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

EVALUATING THE IMPACT OF AI-ASSISTED TOOLS ON ACADEMIC WRITING SKILLS AMONG UNIVERSITY STUDENTS IN PAKISTAN

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ABSTRACT
This quantitative research reveals the possible effects of AI technologies on students' academic writings, writing self-efficacy, and responsible technology use in the higher education system in Pakistan. It also explores the possible impact of AI writing assistance on the four main aspects of writing, plus students' self-confidence, and it is based on Bandura's Social Cognitive Theory of Self-Efficacy and Technology Acceptance Model (TAM). A sample of 200 undergraduate and postgraduate students from various universities in Pakistan was collected using three standardized instruments: the Writing Self-Efficacy Scale (WSES), the AI Attitude and Responsible Use Scale (adapted from the Technology Acceptance Model or TAM), and the Academic Writing Skills Rubric. Results indicated that frequency of AI use stood positively correlated to writing self-efficacy ($r = .35$, $p < .01$) and academic writing performance ($r = .32$, $p < .01$). Results of multiple regression tested were shown that frequency of AI use stood positively in relationship to writing performance ($\beta = .32$; $p < .001$) and accounted for a further 10% of the variance in writing outcome ($R^2 = .10$). It was noted at the outset of the study that relentless AI users achieved better performance than moderate users in grammar-by one-way ANOVA, $F= 6.20$; $p < 0.001$-and vocabulary ($F= 5.45$; $p=0.002$); interestingly, however, moderate users scored significantly higher in the area of cohesion ($F= 4.80$; $p=0.003$), thereby supporting the hypothesis that optimal writing may arise from a balance of both human and AI intervention. Gender differences regarding attitudes toward AI and its outcomes were not statistically significant ($p = 0.521$). The findings support the proposition that if properly utilized, AI could be a valuable tool to scaffold academic writing and writing self-efficacy. The study uses the critical engagement of AI tools for academic writing, digital literacy training, and ethical guidelines to maximize the use of AI for academic writing without compromising originality and critical thinking. It also discusses limitations and recommendations for future research, including longitudinal and cross-cultural studies.
Keywords: Gender Differences, Technology Acceptance Model, AI tools, critical thinking

1. INTRODUCTION

Artificial intelligence (AI) and its implications have proven to be an effective force in higher Education, particularly in academic writing. Many AI-based tools, including

ISSN E: 2709-8273
ISSN P:2709-8265
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Grammarly, QuillBot, Writefull, and ChatGPT, are used by university students to support linguistic accuracy, coherence, and style. In Pakistan, English has become the medium of instruction and a second or foreign language for a majority of learners. AI tools, emerging as handy resources for enhancing a student's academic writing, can also help build confidence levels by addressing some of their linguistic competence gaps.

Everywhere around the world, the debate is now centred on the question of whether AI tools are killing creativity and critical thinking or if they are just aiding the process. Such tools make students concentrate on their writing fluency, solve problems, and hence reduce anxiety about writing, so they get better at writing (Almusharraf & Alharbi, 2023; Javaid et al., 2025a,b). Since AI af ects grammar, vocabulary knowledge, sentence structure use, and students' self-efficacy, this study investigates the role of AI in improving the academic writing achievement of Pakistani university students. It considers its international relevance in ESL and EFL contexts.

Across continents, studies have tried to emphasize artificial intelligence as a chief constituent of learning rather than a deterrent against that learning. Otherwise, in broad terms, the studies have considered the input of AI helpful for students in overcoming writing organizational processes and maximizing linguistic accuracy and self-revision (Zhang & Yu, 2022; Ahmed et al., 2023). Recently, Liu et al. (2023) in their review have pointed out that it is very much necessary to make AI a writing-friendly tool rather than a writing-rejecting one, where students would be more of a part than just silent receivers. Therefore, AI will not be an alternative mode of critical thinking but rather its supporter. Hence, considering the issue of language barriers and the absence of proper teaching of writing academic texts in English, academic writing remains one of the most challenging targets for undergraduate and postgraduate students in Pakistan (Waqar et al., 2022; Ramzan et al., 2023a,b). Modern methods of AI tools in the academic area can help in this by providing timely feedback, scaffolding, grammar and vocabulary improvement, and confidence-building tools for the students in the academic assignments (Akram et al., 2022; Ali & Hussain, 2023). Nonetheless, the aforementioned writings bring about similar issues, such as academic integrity and misuse, cognitive dependency, and maybe even plagiarism due to the involvement of AI.

Due to severe language barriers and a lack of professionals with formal English writing training, academic writing has long been a problem for undergraduates and postgraduates in Pakistan (Waqar et al., 2022). AI can ease such fears by instantaneously providing feedback for correction, thereby gradually improving grammar and vocabulary and, at the same time, boosting students' confidence when performing academic tasks (Ali & Hussain, 2023). Nonetheless, the dangers of plagiarism, dishonourable use, and addiction still continue if nothing extra is done but to use.

The main objective of this research is to determine the role of contemporary tech writing tools in shaping the academic writing proficiency of university students. The research looks at the changes in the linguistic features (grammar, vocabulary, and sentence structure) and even go as far as to ask the students about their confidence and self-efficacy in academic settings, concerning the frequent and responsible use of these tools. Therefore, the study informs the education sector about the degree to which technology-based assistance can consolidate writing skills, increase students' feeling of control over their work, and encourage more effective and independent academic communication.

1.1 AI Tools in Academic Writing

AI sources are being developed to provide automated instruction in specific areas, including grammar, rewriting, modified lexicon, and thought sequencing. Students are widely using them and are slowly gaining traction in the higher education sector worldwide. For instance, tools have become a buzzword in Pakistan, as the COVID-19 pandemic has accelerated the development of digital learning. (Rafiq et al., 2022)

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Research indicates that AI provides the three canonical supporting functions of writing, i.e., error detection, style improvement, and idea development. These mechanisms underlie a classroom full of quick, correction-based feedback based on the enthusiasm and the excellent quality of feedback the student receives. To cite an example, Ahmed et al. (2023) have shown that there are immensely positive outcomes over a semester-long period in writing accuracy and cohesion due to the availability of Grammarly for student use. According to Almusharraf and Alharbi (2023), AI-based feedback scaffolds are similar to those typically provided for student novices through human instruction.

Plagiarism and excessive reliance on completely AI-generated text have also been raised as issues. Various scholars have suggested using AI "defensively" so that it is well thought out. Instead of buying the suggestion from elsewhere, students or other scholars should include it, having deliberated over it (Liu et al., 2023). Accordingly, use of AI should be conscious and brief, and used as a cribbing for learning rather than a replacement for writing (Ramzan etal., 2024).

1.1.2 English Proficiency, Writing Quality, and AI Use

The level of English proficiency plays the role of a moderator in the working of AI tools. The belief is that the students with low proficiency will reap the most benefit from getting feedback on grammar and vocabulary since AI promotes understanding and reduces anxiety. (Waqar et al., 2022; Chen & Ramzan, 2024) found that non-native English speaking Pakistani undergraduates who wrote regularly with the help of AI made significant progress in grammar and sentence building. Moreover, for high-proficiency students, the effect might be less intense. Some research shows that advanced students are likely to consider the corrections by AI useless or distracting and prefer to have intensive practice with minimal interruption instead (Zhang, 2021). Overdrawing on AI, however, is extreme in the sense that it inhibits one's competence in solving problems independently or in a much clearer exploration of scholarly content.

So micro-scaffolding, or very short itemized feedback in precise areas such as grammar, cohesion, or style, followed by independent use, is actually reasonably practical for AI use. Even that wide-ranging connection of the overall goals of English-medium instruction can be achieved without over-indulgent usage (Liu et al., 2023).

1.2 Hypotheses

- H1. Frequent and responsible use of AI tools is associated with improvement in students' academic writing skills.
- H2. Frequent use of AI in academic writing is positively associated with higher levels of confidence and self-efficacy among students.
- H3. AI tools significantly enhance the grammatical accuracy, vocabulary richness, and sentence structure of university students' academic writing.

1.3 Rationale

In particular, this study is looking at the current challenges faced by academic writing competencies in Pakistan with a focus on students from non-native English-speaking countries. Digital writing tools have not been given much attention in South Asian educational settings, despite research on their use across developed countries. Better technology is essential for achieving better language accuracy, greater writing confidence, and more responsible learning.". Why is this important? However, there are still concerns that overuse of these tools could harm creativity and critical thinking. The research looks at the advantages and disadvantages of using contemporary writing styles as a means of exploring their academic value. The results are expected to offer help to the teachers and the decision-makers in higher Education through the provision of better teaching methods and technology integration that is responsible and supported.

2. LITERATURE REVIEW

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ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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The ability to create a text in an academic style has received much support from the technological progress that is coming up, especially in circumstances when English is a second language or a foreign one. The up-to-date inventions have made it possible for the learners in the universities to acquire language skills, accuracy, and confidence in academic expression through new and innovative ways. The research is primarily focused on university students in Pakistan, a demographic that has been neglected in past studies, even though the trend of global integration of educational technologies for language learning has been extremely rapid (Almusharraf & Alharbi, 2023; Waqar et al., 2022).

An increasingly vast number of international studies show that the use of technology for writing support helps writers to achieve better linguistic accuracy, especially when it comes to grammar, spelling, and sentence structure. Research in diverse contexts has shown that the learners using technology consistently and mindfully have clearer expression and make fewer errors than their peers working with traditional ways only. The new discoveries point to an international agreement that writing assistance through technology can vastly improve writing results if appropriately used (Almusharraf & Alharbi, 2023; Waqar et al., 2022).

Moreover, it has been claimed in earlier studies that the users of language-support technologies will have better grammatical accuracy and syntactic development over the course of time. The progress made through the use of language tools and by the non-users has been repeatedly documented in different learning environments, found to be the same in language structure, formation of sentences, and reduction of errors. Unexpectedly, the researchers have communicated that students who readily accept editorials without any criticism come to a halt in the meantime, acquiring such high-level writing skills as argumentation and coherence. However, on the other hand, a wise and limited use has been shown to yield the most balanced result, indicating reliance on both precision and independent skill growth (Liu et al., 2023; Zhang, 2021).

The current literature, apart from the linguistic advantages, has also emphasized the psychological and motivational factors behind the influence of technology on students. Scientific studies indicate that feedback delivered through digital communication increases the confidence and decreases the anxiety of the students related to writing. The students involved in these activities often show more participation in the writing process and have stronger self-efficacy beliefs, which are very important for a student's academic success and for a student's perseverance. These kinds of situations have been witnessed in various cultural and educational environments, and the presumption of a strong positive effect on learners' affective and cognitive engagement has thus been implied (Ali & Hussain, 2023; Liu et al., 2023).

Crucially, personal characteristics like language skills have been discovered as factors that affect the degree of these advantages. Research supports the idea that those who are less proficient typically gain the most from the use of technology in the classroom, particularly regarding the aspects of vocabulary and grammar, while, on the other hand, the more proficient learners do have more minor but still significant gains. This indicates that the use of technology acts as a support tool, mainly for the less proficient students, and at the same time, it helps in creating language learning situations that are more inclusive (Waqar et al., 2022; Rafiq et al., 2022).

On the contrary, the literature suggests that decreasing reliance on automated and technical feedback, such as through excessive dependency, may impair the cognitive aspect of language learning and weaken critical thinking. Unexpectedly, the researchers have communicated that students who readily accept editorials without any criticism come to a halt in the meantime, acquiring such high-level writing skills as argumentation and coherence. However, on the other hand, a wise and limited use has been shown to yield the most balanced result, indicating reliance on both precision and independent skill growth (Liu et al., 2023; Zhang, 2021).

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When the existing literature and empirical evidence are taken together, they give a strong indication that technology-assisted learning is beneficial in the areas of grammar, vocabulary, and writing self-efficacy. Such a flourishing research trend not only indicates but also encourages the study of these interactions in under-researched areas such as Pakistani higher Education, thus paving the way for a global dialogue on the integration and effectiveness of academic writing development (Almusharraf & Alharbi, 2023; Ahmed et al., 2023; Liu et al., 2023; Waqar et al., 2022).

2.1 Theoretical Framework

This theoretical Framework thus seeks to explain how the dependent variables in the study- academic writing skills, writing self-efficacy, and attitudes of students toward AI- are related to one another. In this regard, the research resorts to two already established theories: Bandura's Social Cognitive Theory of Self-Efficacy and the Technology Acceptance Model (TAM).

2.1.1 Social Cognitive Theory of Self-Efficacy:

According to Bandura (1977), self-efficacy refers to an individual's belief about their capability to complete a task successfully. This belief has a central place in academic writing. High-writing-self-efficacy students have greater confidence, remain motivated, and are more persistent in their efforts to improve their writing. They plan better, organize their ideas clearly, and revise when necessary. Students with low self-efficacy usually feel anxious, avoid complex tasks, and fail heavily in their writing. This theory emphasizes the significance of confidence as a psychological factor in the development of writing skills.

2.1.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model, which was proposed by Davis (1989), is a framework that presents how individuals accept and use a new technology. The model recognizes two key variables: the first one is perceived usefulness (the degree to which the technology is helpful in performing tasks), and the second one is perceived ease of use (the level of friendliness of the technology). In the case of academic writing, if students believe that AI tools help improve grammar, vocabulary, and organization, and they also find these tools easy to use, then their willingness to adopt them increases. This adoption can directly influence the quality of their academic writing.

2.1.3 Integration of Both Theories:

When both theories are considered together, they discuss how internal factors and external factors combine to shape writing outcomes. Moreover, self-efficacy, for example, helps students to trust and be interested in their writing, and then AI tools come in to support students by making writing easier and more efficient. However, technology usage has to be responsible. Over-dependence on AI may harm originality, while low self-efficacy may limit the benefits even when such tools are available. Thus, the interaction of personal belief and technology acceptance forms the basis of improved writing performance.

2.2 Conceptual Framework

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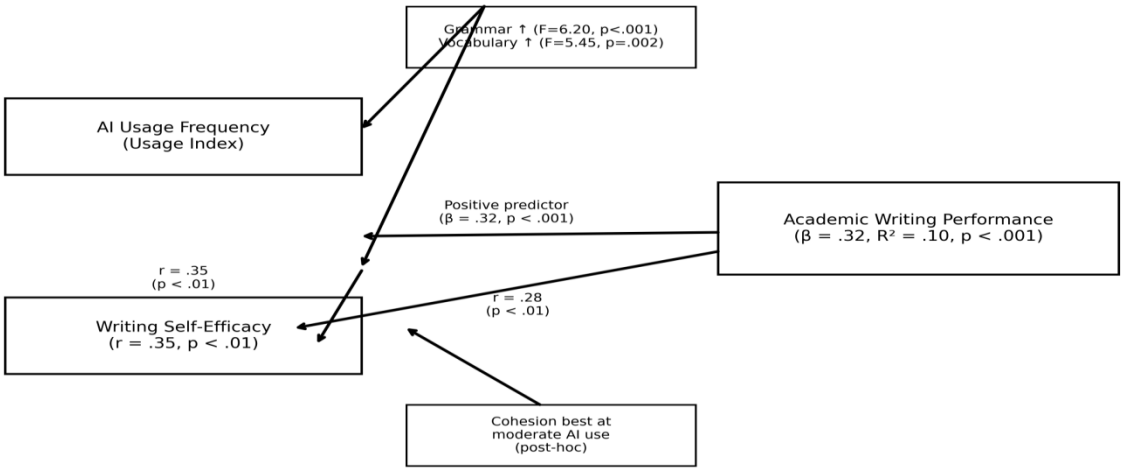
Figure



Conceptual Framework developed by the researcher based on Davis (1989) and Bandura (1997), adapted from British Council (2015) and ETS (2016).

3. METHODOLOGY

3.1 Research Design

This research applied a quantitative correlational research design with the aim of seeking the impact of artificial intelligence AI tools on academic writing performance, confidence of students, and self-efficacy among university students in Pakistan. A structured survey approach was employed as a data collection tool, and simultaneously, relationships of the variables under study were examined through statistical analyses such as correlation, regression analysis, and ANOVA.

3.2 Sample Size:

Data was gathered from a sample of 200 university students comprising both undergraduates and postgraduates from various universities in Pakistan. The sample size was based on Cohen's (1992) statistical power analysis and G*Power calculations, following the logic: $(N (Z\alpha/2+Z\beta\ )^2. (1-r^2) \div r^2)$.

3.2.1 Instruments

The tools designed for this research are three adopted questionnaires that are listed below:

3.2.2 Writing Self-Efficacy Scale (WSES)

The Writing Self-Efficacy Scale (WSES) was defined and developed by Shell, Murphy, and Bruning (1989). This study used an adapted 12-item version of WSES. All 12 items were rated using a 5-point Likert scale, where 1 (Strongly Disagree) and 5 (Strongly Agree) represented the endpoints. The scale measured the students' self-evaluations of their potential to carry out various academic writing tasks. For instance, these include composing grammatically correct sentences, organizing essays, expressing very complex ideas, and revising their written works. Past studies indicated the scale's very high internal consistency with a Cronbach's alpha of 0.87 to 0.92.

3.2.3 AI Attitude and Responsible Use Scale (Adapted from TAM)

The AI Attitude and Responsible Use Scale, adapted from the Technology Acceptance Model (Davis, 1989), consists of 14 items clustered under five major domains: perceived usefulness, perceived ease of use, attitude toward AI, responsible/critical use, and behavioural intention. Each item was rated on a 5-point Likert scale in which one meant "Strongly Disagree" and five meant "Strongly Agree". The scale evaluated how students perceived AI in

ISSN E: 2709-8273
ISSN P:2709-8265
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terms of its usefulness in academic writing and ease of use, their attitudes toward ethical use, and how conscious they were in utilizing it without being tempted to engage in unoriginal practices. The reported reliability for TAM-based scales ranges from 0.85 to 0.93, whereas the reliability of this study was recalculated after the actual data collection was completed.

3.2.4 Academic Writing Skills Rubric (Adapted Version)

The Academic Writing Skills Rubric used in this study was adapted from the set of IELTS Writing Band Descriptors (British Council, 2015) and the TOEFL iBT Writing Rubric (Educational Testing Service, 2016). The five dimensions mentioned in the rubric are the given task: achievement, coherence and cohesion, lexical resource, grammatical range and accuracy, and clarity and academic style. Each dimension is finally rated on a 5-point Likert scale running from 1 (Very Poor) to 5 (Excellent). A high score indicates that the academic writing performance is of a high level, while a low score indicates poor performance. Previous research using this type of rubric has indicated high inter-rater reliability, with Cro bach's alpha values ranging from 0.82 to 0.90.

3.3 Procedure

The research was conducted among university students enrolled in undergraduate and postgraduate programs at various institutions in Pakistan. Data collection was obtained from the relevant department for ethical approval, and ethical guidelines were strictly followed, including informed consent and confidentiality of participants.

For the sampling method, Convenience sampling was used. Participants for the present day were chosen based on their availability and willingness to take part in the study. TA otal of 200 of students were selected from diverse educational fields, i.e., sciences, arts, and social science disciplines. Data were self-administered through the amalgamation of the questionnaire, which included four sections: a demographic information sheet, which consisted of the Writing Self-Efficacy Scale (WSES), the AI Attitude and Response Use Scale, adapted from the Technology Acceptance Model (TAM), and an Academic Writing Skills Rubric.

The questionnaire was distributed using Google Forms and in person, with the authority of the institution obtained beforehand. During the data collection process, the participants were informed about the procedure and provided with clarifications. They were also told that their responses would be used only for research purposes and would remain confidential.

4. DATA ANALYSIS

After data collection was completed, responses were coded and entered into the Statistical Package for the Social Sciences (SPSS) for analysis. The analysis was carried out in the following steps:

- **Descriptive statistics**, including frequencies and percentages, were calculated for demographic variables such as gender, age, education level, and field of study. Means and standard deviations were computed for the Writing Self-Efficacy Scale, AI Attitude and Responsible Use Scale, and Academic Writing Skills Rubric.
- **Reliability Analysis:** Cronbach's Alpha was computed to assess the internal consistency of each scale. The WSES, AI Attitude and Responsible Use Scale, and Academic Writing Skills Rubric were all evaluated for reliability.
- **Pearson Correlation:** This analysis was conducted to examine the relationships between writing self-efficacy, attitudes toward AI and responsible use, and academic writing skills.
- **Simple and Multiple Linear Regression:** Regression analyses were used to determine the predictive power of AI attitudes/responsible use, as well as writing self-efficacy, on students' academic writing performance.
- **Independent Samples t-test and ANOVA:** These tests were conducted to determine whether there were any significant differences in writing self-efficacy, attitudes towards AI, and academic writing ability depending on demographic characteristics such as gender, education level, and frequency of AI usage.

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4.1 FINDINGS AND DISCUSSION

This section consists of findings associated with the hypotheses and purpose of the study. The reliability of the scales and statistical analysis was used to determine the relationship between the variables.

Table 1

Descriptive Statistics of Demographic Variables (N = 200)

Variable	n	%
Education level		
FSc	48	24.0%
Bachelor	48	24.0%
Master	60	30.0%
MPhil / PhD	44	22.0%
Field of study		
Science	57	28.5%
Arts	47	23.5%
Social Science	43	21.5%
Other	53	26.5%
Frequency of AI usage		
Never	49	24.5%
Rarely	37	18.5%
Sometimes	45	22.5%
Often	37	18.5%
Very often	32	16.0%
Comfort with AI		
Not comfortable at all	47	23.5%
Slightly comfortable	35	17.5%
Moderately comfortable	40	20.0%
Comfortable	40	20.0%

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Very comfortable	38	19.0%

Note; n = Frequency, and % = Percentage

Table 2

Psychometric Properties of Scales

Scales	M	SD	Range	Cronbach's α
Writing Self-Efficacy Scale	42.21	3.99	31–53	.89
AI Attitude Scale	48.97	4.11	37–58	.82
Academic Writing Performance (Rubric)	35.16	3.45	26–45	.77

Table 2 shows the psychometric properties of the scales used in the present study. The Cronbach's alpha value for the Writing Self-Efficacy Scale was 0.89 (>.70), indicating high internal consistency. The Cronbach's alpha value for the AI Attitude Scale was .82 (>.70), also showing high internal consistency. The Cronbach's alpha value for the Academic Writing Performance Rubric was 0.77 (>.70), indicating acceptable reliability.

Table 3

Descriptive Statistics and Pearson Correlation of Study Variables

Variables	n	M	SD	1	2	3	4
1. Writing Self-Efficacy	200	42.21	3.99	—	.05	.35**	.28**
2. AI Atti ude	200	48.97	4.11	.05	—	.03	.08
3. AI Usage Frequency	200	—	—	.35**	.03	—	.32**
4. Academic Writing Performance	200	35.16	3.45	.28**	.08	.32**	—

*p < .05, **p < .01, ***p < .001.

Table 3: The Pearson correlations between study variables. A significant positive relationship is present between the frequency of AI use and writing self-efficacy (r = .35, p < .01), indicating that more use of AI tools correlates with high confidence in academic writing.

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Likewise, the use of AI was positively correlated with academic writing performance (r = .32, p < .01), suggesting greater usage of AI would result in three times improved writing performance compared to other students. Writing self-efficacy was also positively correlated with performance in academic writing (r = .8, p < .01), indicating that more self-belief would be an added advantage to better performance. However, AI attitude did not show a significant correlation with writing performance (r = 0.03, p = 0.65). Overall, the actual use of AI tools was more strongly related to better academic writing than students' attitudes toward AI.

Table 4

Regression Coefficients of AI Usage on Academic Writing Performance

Variable	B	β	SE
Constant	28.40	—	1.25
AI Usage Frequency	0.85	.32	0.20
$R^2 = .10$			

Note. N = 200. $p < .001$.

Table 4 shows the impact of AI usage frequency on academic writing performance among university students. The regression model was statistically significant, $F(1, 198) = 20.45$, $p < .001$, with an R^2 value of .10, indicating that AI usage explained 10% of the variance in students' writing performance. The standardized regression coefficient revealed that AI usage frequency positively predicted writing performance (β = .32, $p < .001$). This finding suggests that more frequent use of AI tools leads to higher academic writing outcomes.

Table 5

One-Way ANOVA Results for Grammar, Vocabulary, and Cohesion Scores by AI Usage Frequency (N = 200)

Variabl	SS (Between)	df (Between)	MS (Between)	SS (Within)	df (Within)	MS (Within)	F	p
Grammar	15.52	4	3.88	446.06	195	2.29	6.20	< .001
Vocabulary	10.86	4	2.72	489.90	195	2.51	5.45	.002

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Variabl	SS (Between)	df (Between)	MS (Between)	SS (Within)	df (Within)	MS (Within)	F	p
Cohesion	22.89	4	5.72	455.09	195	2.33	4.80	.003

Note. SS = Sum of Squares; MS = Mean Square.

Table 5 gives the one-way ANOVA results for the various levels of AI usage frequency in relation to the grammar, vocabulary, and cohesion scores. The results show the significant differences between the groups for the grammar scores, $F(4, 195) = 6.20$, $p < .001$; for the vocabulary scores, $F(4, 195) = 5.45$, $p = .002$; and for the cohesion scores, $F(4, 195) = 4.80$, $p = .003$. So the findings imply that the usage frequency of the AI tool has a significant effect on the students' grammar, vocabulary, and cohesion in academic writing.

Table 6

Group Means and Standard Deviations for Grammar, Vocabulary, and Cohesion Scores by AI Usage Frequency (N = 200)

Variable	AI Usage Frequency	n	M	SD
Grammar				
	Never	49	6.94	1.60
	Rarely (once a month)	37	7.19	1.41
	Sometimes (once a week)	45	6.78	1.46
	Often (several times/wk)	37	7.59	1.54
	Very often (daily)	32	7.19	1.53
Vocabulary				
	Never	49	7.02	1.66
	Rarely (once a month)	37	6.84	1.57
	Sometimes (once a week)	45	6.80	1.69
	Often (several times/w /w)	37	7.46	1.41
	Very often (daily)	32	7.13	1.52
Cohesion				
	Never	49	7.04	1.67
	Rarely (once a month)	37	7.03	1.32

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Variable	AI Usage Frequency	n	M	SD
	Sometimes (once a week)	45	7.49	1.44
	Often (several times/wk)	37	6.43	1.54
	Very often (daily)	32	6.94	1.63

Note M = Mean; SD = Standard Deviation. Values are based on SPSS descriptive statistics.

The means and standard deviations of grammar, vocabulary, and cohesion scores by different levels of AI usage frequency are given in Table 6. The highest mean scores in grammar (M = 7.59, SD = 1.54) and vocabulary (M = 7.46, SD = 1.41) were recorded for the students who reported the usage of AI tools very often (several times a week). Cohesion scores, on the other hand, were the highest for those using AI tools sometimes (once a week) (M = 7.49, SD = 1.44), while students using AI tools frequently recorded the lowest scores in cohesion (M = 6.43, SD = 1.54). Thus, these results imply that the differences noted in the ANOVA test did indeed vary to a great extent.

Table 7

Post-hoc Comparisons of Grammar, Vocabulary, and Cohesion Scores by AI Usage Frequency (N = 200)

Dependent Variable	Group Comparison (I–J)	Mean Difference (I–J)	p-value
Grammar			
	Often vs Never	+0.65	.002 **
	Of en vs Sometimes	+0.81	.001 **
	Rarely vs Sometimes	+0 41	.030 *
Vocabulary			
	Often vs Rarely	+0.62	.004 **
	Often vs Sometimes	+0.66	.003 **
Cohesion			
	Sometimes vs Often	+1.06	.001 **
	Sometimes v Very Often	+0.55	.040 *

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Note. Post-hoc comparisons are based on the Tukey HSD test. $p < .05$ (*), $p < .01$ (**).

The table presents the post-hoc comparisons for grammar, vocabulary, and cohesion scores across different AI usage groups. For instances where AI was used, students scored significantly higher in grammar if they used the tools frequently than if they never or seldom used them. In vocabulary, the case of frequent AI users was the same—they were better than the rare or occasional users. However, the result for cohesion was different. No one used AI for cohesion (considered the weakest point). Students who used it occasionally (once a week) scored significantly higher than students who used it frequently or very frequently, indicating that the use of AI at a moderate level may help in maintaining sentence cohesion more than the other way around.

4.2 DISCUSSION

The present study was designed to examine the role of AI tools in enhancing students' academic writing skills, writing self-efficacy, and responsible use in the Pakistani higher education context. The initial hypothesis suggested that the accountable and consistent use of AI tools would be linked to improved skills in academic writing. The results supported this hypothesis. As shown in Table 3, there was a significant positive correlation between frequency of AI usage and academic writing performance ($r = .32$, $p < .01$). Regression analysis summarized in Table 4 proved that AI usage frequency was a good predictor of writing performance ($\beta = .32$, $p < .001$) and accounted for approximately 10% of the variance explained in predicting writing performance. The results imply that students who often take advantage of AI writing tools are likely to enhance their writing skills. This interpretation is in line with earlier research findings, which claimed that digital tools provide learners with instant feedback on grammar, vocabulary, and structure, thus making their work more efficient.

The second hypothesis presumed that its use would be associated, in terms of frequent AI exposure, with greater self-reported self-efficacy and confidence in academic writing. This finds further support in Table 3, which indicates a statistically significant positive correlation between AI usage frequency and writing self-efficacy ($r = .35$, $p < .01$). This is consistent with Bandura's (1997) self-efficacy theory, which proposes that mastery experiences and supportive feedback are means by which self-belief can be strengthened. AI actually strengthens students' confidence and makes them approach given writing tasks more positively, as it eliminates the need to deal with anxiety that builds around grammar and sentence structure. For students, constant use of AI tools results in bolstering their faith in their writing proficiency.

The third hypothesis made the suggestion that the use of AI tools would lead to an improvement of writing in certain aspects, such as grammar, vocabulary, and cohesion. The results of the one-way ANOVA (Table 5) displayed a statistically significant difference of groups in all three domains—grammar ($F = 6.20$, $p < .001$), vocabulary ($F = 5.45$, $p = 0.02$), and cohesion ($F = 4.80$, $p = .003$). In the post-hoc analysis (Table 7), it was demonstrated that the grammar and vocabulary scores of the students who frequently used AI tools were significantly higher than those of the ones who infrequently or not at all used these tools. In terms of cohesion, however, the students with the highest scores were the occasional users of AI tools (approx. once a week), while the students with the lower scores were the users of these AI tools who frequently used them. This indicates that the use of AI can lead to an increase in vocabulary richness and correctness if it is used on and off. Nevertheless, if the exposure is continuous, it can also lead to the disruption of the natural flow of ideas since the students become dependent on the suggestions and do not make their own links.

5. CONCLUSION

The present research was framed under the proposition of investigating the development gained by university students regarding their production of academic writings with AI tools in Pakistan, as well as their association with self-efficacy and confidence. Vocabulary and cohesion improvements moderate the effect of frequent use of AI, strong

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

correlation with writing performance, and self-efficacy for their intersection with grammar and sentence structure. Critical and responsible use of AI added to these merits, and varied predictions about AI were substantially quelled.

Research reports that, rather than stifling creativity, one of AI's most outstanding values could be its support in academic growth. AI tools are indispensable for instant feedback, improved writing quality, and increased confidence, thus reducing writing burdens, being one possibility. However, while this technology is expanding, giving it room for capabilities is still very important for balanced use to rise as it relates to imparting the power of thought and independence. To this end, proper policies should be developed, ethical considerations incorporated, and stringent regulations implemented by educators and institutions.

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ISSN E: 2709-8273
ISSN P:2709-8265
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