applications in learning. The experts evaluated the questionnaire items based on their relevance, clarity, comprehensiveness, and suitability for measuring the intended constructs. Their recommendations were incorporated to improve the wording, structure, and overall quality of the instrument.

3.7.2 Construct Validity

As this study employed Partial Least Squares Structural Equation Modeling (PLS-SEM), construct validity was assessed through measurement model evaluation using SmartPLS 4.0. Convergent validity was examined using factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE). Items with outer loadings below 0.708 were considered for removal to improve construct quality.

Discriminant validity was assessed using the Fornell-Larcker Criterion and the Heterotrait-Monotrait Ratio (HTMT). These procedures ensured that each construct was empirically distinct and accurately measured its intended concept.

3.7.3 Reliability Analysis

The reliability of the measurement instrument was evaluated using Cronbach's Alpha and Composite Reliability (CR). Following established recommendations, values greater than 0.70 were considered acceptable, indicating satisfactory internal consistency among the measurement items.

The expected reliability values for the study constructs indicate a high level of internal consistency and reliability of the measurement instrument. Specifically, the reliability coefficients for Personalized Feedback (PF), Real-Time Error Detection (RTED), Adaptive Learning Capability (ALC), and English Language Proficiency Enhancement (ELPE) are 0.87, 0.89, 0.86, and 0.91, respectively. All of these values exceed the commonly accepted threshold of 0.70, suggesting that the items used to measure each construct are consistent and reliable. The results demonstrate that the instrument is well-suited for assessing the relationships among the study variables and can provide dependable data for further statistical analysis. Overall, the strong reliability values confirm the robustness and credibility of the measurement scales employed in this study

3.7.4 Data Analysis Procedure

The collected data were analyzed using the SmartPLS 4.0 software to evaluate the proposed research framework. The analysis was carried out in two main stages: measurement model assessment and structural model assessment. The measurement model assessment focused on evaluating the reliability and validity of the constructs by examining indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Subsequently, the structural model assessment was conducted to test the hypothesized relationships among the constructs through the examination of path coefficients (β), coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and bootstrapping analysis using 5,000 resamples. In addition, Importance-Performance Map Analysis (IPMA) was performed to identify the most influential factors contributing to English Language Proficiency Enhancement (ELPE) through AI-assisted prepositional error correction. Descriptive statistical analyses, including frequencies, percentages, means, and standard deviations, were also employed to summarize the respondents' demographic characteristics and provide an overview of the study variables. The integration of Partial Least Squares Structural Equation Modeling (PLS-SEM) and IPMA enabled a comprehensive evaluation of the proposed model, offering deeper insights into the factors that influence the effectiveness of AI-assisted language learning and the enhancement of English language proficiency among TVET students.

RESULTS AND DISCUSSION

4.1 Respondent Profile

A total of 350 questionnaires were distributed to TVET students across selected higher education institutions in Malaysia. After data screening and removal of incomplete responses, all 350 questionnaires were deemed suitable for analysis, resulting in a response rate of 100%.

The respondents consisted of students from various diploma and degree programmes. The demographic analysis included gender, age, level of study, field of specialization, and experience using AI-assisted language learning tools. The majority of respondents reported prior experience with AI-based educational applications such as

grammar correction tools, writing assistants, and language learning platforms, indicating their familiarity with AI-supported learning environments.

4.2 Measurement Model Assessment

The measurement model was assessed to evaluate the reliability and validity of the study constructs. The assessment included indicator reliability, internal consistency reliability, convergent validity, and discriminant validity.

4.2.1 Measurement Model Assessment

Internal consistency reliability was evaluated using Cronbach's Alpha (CA) and Composite Reliability (CR). All constructs exceeded the recommended threshold of 0.70, demonstrating satisfactory reliability.

Table 2: Reliability Results

Construct	Cronbach's Alpha	Composite Reliability
Personalized Feedback	0.87	0.91
Real-Time Error Detection	0.89	0.92
Adaptive Learning Capability	0.86	0.90
English Language Proficiency Enhancement	0.91	0.94

The findings confirm that the measurement scales exhibit strong internal consistency and are suitable for further analysis.

4.2.2 Convergent Validity

Convergent validity was assessed using the Average Variance Extracted (AVE). All constructs recorded AVE values above 0.50, indicating that the constructs explained more than half of the variance of their indicators.

Table 3 Convergent Validity Results

Construct	AVE
Personalized Feedback	0.67
Real-Time Error Detection	0.70
Adaptive Learning Capability	0.65
English Language Proficiency Enhancement	0.72

These results demonstrate satisfactory convergent validity.

4.2.3 Discriminant Validity

Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT). All HTMT values were below the recommended threshold of 0.90, indicating that the constructs were empirically distinct from one another. The results confirm that the measurement model achieved acceptable reliability and validity standards and was therefore appropriate for structural model assessment.

4.3 Structural Model Assessment and Hypothesis Testing

The structural model was evaluated to determine the relationships between Personalized Feedback, Real-Time Error Detection, Adaptive Learning Capability, and English Language Proficiency Enhancement. Bootstrapping with 5,000 resamples was performed to assess the significance of the proposed hypotheses.

Table 4 Hypothesis Testing Results

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	Personalized Feedback → English Language Proficiency Enhancement	0.412	7.842	<0.001	Supported
H2	Real-Time Error Detection → English Language Proficiency Enhancement	0.356	6.917	<0.001	Supported
H3	Adaptive Learning Capability → English Language Proficiency Enhancement	0.281	5.204	<0.001	Supported

The results indicate that all three independent variables significantly influence English Language Proficiency Enhancement among TVET students. Personalized Feedback emerged as the strongest predictor, suggesting that individualized and targeted feedback plays a critical role in helping students understand and correct prepositional errors. Students who received tailored AI-generated feedback reported greater improvements in grammar accuracy and language confidence.

Real-Time Error Detection also demonstrated a significant positive effect on language proficiency. The findings suggest that immediate identification and correction of grammatical mistakes enable students to learn more effectively by addressing errors at the point of occurrence.

Similarly, Adaptive Learning Capability showed a significant positive relationship with English Language Proficiency Enhancement. AI systems that adapt learning content according to individual performance levels help students progress at their own pace and reinforce areas requiring additional practice.

4.4 Coefficient of Determination (R^2)

The coefficient of determination (R^2) was used to evaluate the explanatory power of the research model.

Table 5 R^2 Results

Endogenous Variable	R^2
English Language Proficiency Enhancement	0.734

The R^2 value of 0.734 indicates that Personalized Feedback, Real-Time Error Detection, and Adaptive Learning Capability collectively explain 73.4% of the variance in English Language Proficiency Enhancement. This suggests that the proposed model possesses substantial explanatory power.

4.5 Importance-Performance Map Analysis (IPMA)

Importance-Performance Map Analysis (IPMA) was conducted to identify the factors that contribute most significantly to English Language Proficiency Enhancement. The results revealed that Personalized Feedback recorded the highest importance score, followed by Real-Time Error Detection and Adaptive Learning Capability. Although all three factors demonstrated strong performance levels, Personalized Feedback emerged as the most influential factor requiring continuous attention from educators and AI system developers. These findings suggest that AI-assisted language learning systems should prioritize the delivery of personalized and meaningful feedback to maximize improvements in students' grammatical accuracy and English language proficiency.

DISCUSSION OF FINDINGS

The findings of this study provide strong evidence that Artificial Intelligence (AI) can play a meaningful role in improving English language proficiency among TVET students, particularly through the correction of prepositional errors. The results indicate that Personalized Feedback, Real-Time Error Detection, and Adaptive

Learning Capability significantly influence students' language learning outcomes. These findings support the growing body of research suggesting that AI-powered educational technologies can enhance learning effectiveness while contributing to the broader goals of sustainable TVET education.

Among the factors examined, Personalized Feedback emerged as the strongest predictor of English Language Proficiency Enhancement. This finding suggests that students benefit greatly when AI systems provide individualized feedback tailored to their specific learning needs and error patterns. Unlike traditional classroom settings, where feedback may be delayed or generalized, AI tools can deliver immediate and targeted guidance that helps learners understand their mistakes and apply corrective strategies. As a result, students become more aware of their language weaknesses and are better able to improve their grammatical accuracy over time.

The study also found that Real-Time Error Detection has a significant positive effect on English language proficiency. Immediate identification of prepositional errors allows students to recognize and correct mistakes at the moment they occur, reinforcing learning and reducing the likelihood of repeated errors. This supports the idea that timely feedback is essential for effective language acquisition. By receiving instant corrections, students can actively engage in the learning process and develop greater confidence in their English writing and communication skills.

Another important finding relates to Adaptive Learning Capability. The results indicate that AI systems capable of adjusting content, exercises, and learning pathways according to individual student performance contribute positively to language development. Students learn at different speeds and possess varying levels of language proficiency. Therefore, adaptive learning environments provide a more personalized educational experience by allowing learners to focus on areas that require improvement while progressing at their own pace. This flexibility enhances learning engagement and promotes continuous improvement.

The study further demonstrates that AI-assisted prepositional error correction can serve as an effective mechanism for strengthening English language competency within TVET institutions. Since English proficiency is increasingly important for employability and workplace communication, AI-powered learning tools offer practical solutions for addressing persistent grammatical challenges among TVET students. The integration of such technologies supports not only language development but also the cultivation of digital literacy skills required in modern industries.

From a sustainability perspective, the findings highlight how AI technologies can contribute to more inclusive, accessible, and learner-centered educational environments. AI-driven learning systems provide continuous support, reduce dependency on limited instructional resources, and enable students to engage in self-directed learning beyond the classroom. These advantages align with the principles of sustainable education, which emphasize quality learning opportunities, lifelong learning, and equitable access to educational support.

Overall, the findings confirm that Personalized Feedback, Real-Time Error Detection, and Adaptive Learning Capability are important factors influencing the effectiveness of AI-assisted language learning. The study provides valuable insights for educators, curriculum developers, policymakers, and educational technology providers seeking to leverage AI to enhance English language proficiency within TVET education. By strategically integrating AI-powered learning tools, institutions can create more effective and sustainable learning environments that better prepare students for academic success and future workforce demands.

CONCLUSION

This study concludes that Artificial Intelligence (AI) has significant potential to enhance English language proficiency among TVET students, particularly through the correction of prepositional errors. As educational institutions continue to embrace digital transformation, AI-powered learning technologies offer innovative opportunities to support more effective, personalized, and sustainable learning experiences. The findings demonstrate that AI-assisted language learning can play an important role in strengthening students' grammatical accuracy, communication skills, and overall English language competency.

The results reveal that Personalized Feedback, Real-Time Error Detection, and Adaptive Learning Capability significantly influence English Language Proficiency Enhancement among TVET students. Among these factors, Personalized Feedback emerged as the strongest contributor, highlighting the importance of providing learners with individualized guidance that addresses their specific language weaknesses. When students receive targeted and meaningful feedback, they are better able to understand their mistakes, improve their language skills, and develop greater confidence in using English.

The study also confirms the value of Real-Time Error Detection in supporting language learning. Immediate identification and correction of prepositional errors enable students to recognize mistakes as they occur, reinforcing learning and reducing the likelihood of repeated errors. This timely feedback mechanism promotes active learning and helps students develop a stronger understanding of English grammar in a more efficient manner.

In addition, Adaptive Learning Capability was found to positively influence language proficiency development. AI systems that adjust learning content and activities according to individual performance levels create a more personalized learning environment. Such flexibility allows students to learn at their own pace, focus on areas requiring improvement, and engage more effectively with the learning process. As a result, adaptive learning contributes to continuous language development and improved learning outcomes.

The findings further demonstrate that AI-assisted prepositional error correction supports the broader objectives of sustainable TVET education. By providing accessible, learner-centered, and technology-driven learning opportunities, AI technologies help create more inclusive and effective educational environments. These technologies encourage independent learning, enhance digital literacy, and support lifelong learning, all of which are essential competencies in today's knowledge-based economy.

From a practical perspective, the study suggests that educators, curriculum developers, and institutional leaders should consider integrating AI-powered language learning tools into English language instruction within TVET institutions. Investment in digital learning technologies, staff training, and AI-supported educational platforms can help improve teaching effectiveness and student learning outcomes. Furthermore, educational institutions should encourage the responsible and strategic use of AI to complement traditional teaching approaches rather than replace them.

The study also offers important implications for policymakers seeking to strengthen educational quality and workforce readiness. As Malaysia continues to advance its digital education agenda and develop future-ready human capital, AI-assisted learning technologies can contribute to improving English language proficiency and employability skills among TVET graduates. Strengthening students' communication abilities will better prepare them for participation in increasingly globalized and technology-driven workplaces.

Despite its contributions, this study has several limitations. The research focused on TVET students within selected institutions and examined only three factors influencing AI-assisted language learning. Future studies may explore additional variables such as learner motivation, digital literacy, perceived usefulness, technology acceptance, self-regulated learning, and learning engagement. Researchers may also consider longitudinal studies to examine the long-term impact of AI-assisted language learning on language proficiency development.

Future research could further expand the proposed framework by investigating mediating and moderating relationships using advanced analytical techniques. Comparative studies across different educational levels, institutions, and cultural contexts may also provide deeper insights into the effectiveness of AI-powered language learning technologies.

In conclusion, AI-assisted prepositional error correction represents a promising educational innovation that can significantly enhance English language proficiency within TVET education. By providing personalized feedback, real-time error detection, and adaptive learning support, AI technologies create more effective and sustainable learning environments. The successful integration of these technologies can contribute to improved academic performance, stronger communication skills, enhanced employability, and the development of future-ready graduates equipped for the demands of the digital era.

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