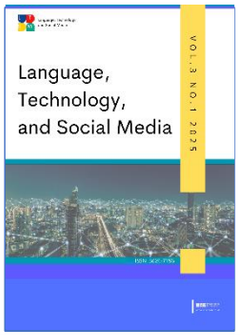

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Harnessing Artificial Intelligence for ESL Assessments: Efficiency, Challenges, and Future Directions

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Research Article

Harnessing Artificial Intelligence for ESL Assessments: Efficiency, Challenges, and Future Directions

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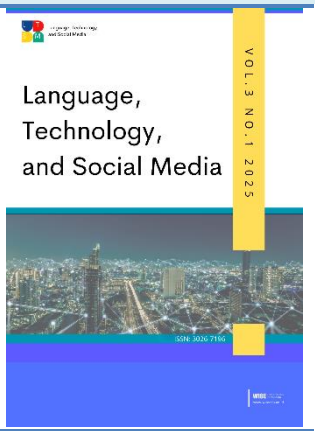
Abstract

The integration of Artificial Intelligence (AI) into English as a Second Language (ESL) assessments has revolutionized traditional practices by offering efficiency, accuracy, and personalized learning pathways. This study employs a mixed-methods approach to evaluate the effectiveness of AI tools, such as Grammarly, Duolingo, and Write & Improve, in improving ESL learners' proficiency across writing, reading, speaking, and listening skills. Quantitative findings from 150 learners show significant improvements in writing (16.6%) and reading (13.8%), while gains in speaking (5.4%) and listening (4.2%) remain modest, reflecting the limitations of AI in handling nuanced oral communication. Qualitative insights from 20 instructors reveal challenges, including algorithmic bias, cultural insensitivity, and concerns over data privacy. Despite these issues, AI tools are praised for reducing grading time and providing instant feedback. The study emphasizes the need for ethical guidelines, equitable access, and human oversight to address existing limitations and ensure inclusive educational outcomes. Additionally, it highlights the digital divide, where socio-economic disparities limit access to premium AI tools, exacerbating educational inequalities. By combining quantitative data with qualitative insights, this research provides a comprehensive understanding of AI's role in ESL education. It advocates for a balanced integration of AI, positioning it as a complementary tool that amplifies human expertise rather than replacing it. This study contributes to ongoing discussions on the ethical and practical implications of AI in education, offering recommendations for policymakers, educators, and developers to optimize its potential.

Keywords: Artificial Intelligence; Digital Media; Ethical Implications; Human Creativity; Sociocultural Impact; Digital Art; Technology



INTRODUCTION

The integration of Artificial Intelligence (AI) in education has significantly transformed traditional pedagogical frameworks, particularly in the realm of language learning and assessment [1], [2], [3], [4], [5]. English as a Second Language (ESL) assessments, which have long been characterized by their labor-intensive processes, have evolved with the advent of AI technologies, offering unprecedented opportunities to enhance efficiency, accuracy, and scalability [6], [7], [8], [9]. These advancements address the growing global demand for accessible language proficiency evaluation, yet they simultaneously introduce critical challenges, such as algorithmic bias, cultural insensitivity, and socio-economic disparities in access to technology. AI-powered tools like Grammarly, Duolingo, and Write & Improve exemplify the transformative potential of AI in education [10], [11], [12]. By leveraging advanced technologies, including natural language processing (NLP) and speech recognition, these tools provide immediate, data-driven feedback for language learners. They automate grading, enable adaptive testing, and facilitate real-time progress tracking, effectively mitigating the inefficiencies and subjectivity inherent in traditional assessments [13], [14], [15], [16]. However, despite these benefits, AI systems often struggle with nuanced oral communication, regional accents, and idiomatic expressions, highlighting gaps in their applicability for diverse ESL learners.

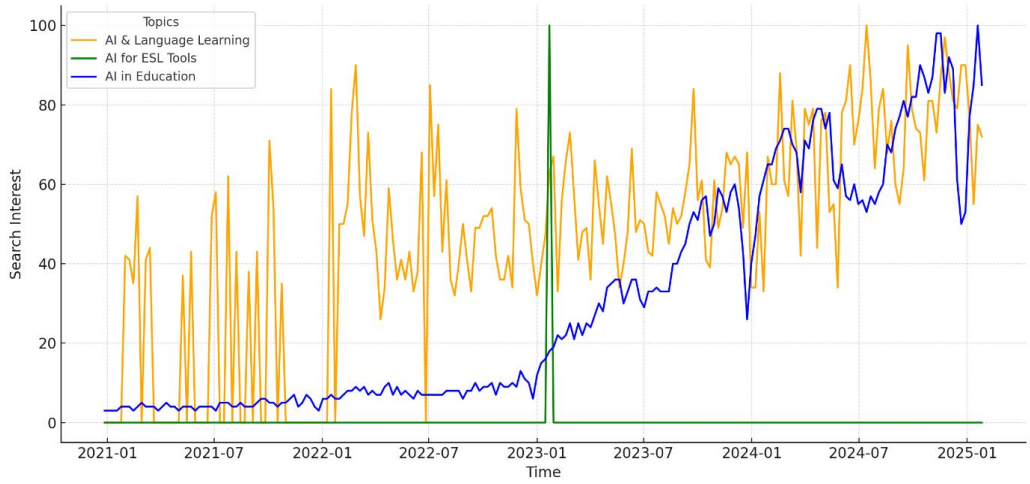


Figure 1. Trend in AI Usage for Education and ESL Tools (2020 – 2025)

A critical examination of global trends underscores the urgency of addressing these challenges. Google Trends data from 2020 to 2024 shows consistent growth in interest toward "AI in Education," reflecting widespread recognition of its transformative potential. However, more specialized applications, such as "AI for ESL Tools," have received comparatively less attention, suggesting a significant research gap. This lack of focus is particularly concerning given the pressing need to explore how AI tools can be optimized for equitable and culturally sensitive applications in ESL education.

Although prior studies, such as those by Kamalov et al. [17] and Son et al. [10], have demonstrated the efficacy of AI-driven feedback systems in improving learning outcomes, critical issues remain unaddressed. For instance, algorithmic bias in AI-based tools disproportionately affects learners from underrepresented linguistic and cultural backgrounds. Furthermore, socio-economic disparities limit access to premium AI functionalities, perpetuating educational

inequities. Current research also provides limited insights into how AI systems can reliably assess oral skills, such as speaking and listening, which are essential for comprehensive language acquisition.

This study seeks to bridge these gaps by employing a mixed-methods approach that evaluates the effectiveness of AI tools in enhancing language proficiency while exploring their socio-cultural and ethical implications. By integrating quantitative data with qualitative insights from learners and instructors, the research aims to develop a balanced framework that harmonizes the capabilities of AI with the irreplaceable expertise of human educators. This approach positions AI as a complementary tool, ensuring its transformative potential is leveraged to support equitable, inclusive, and culturally responsive ESL assessments worldwide.

METHODS

Research Design

This study employed a mixed-methods approach, combining quantitative and qualitative data to conduct a thorough analysis of the role of AI in ESL assessments. The mixed-methods approach was chosen to capture both the measurable outcomes of AI integration in language learning and the subjective experiences of instructors and learners. Quantitative data was cantered on enhancements in language proficiency, while qualitative data provided insights into user satisfaction and perceived challenges.

Population and Sample

The study included 150 ESL learners and 20 ESL instructors from six language institutes and colleges. Participants were selected using purposive sampling technique to ensure a wide range of English proficiency levels, from A1 (beginner) to C1 (advanced), as defined by the Common European Framework of Reference (CEFR). The student participants, aged18 to 35 years, came from diverse socio-economic backgrounds, providing various perspectives on the use of AI-assisted tools. The 20 instructors had an average of more than five years of ESL teaching experience and were actively incorporating AI-based tools into their teaching practices. This professional background provided valuable insights into the practical application of AI in language education. The selection criteria for both students and instructors emphasized diversity in proficiency levels and teaching methods to thoroughly evaluate the effectiveness and challenges of AI in ESL assessments.

Research Instrument

To ensure comprehensive data collection, this study utilized a combination of standardized instruments and researcher-developed tools. These instruments were designed to measure the impact of AI on ESL assessments, focusing on both quantitative and qualitative aspects.

Standardized Instruments

Pre- and Post-Tests: The quantitative assessment utilized standardized ESL proficiency tests adapted from the Cambridge English Assessment Framework. These tests evaluated four language skills: Reading, Writing, Speaking and Listening.

Rubrics for Scoring: Pre- and post-tests were scored using a five-point rubric that measured accuracy, fluency, vocabulary use, grammatical range, and coherence.

Researcher-Developed Tools

Teacher Interview Protocol: A semi-structured interview guide was developed to explore teachers' perceptions of AI tools. The guide consisted of 10 open-ended questions focusing on: a) The effectiveness of AI tools in assessing language skills; b) Challenges encountered, including algorithmic bias and data privacy; c) Recommendations for enhancing AI tools in the future.

Student Survey: A survey to gauge student satisfaction with AI tools was developed. The survey included: a) Closed-ended questions (using a Likert scale: 1-5) to evaluate perceived effectiveness, usability, and satisfaction; b) Open-ended questions to gather qualitative insights on challenges and expectations.

Table 1. Summary of Research Instruments

Instrument	Purpose	Target Group	Items/Focus
Pre- and Post-Tests	Measure language proficiency improvement	Students (N = 150)	Four skills: reading, writing, speaking, and listening. Each test contained 40 items, with 10 items per skill.
Rubrics for Scoring	Provide standardized scoring for test responses	Scorers	Five dimensions: accuracy, fluency, vocabulary use, grammatical range, and coherence.
Teacher Interview Protocol	Explore teacher perceptions of AI tools	Teachers (N = 20)	10 open-ended questions: effectiveness, challenges (bias, privacy), and future recommendations.
Student Survey	Evaluate satisfaction and perceived effectiveness	Students (N = 150)	20 closed-ended questions (Likert scale: 1-5) and 5 open-ended questions focusing on usability, challenges, and feedback.

Table 2. Sample Pre- and Post-Test Rubric

Dimension	Description	Score Range (1-5)
Accuracy	Correct use of grammar, vocabulary, and sentence structure.	1 (poor) - 5 (excellent)
Fluency	Smooth flow of ideas and natural use of language.	1 (poor) - 5 (excellent)
Vocabulary Use	Appropriateness and variety of word choices.	1 (poor) - 5 (excellent)
Grammatical Range	Use of diverse grammatical structures.	1 (poor) - 5 (excellent)
Coherence	Logical connection and overall structure of the response.	1 (poor) - 5 (excellent)

Data Collection Procedures

Data collection in this study was conducted over a six-month period to comprehensively evaluate the role of AI in ESL assessments. Quantitative data were gathered through pre- and post-tests, adapted from the Cambridge English Assessment Framework, to measure participants' proficiency across the four core language skills: reading, writing, speaking, and listening. These tests were administered at two key intervals: before the integration of AI tools and after their sustained use.

AI tools such as Grammarly, Duolingo, and Write & Improve were employed to provide automated feedback and adaptive learning experiences during this period. To complement the quantitative data, qualitative insights were collected through semi-structured interviews and surveys. Twenty ESL instructors, selected based on their active use of AI tools in their classrooms, participated in interviews designed to explore their perspectives on the effectiveness, challenges, and future potential of AI-driven assessments. The interviews were guided by ten open-ended questions focusing on issues such as algorithmic bias, data privacy, and the contextual accuracy of AI tools.

Additionally, 150 students completed a survey that combined closed-ended Likert scale questions with open-ended responses to capture their satisfaction levels, perceived effectiveness of the tools, and any challenges they encountered. To ensure validity and reliability, the pre- and post-tests underwent a pilot test with a small sample prior to the main study, while the interview and survey instruments were reviewed by senior ESL educators. The integration of these quantitative and qualitative methods provided a robust basis for understanding the measurable outcomes and contextual nuances of AI implementation in ESL assessments.

Data Analysis Procedures

The data analysis in this study was conducted using both quantitative and qualitative methods to ensure a comprehensive understanding of the role of AI in ESL assessments. Quantitative data, obtained from pre- and post-tests, were analyzed using paired t-tests to assess the statistical significance of improvements in the four primary language skills: reading, writing, speaking, and listening. This analysis was performed using SPSS version 27, enabling a thorough evaluation of the effectiveness of AI tools in enhancing language proficiency. Additionally, Cohen's d was used to calculate effect sizes, providing insight into the practical significance of the results and the magnitude of the impact. The data was also broken down by skill area to pinpoint specific domains where AI tools had the most significant impact, revealing substantial improvements in writing and reading skills, with more modest gains in speaking and listening. Qualitative data, gathered through semi-structured interviews and surveys, were analyzed using a grounded theory approach to uncover recurring themes and patterns. NVivo 12 software was utilized to ensure systematic coding and rigorous thematic analysis. Themes that emerged from the data included instructor perspectives on the strengths and limitations of AI-driven automated grading and feedback, as well as student perceptions regarding the contextual accuracy and usability of AI tools. Specific challenges such as algorithmic bias, data privacy concerns, and AI's inability to fully interpret creative and idiomatic expressions were also identified. By integrating these qualitative insights with quantitative findings, a multidimensional view of the role of AI in ESL assessments was achieved, highlighting both its potential and limitations in current educational settings.

RESULTS AND DISCUSSION

Effectiveness of AI Tools on Language Skills

The quantitative results revealed significant improvements in students' performance across the four primary language skills: writing, reading, speaking, and listening. The improvement rates varied, with the highest gains observed in writing and reading. Detailed pre- and post-test scores are presented in Table 3.

Table 3. Pre- and Post-Test Scores by Skill Area

Skill Area	Pre-Test Mean	Post-Test Mean	Improvement (%)	Effect Size (Cohen's d)
Writing	68.2	79.5	16.6%	1.15
Reading	71.0	80.8	13.8%	0.98
Speaking	64.5	68.0	5.4%	0.45
Listening	66.3	69.1	4.2%	0.35

From the data, it is evident that writing skills showed the highest improvement at 16.6%. This significant increase can be attributed to AI tools such as Grammarly and Write & Improve, which offer automated and detailed feedback on grammar, vocabulary, and coherence. Similarly, reading skills saw an improvement of 13.8%, as AI tools helped enhance comprehension and vocabulary development through adaptive exercises. On the other hand, speaking and listening skills only showed modest gains of 5.4% and 4.2%, respectively. These smaller improvements underscore the current limitations of AI tools in accurately capturing speech fluency and pronunciation, especially when faced with diverse accents and nuanced expressions.

Perceptions of AI Tools Among Instructors and Students

To complement the quantitative findings, qualitative data from teacher interviews and student surveys were analyzed to explore their perceptions of AI tools. Table 4 summarizes the recurring themes identified from the qualitative data.

Table 4. Key Themes from Teacher Interviews and Student Surveys

Perspective	Key Themes	Explanation
Teachers	Efficiency in Grading	AI tools significantly reduced grading time, particularly for writing tasks.
	Challenges in Evaluating Creativity	Teachers noted AI's inability to assess creative or idiomatic expressions.
	Data Privacy Concerns	Teachers expressed apprehension about how user data is stored and utilized.
Students	High Satisfaction	84% of students rated the tools as "satisfactory" or "very satisfactory."
	Contextual Limitations	Students highlighted issues in AI's adaptability to cultural nuances.
	Usability	Tools were praised for their user-friendly design and instant feedback.

Teachers appreciated the efficiency of AI in automating grading processes but emphasized the need for human oversight to address creativity and contextual understanding. Students were generally satisfied with the tools, particularly their ease of use and the quality of instant feedback. However, some raised concerns about AI's limitations in adapting to idiomatic and culturally specific language.

Impact of AI on Individual Language Skills

The impact of AI tools on individual skills varied significantly, as detailed in Table 5.

Table 5. Skill-Specific Impact of AI Tools

Language Skill	Observed Impact	Contributing Factors
Writing	High improvement	Detailed grammar correction and structured feedback.
Reading	Significant improvement	Adaptive exercises enhanced comprehension and vocabulary.
Speaking	Moderate improvement	Limited ability to assess fluency and pronunciation accuracy.
Listening	Minimal improvement	Challenges in understanding diverse accents and complex phrases.

The tools demonstrated exceptional effectiveness in improving writing and reading skills by offering precise and immediate feedback. However, gains in speaking and listening skills were minimal. Speech recognition technology faces challenges with linguistic diversity and accent nuances, which hinders its effectiveness in assessing oral proficiency.

Equity in Access and Digital Divide

The study also examined equity in access to AI tools, revealing significant disparities based on socio-economic factors. Table 4 outlines access levels to AI tools among participants.

Table 6. Access to AI Tools by Socio-Economic Status

Socio-Economic Group	Access to AI Tools	Observed Outcomes
High-Income	Premium subscriptions	Significant improvements across all skill areas.
Low-Income	Free versions only	Limited improvement due to restricted features.

Students from higher-income groups had access to premium versions of AI tools, which provided advanced features like personalized feedback and extensive content libraries. Conversely, those from lower-income groups relied on free versions, which limited their ability to achieve comparable learning outcomes. This highlights the pressing need for equitable policies and resource distribution to bridge the digital divide.

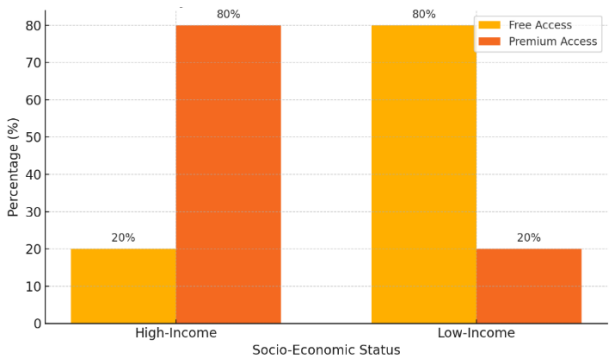


Figure 2. Accessibility of AI Tools Based on Socio-Economic Status

Discussion

This study reinforces the transformative role of AI in ESL assessments, particularly in enhancing efficiency and objectivity. The quantitative findings indicate significant improvements in students' writing and reading skills, aligning with prior research by Marzuki et al. [18], which emphasized the effectiveness of AI tools, such as Grammarly, in identifying grammatical errors and enhancing vocabulary. These improvements substantiate the argument that AI can mitigate the subjectivity inherent in traditional assessments while expediting the learning process. The integration of AI in language education, particularly in enhancing speaking and listening skills, presents both promising advancements and significant challenges. Despite the potential of AI tools like intelligent tutoring systems and speech recognition to transform language learning by offering personalized and adaptive experiences, these technologies still face limitations in capturing the nuances of accent, natural rhythm, and idiomatic expressions, which are crucial for effective communication in linguistically diverse contexts [19], [26], [27]. The modest improvements in speaking (5.4%) and listening (4.2%) skills highlight the need for further innovation in AI-driven oral language assessment tools [26]. While AI has shown efficacy in improving pronunciation accuracy and learner engagement, as demonstrated by the use of AI tools like Listnr and Murf, challenges remain in accurately interpreting feedback and capturing subtle pronunciation differences [20] [28] [29]. Additionally, machine learning approaches in analyzing public speaking and vocal delivery have shown promise in providing objective evaluations but are hindered by issues such as data privacy and the need for diverse datasets [30]. These challenges underscore the necessity for ongoing research and development to enhance AI's ability to handle the complexities of human language, ensuring that AI tools can effectively support language learning in diverse educational settings [28] [29].

The integration of AI in education, particularly in ESL assessments, presents significant ethical and socio-economic challenges. Disparities in access to AI tools, as highlighted by various studies, indicate that students from lower-income backgrounds, who often rely on free versions, experience less improvement in language skills compared to their higher-income peers with access to premium features, thereby exacerbating existing educational inequalities [21]. Furthermore, despite advancements in speech recognition technologies, persistent limitations remain in capturing linguistic nuances, which underscores the need for innovation in AI-driven assessment tools [25]. The findings emphasize the urgency for policies that ensure equitable access to educational technology, such as subsidies for premium tools, to mitigate these disparities and promote inclusive education [30]. The study highlights the critical need for culturally representative training datasets to address algorithmic bias and accessibility issues in AI implementation within multicultural contexts. Research indicates that AI systems often struggle with culturally nuanced expressions, which can lead to misinterpretations and reinforce existing biases, particularly when trained on datasets lacking diversity [21], [23], [25]. Furthermore, the advocacy for a collaborative framework positions AI as a supportive tool for educators, enhancing language learning and assessment rather than replacing human roles [22], [24]. This approach not only promotes inclusivity but also emphasizes the importance of ethical AI practices that engage local communities and reflect diverse cultural perspectives, ultimately fostering trust and equity in AI applications [25], [27].

The integration of AI in education presents significant implications for educators, technology developers, and policymakers. Educators are encouraged to incorporate AI tools with human oversight to mitigate algorithmic biases and enhance accountability, ensuring that

personalized learning experiences do not compromise the essential human element of education [29]. Technology developers can utilize findings from recent studies to refine speech recognition algorithms and create culturally inclusive educational tools, addressing the disparities in access to AI technologies [28]. Policymakers are urged to establish regulatory frameworks that promote ethical AI use, equitable access, and robust data protection, thereby fostering an environment where AI can effectively support diverse learning needs while safeguarding against potential discrimination and privacy concerns [20]. This collaborative approach among stakeholders is vital for maximizing the benefits of AI in educational contexts. By integrating quantitative improvements in language proficiency with qualitative insights from instructors and students, this discussion offers a comprehensive understanding of AI's impact on ESL assessments. The findings confirm AI's potential to transform assessment practices, but also emphasize its limitations and risks, calling for a balanced integration that harmonizes technological innovation with the indispensable human elements of teaching and learning. Such an approach not only ensures the effectiveness of AI-enhanced education but also promotes inclusive and equitable learning environments.

CONCLUSION

The study concludes that AI significantly enhances the efficiency and objectivity of ESL assessments, particularly in improving writing and reading skills. However, limitations persist in addressing speaking and listening proficiency, as AI tools struggle with cultural nuances and diverse accents. Ethical challenges such as algorithmic bias, data privacy, and the digital divide underscore the necessity for equitable and inclusive AI integration. While AI proves valuable as a complement to human instruction, its reliance on human oversight for contextual and creative understanding remains crucial. Future research should explore diverse populations, evaluate a broader range of AI tools, and adopt longitudinal approaches to assess the sustained impact of AI on language education, ensuring its role as an enabler of equitable and meaningful learning experiences.

LIMITATIONS

This study is limited by its sample drawn from a few language institutes, which may affect generalizability. The assessment tools may not fully capture improvements in speaking and listening skills, where AI shows limitations. Qualitative findings reflect subjective experiences that could introduce bias. The six-month duration restricts insights into long-term impacts, and socio-economic disparities limit equitable access to AI features. Future research should address these issues with broader samples, longer timelines, and enhanced oral skill assessments.

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AUTHOR CONTRIBUTION

SRA, FD, SRM, and HTG contributed to this study. SRA conceptualized the research, designed the methodology, and supervised the overall project. FD managed data collection, conducted statistical analyses, and prepared the visualizations. SRM contributed to the literature review, data interpretation, and drafting of the discussion section. HTG critically revised the manuscript to ensure academic rigor and compliance with international journal standards. All authors reviewed, edited, and approved the final version of the manuscript, agreeing to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors used ChatGPT during the preparation of this work to create graphics for enhanced visual appeal. After utilizing the tool, the authors thoroughly reviewed and edited the content as necessary and assumed full responsibility for the publication's content.

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