ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL

LEVERAGING AI-POWERED LANGUAGE TOOLS TO ENHANCE ENGLISH PROFICIENCY AMONG SECONDARY SCHOOL STUDENTS IN PAKISTAN: CHALLENGES AND OPPORTUNITIES

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Abstract:
This study explores the integration of AI-powered language learning tools in enhancing English language proficiency among secondary school students in Pakistan. Adopting a mixed-method approach, quantitative data was collected through pre- and post-intervention language assessments of 200 students using AI tools such as ChatGPT, Grammarly, and Duolingo. Qualitative insights were drawn from semi-structured interviews with 20 English teachers and focus group discussions with students from both urban and rural schools. Findings revealed significant improvements in students' vocabulary acquisition, grammar accuracy, and writing fluency, particularly in urban settings with better digital access. However, challenges such as limited infrastructure, low digital literacy, and resistance from traditionally trained educators hinder widespread adoption. Teachers also expressed concern over students' overreliance on AI for tasks that require critical thinking. The study highlights the need for policy support, localized AI tool development, and teacher training to maximize the pedagogical benefits of AI in ESL contexts. These findings offer practical implications for curriculum developers, education policymakers, and EdTech innovators in Pakistan aiming to bridge the English proficiency gap through technology.

Keywords:
AI in education, ESL in Pakistan, English language learning, secondary education, language technology, digital literacy, mixed-method research, educational equity, ChatGPT in classrooms, EdTech in South Asia.

Introduction
The integration of Artificial Intelligence (AI) into educational practices has revolutionized language learning globally, offering personalized, adaptive, and efficient learning experiences. AI-powered language tools such as ChatGPT, Grammarly, and Duolingo have demonstrated significant potential in enhancing English language proficiency by providing real-time feedback, personalized learning paths, and interactive engagement (Woo & Choi, 2021). These tools leverage Natural Language Processing (NLP) and machine learning algorithms to tailor content to individual learner needs, thereby facilitating improved vocabulary acquisition, grammar accuracy, and writing fluency (Liu et al., 2021; Ma et al., 2024).

In the context of Pakistan, where English serves as a critical medium for academic and professional advancement (Akram et al., 2019, 2020; Ramzan et al., 2025, 2023), the adoption of AI-driven language learning tools presents both opportunities and challenges (Ramzan & Alahmadi, 2024). Despite the potential benefits, the implementation of such technologies in Pakistani secondary schools is hindered by factors including limited digital infrastructure, low digital literacy among students and educators, and resistance from traditionally trained teachers (Cukurova et al., 2023). Moreover, socio-economic disparities and the urban-rural divide exacerbate these challenges, leading to unequal access to AI-based educational resources (Owoc et al., 2021).

Recent studies have highlighted the positive impact of AI tools on language learning outcomes (Akram & Abdelrady, 2023, 2025). For instance, the use of ChatGPT has been associated with improvements in students' writing skills and motivation (Woo & Choi, 2021). Similarly, adaptive learning platforms have been effective in providing personalized

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
JOURNAL OF APPLIED LINGUISTICS AND TESOL (JALT)
Vol.8.No.2 2025

feedback, thereby enhancing learner engagement and proficiency (Liu et al., 2021). However, the over-reliance on AI tools without critical oversight may impede the development of higher-order thinking skills, such as critical analysis and problem-solving (Yan et al., 2023)

In Pakistan, the educational landscape is characterized by a diverse range of challenges, including inadequate teacher training in digital technologies, limited access to reliable internet connectivity, and a lack of culturally relevant AI content (Cukurova et al., 2023). These issues necessitate a comprehensive examination of the integration of AI-powered language tools within the Pakistani secondary education system. Understanding the specific barriers and facilitators in this context is crucial for developing effective strategies to enhance English language proficiency among students.

This study aims to explore the integration of AI-powered language learning tools in enhancing English language proficiency among secondary school students in Pakistan. By adopting a mixed-method approach, the research seeks to assess the effectiveness of AI tools in improving language skills and to identify the challenges and opportunities associated with their implementation. The findings are expected to inform policymakers, educators, and Education Technology developers in designing and deploying AI-based language learning solutions that are contextually appropriate and pedagogically effective for the Pakistani educational setting.

Literature Review

The integration of Artificial Intelligence (AI) in education, particularly in language learning, has garnered significant attention globally. In Pakistan, where English proficiency is pivotal for academic and professional advancement, AI-powered language tools present both opportunities and challenges (Ramzan et al., 2023). This literature review delves into the current state of AI applications in English language learning, emphasizing their potential and limitations within the Pakistani secondary education context (Chen & Ramzan, 2024; Cukurova et al., 2023).AI-driven tools such as ChatGPT, Grammarly, and Duolingo have revolutionized language learning by offering personalized feedback, real-time corrections, and interactive learning experiences. These tools utilize Natural Language Processing (NLP) and Machine Learning (ML) algorithms to adapt to individual learner needs, enhancing vocabulary acquisition, grammar accuracy, and writing fluency. For instance, ChatGPT has been instrumental in improving students' writing skills by providing instant feedback and suggestions, thereby fostering learner autonomy and motivation (Biju et al., 2024).

Studies have demonstrated that AI tools significantly aid in vocabulary expansion and grammar correction. ChatGPT, for example, assists learners in understanding word usage in context, making vocabulary retention more effective. Similarly, Grammarly provides real-time grammar checks, helping students recognize and rectify errors promptly, which reinforces grammar rules and usage (Wang et al., 2024). AI applications contribute to improved writing fluency by offering structured writing assistance. Tools like Duolingo and ChatGPT guide learners through sentence construction, coherence, and organization, enabling them to produce well-structured texts. This structured approach not only enhances writing skills but also builds confidence among learners (Labadze et al., 2023).

The effective implementation of AI tools in Pakistani secondary schools faces infrastructural challenges, particularly in rural areas. Limited access to high-speed internet, lack of digital devices, and inadequate technological infrastructure hinder the widespread adoption of AI in education .A significant barrier to integrating AI tools is the low level of digital literacy among teachers and students. Many educators are unfamiliar with AI technologies, leading to resistance or ineffective utilization in classrooms (Akram et al., 2021, 2022). Comprehensive training programs are essential to equip teachers with the necessary skills to incorporate AI tools effectively (Wang et al., 2024 .While AI tools offer numerous benefits, there is a

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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concern regarding students' overreliance on these technologies, potentially impeding the development of critical thinking and problem-solving skills. Excessive dependence on AI for language tasks may lead to passive learning, where students accept AI-generated responses without critical evaluation (Labadze et al., 2023).

AI tools can tailor learning experiences to individual student needs, allowing for adaptive learning paths that cater to varying proficiency levels (Akram et al., 2021). This personalization fosters a more engaging and effective learning environment, accommodating diverse learner profiles. In regions with limited access to qualified English teachers, AI-powered tools can serve as supplementary resources, providing consistent and quality language instruction (Li & Akram, 2023, 2024). This can help bridge educational disparities between urban and rural schools, promoting equitable learning opportunities .AI applications can assist teachers by automating routine tasks such as grading and providing feedback, allowing educators to focus more on interactive and student-centered teaching approaches. This support can lead to more efficient classroom management and improved instructional quality .AI-powered language learning tools hold significant promise for enhancing English proficiency among secondary school students in Pakistan. While challenges related to infrastructure, digital literacy, and potential overreliance exist, strategic implementation and supportive policies can mitigate these issues. By embracing AI technologies thoughtfully, Pakistan can make substantial strides in improving English language education, fostering greater academic and professional opportunities for its youth (Owoc et al., 2019).

Significance of the Study

English language proficiency is a critical skill in Pakistan, significantly impacting students' academic success, employability, and access to global opportunities. With the rise of AI-powered educational technologies, tools such as ChatGPT, Grammarly, and Duolingo have emerged as innovative resources for language instruction. However, their application in Pakistani secondary schools remains underexplored. This study is significant as it evaluates the tangible impact of these AI tools on students' English language proficiency, particularly in vocabulary acquisition, grammar accuracy, and writing fluency. It also sheds light on the socio-educational challenges faced in implementing such technologies across urban and rural settings. By identifying both the benefits and barriers, the study contributes to the development of informed, equitable, and tech-integrated language education policies. It holds practical relevance for curriculum designers, educators, EdTech developers, and policymakers working to bridge the digital and linguistic divide in Pakistan's secondary education system.

Rationale of the Study

Pakistan's multilingual landscape and uneven access to quality English language instruction pose ongoing challenges in secondary education. Traditional ESL teaching methods often fail to engage students or cater to individual learning needs. AI-powered tools offer adaptive learning pathways, immediate feedback, and learner autonomy, presenting a transformative potential for English language education. However, the effectiveness of these tools in the Pakistani context has not been empirically evaluated. The rationale for this study lies in addressing this research gap by systematically assessing how AI technologies influence language proficiency, what contextual factors affect their implementation, and how educational institutions can better integrate such tools. This inquiry is particularly timely in light of increasing digitalization in education post-COVID-19 and the global movement toward technology-enhanced learning.

Statement of the Problem

Despite growing global recognition of AI in education, its integration in Pakistan's secondary school ESL classrooms remains limited and uneven. Secondary students across the country,

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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particularly in rural areas, continue to face low English proficiency levels due to outdated pedagogical practices, insufficient teacher training, and lack of technological infrastructure. While AI-powered tools like ChatGPT, Grammarly, and Duolingo offer potential solutions by providing personalized, scalable, and engaging language learning experiences, there is limited empirical evidence on their effectiveness in the Pakistani secondary school context. Furthermore, there are concerns regarding digital literacy, infrastructure disparities, and resistance from educators unfamiliar with such technologies. Therefore, this study seeks to examine the impact, challenges, and opportunities associated with leveraging AI-powered language tools to improve English language proficiency among secondary school students in Pakistan.

Research Methodology

1. Research Design

This study employed a **convergent parallel mixed-methods design**, integrating both quantitative and qualitative data to provide a holistic understanding of the impact of AI-powered language tools on English language proficiency among secondary school students in Pakistan. The quantitative component assessed measurable improvements in language skills, while the qualitative component explored user experiences, contextual challenges, and pedagogical implications.

2. Participants and Sampling

2.1 Student Participants:

A total of **200 secondary school students** (grades 9 and 10) were selected through **stratified random sampling** from four public and four private schools—two each from urban (e.g., Lahore, Karachi) and rural (e.g., Chakwal, Thatta) settings. Stratification was based on geographic location and type of institution to ensure diversity in digital access and educational background.

2.2 Teacher Participants:

20 English language teachers were selected using **purposive sampling** for semi-structured interviews. They were chosen based on experience (minimum 3 years teaching ESL) and willingness to engage with AI tools during the intervention period.

2.3 Focus Groups:

Four focus group discussions (FGDs) were conducted with students—two from urban and two from rural schools—with 6–8 participants each. These students were active users of at least one AI language tool during the intervention.

3. Intervention Procedure

The intervention spanned **12 weeks** and involved integrating three AI-powered language tools into the students' English curriculum:

- **ChatGPT**: Used for writing prompts, grammar explanations, and vocabulary building.
- **Grammarly**: Applied for self-editing and grammar correction tasks.
- **Duolingo**: Used as a gamified tool for daily vocabulary and sentence structure exercises.

Students were guided by teachers in both classroom and self-study settings. Urban schools had more structured, tech-supported sessions, while rural schools operated in blended or offline-access modes where feasible.

4. Data Collection Instruments

4.1 Quantitative Instruments:

- **Pre- and Post-Intervention English Language Proficiency Tests**: Developed in alignment with CEFR (Common European Framework of Reference) levels, assessing vocabulary, grammar, reading comprehension, and writing fluency.

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ISSN P:2709-8265
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- **Usage Logs**: Automatically generated logs from AI tools were analyzed to quantify tool interaction frequency and types of tasks performed.

4.2 Qualitative Instruments:

- **Semi-Structured Teacher Interviews**: Explored teachers' perceptions of AI integration, challenges faced, and pedagogical shifts.
- **Focus Group Discussions with Students**: Investigated students' experiences with AI tools, perceived learning benefits, usability, and digital constraints.
- **Classroom Observations**: Conducted using a structured observation checklist focusing on AI tool integration, student engagement, and teacher mediation strategies.

5. Data Analysis

5.1 Quantitative Analysis:

- **Descriptive statistics** (mean, standard deviation) were calculated for pre- and post-test scores.
- **Inferential statistics**: Paired **t-tests** and **ANCOVA** were used to assess statistically significant changes in language proficiency across groups (urban vs. rural, public vs. private).
- **Correlation analysis** examined the relationship between AI tool usage frequency and improvement scores.

5.2 Qualitative Analysis:

- Interview and FGD transcripts were analyzed using **thematic analysis** (Braun & Clarke, 2006), identifying recurring patterns related to usability, learning behavior, and infrastructural issues.
- Coding was conducted in NVivo software to ensure consistency and rigor.
- Observational data were triangulated with student and teacher reports to validate findings.

6. Validity and Reliability

- **Content validity** of the tests was ensured through expert review by three ESL professionals.
- **Triangulation** across multiple data sources (test scores, interviews, FGDs, observations) enhanced the trustworthiness of findings.
- A **pilot study** with 20 students was conducted to test instrument clarity and refine procedures.
- Internal consistency of the tests was verified using **Cronbach's alpha** ($\alpha = 0.87$).

7. Ethical Considerations

- **Informed consent** was obtained from all participants and guardians (for students under 18).
- Participation was voluntary, and respondents could withdraw at any stage without penalty.
- Anonymity and confidentiality of participants were strictly maintained.
- The study received ethical approval from the institutional review board (IRB) of the lead researcher's university.

8. Limitations

- The digital divide between urban and rural schools limited consistent access to AI tools across settings.
- Short duration of the intervention may not reflect long-term impacts on proficiency.
- External factors such as home internet access and device availability were not fully controlled.

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ISSN P:2709-8265
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Results

This section presents the findings of the 12-week intervention study aimed at evaluating the impact of AI-powered language tools (ChatGPT, Grammarly, Duolingo) on the English language proficiency of secondary school students in Pakistan. The results are structured around the two key components of the study: **quantitative outcomes** (from pre- and post-assessments) and **qualitative insights** (from teacher interviews, student focus groups, and classroom observations).

1. Quantitative Results

1.1 Improvement in Language Proficiency

Paired-sample t-tests were conducted to compare students' pre- and post-test scores across four language domains: vocabulary, grammar, writing fluency, and reading comprehension.

Language Skill	Pre Test Mean (SD)	Post Test Mean (SD)	Mean Gain	t-value	p-value
Vocabulary	58.6 (10.3)	72.1 (9.4)	+13.5	12.42	< 0.001
Grammar Accuracy	61.4 (11.2)	74.3 (10.6)	+12.9	11.87	< 0.001
Writing Fluency	56.9 (12.7)	70.2 (11.3)	+13.3	10.94	< 0.001
Reading Comprehension	63.2 (9.1)	71.5 (8.8)	+8.3	9.05	< 0.001

Interpretation:

All four skill areas showed statistically significant improvements after the intervention ($p < 0.001$). Vocabulary and writing fluency exhibited the largest gains, suggesting that AI tools are particularly effective in these areas.

1.2 Urban-Rural Comparison

An ANCOVA was conducted using school location (urban vs. rural) as the independent variable and pre-test scores as covariates to examine differences in language gains.

Skill Area	**Urban Mean Gain**	**Rural Mean Gain**	**F-value**	**p-value**
Vocabulary	15.1	10.2	6.89	0.011
Grammar	14.3	9.7	7.21	0.009
Writing Fluency	14.7	11.4	4.56	0.036
Reading	9.2	6.3	3.78	0.052

Interpretation:

Urban students outperformed rural students in all areas, with statistically significant differences in vocabulary, grammar, and writing. This suggests a strong influence of infrastructure and digital accessibility on the effectiveness of AI tools.

1.3 Tool Usage and Learning Gains

Correlation analysis showed a positive relationship between the frequency of AI tool usage and language improvement:

- **Grammarly usage** was most strongly correlated with grammar accuracy improvement ($r = 0.61$).
- **ChatGPT usage** correlated with gains in writing fluency ($r = 0.58$).
- **Duolingo usage** was moderately correlated with vocabulary development ($r = 0.54$).

These correlations were all statistically significant at the 0.01 level, indicating that higher engagement with AI tools generally led to better language outcomes.

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2. Qualitative Results

2.1 Teacher Perceptions

Thematic analysis of 20 semi-structured interviews with ESL teachers yielded the following key themes:

- **Enhanced Student Engagement**: Teachers noted a visible increase in motivation and participation, especially when using gamified tools like Duolingo and interactive prompts on ChatGPT.
- **Pedagogical Support**: Teachers used Grammarly to support students' editing and feedback process, reducing their own workload.
- **Professional Resistance**: Older or less tech-savvy teachers expressed reluctance or skepticism toward AI integration, citing lack of training and concerns over job relevance.

Illustrative Quote:

"AI tools help students improve quickly, but many of us teachers need proper training. Right now, we're experimenting blindly." —Teacher from a public rural school

2.2 Student Focus Group Insights

Key insights from the four student FGDs revealed the following:

- **Perceived Benefits**: Students appreciated instant feedback and personalized learning. ChatGPT was especially popular for essay help and grammar explanations.
- **Digital Divide**: Rural students reported issues like poor internet, lack of devices, or limited app access, which hindered full participation.
- **Overreliance Concern**: Some students admitted they copy-pasted AI responses without fully understanding them, especially during homework.

Illustrative Quote:

"I like how ChatGPT explains things in easy words, but sometimes I just copy the answers without thinking." —Student from a private urban school

2.3 Classroom Observations

Observational data confirmed three broad patterns:

- **High Engagement**: Classrooms where AI was used saw increased student participation and longer on-task behavior.
- **Teacher Mediation Crucial**: Students performed better when teachers scaffolded AI use, rather than letting them use tools independently.
- **Infrastructure Limits**: In some rural settings, AI use was limited to teacher demonstration due to lack of student devices.

Discussion

The integration of AI-powered language tools—namely ChatGPT, Grammarly, and Duolingo—into the English as a Second Language (ESL) curriculum for secondary school students in Pakistan has yielded significant improvements in vocabulary acquisition, grammar accuracy, and writing fluency. These findings align with global research indicating the efficacy of AI tools in enhancing language learning outcomes. For instance, Shadiev and Liang (2023) observed that ChatGPT positively influences students' learning experiences, particularly in writing, grammar, and vocabulary acquisition, while also enhancing motivation and engagement through its versatile and accessible nature. Similarly, Biju et al. (2024) found that AI-assisted language assessments can reduce foreign language anxiety and improve learners' attitudes and motivation, thereby creating a more conducive learning environment. The study's results also highlight the disparity between urban and rural settings, with urban students demonstrating greater gains in language proficiency. This discrepancy can be attributed to better digital infrastructure and access to technology in urban areas. Such findings underscore the digital divide's impact on educational equity, a concern echoed by

ISSN E: 2709-8273
ISSN P:2709-8265
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researchers emphasizing the need for inclusive technology integration strategies (Abdelrady & Akram, 2022). However, the study also reveals potential drawbacks, notably the risk of students' overreliance on AI tools, which may impede the development of critical thinking skills. Zhai et al. (2024) caution that excessive dependence on AI dialogue systems can diminish students' cognitive abilities, including decision-making and analytical reasoning. Therefore, while AI tools offer substantial benefits, their integration must be balanced with pedagogical approaches that foster independent thinking. Teacher perceptions further illuminate the challenges of AI integration, with some educators expressing resistance due to limited digital literacy and concerns over job relevance. This resistance highlights the necessity for comprehensive teacher training programs to equip educators with the skills required to effectively incorporate AI tools into their teaching practices. Such initiatives are crucial for maximizing the pedagogical benefits of AI in ESL contexts.

Conclusion

The study demonstrates that AI-powered language tools can significantly enhance English language proficiency among secondary school students in Pakistan, particularly in vocabulary, grammar, and writing skills. These tools offer personalized learning experiences and immediate feedback, contributing to increased student engagement and motivation.However, the effectiveness of AI integration is contingent upon several factors, including digital infrastructure, teacher readiness, and balanced pedagogical approaches. To fully realize the potential of AI in language education, it is imperative to address the digital divide, provide targeted teacher training, and develop strategies that mitigate overreliance on technology.In conclusion, while AI-powered language tools present promising opportunities for enhancing ESL education in Pakistan, their successful implementation requires a holistic approach that considers infrastructural, pedagogical, and ethical dimensions. Future research should explore long-term impacts, scalability, and the development of localized AI tools tailored to the Pakistani educational context.

6. Recommendations for Effective Integration

- **Policy Development**: Formulate national policies that support the integration of AI in education, ensuring resource allocation for infrastructure development and training programs.
- **Teacher Training**: Implement comprehensive professional development programs to enhance teachers' digital literacy and proficiency in using AI tools effectively.
- **Localized Content**: Develop AI tools with localized content that aligns with the national curriculum and cultural context, making them more relevant and accessible to Pakistani students.
- **Monitoring and Evaluation**: Establish mechanisms to monitor the impact of AI tools on student learning outcomes, ensuring continuous improvement and addressing potential drawbacks such as overreliance.

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