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ACCURACY AND FLUENCY IN ACADEMIC WRITING: THE ROLE OF GENERATIVE AI SUPPORT

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Abstract

Generative Artificial Intelligence (AI) platforms are revolutionizing the way that students learn foreign languages today, but the particular impact that Generative AI has on the development of students' long-term independent learning skills is still an unanswered question. The study aimed at finding out if AI digital tools support learning writing skills at undergraduate level. This research is grounded in the theoretical framework of Holec (1981) Learner Autonomy and Vygotsky (1978) Sociocultural theory used with quantitative research design. A single group experiment design was used and data were collected from a purposefully selected undergraduate class at a private university in Lahore. The quantitative analysis indicated a significant difference between the mean scores (paired t-test) of the group obtained before and after the three weeks AI-intervention. The study contributes to academic writing skills in the classroom and for professional competence for an AI-based skills set highly in demand for employability of the undergraduates.

Introduction

The use of Artificial Intelligence (AI) in education has really changed the situation in the field of language learning, especially when it comes to the field of academic writing. With the recent developments in generative AI technologies, such as Chat-GPT and Gemini, and newer AI writing tools, new opportunities have opened up in offering instant feedback, brainstorming ideas, and revising (Zhai, 2022; Dogar & Khan, 2025). These tools employ state-of-the-art natural language processing systems that can make suggestions for grammar, vocabulary, cohesion, argument structure, and clarity. As a result, AI is now being utilized in the English as a Foreign Language (EFL) classroom all over the globe.

Digital technology has been seen traditionally as a mediating technology that facilitates language learning when it is exposed to more authentic language input and allows for individualized practice (Chapelle, 2001; Warschauer & Healey, 1998) in the larger context of Computer-Assisted Language Learning (CALL). Unlike the past, generative AI can go beyond the correction of errors, by producing content and offering formative ideas for rewriting learners' writing, which can have a transformative effect on their writing (Hsu et al., 2023). This process of substituting the corrective feedback with the generative assistance has brought up significant pedagogical and ethical issues of authorship, agency, and independent learning.

One of the most burning issues that emerge as a result of the present study is the role of AI assisted writing with regard to learner autonomy. One of the most important objectives in any language teaching is to have the ability to take

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responsibility in the field of self-learning (Holec, 1981). Benson (2011) also stresses the importance of autonomy as freedom to control which includes the cognitive processes, learning strategies, and choice of resources. Although AI may allow students to be independent in revising their work and be able to get immediate feedback, it should also be noted that they might lose the need to engage in a deep cognitive process and critical thinking because of the constant use of automated suggestions (Li et al., 2023).

Empirical studies have now started looking into these tensions. Research shows that the system using AI can enhance grammatical correctness and lexical complexity (Li et al., 2023). Similarly, O'Neill and Russell (2019) report that at the university, automated feedback is fast and easy for the students. However, others argue that students are able to adapt and adopt AI changes without critically analyzing their appropriateness, which in turn weakens their long-term development of writing (Zhai, 2022). The twofold prospect can make AI a digital scaffold and/or a dependency for people to learn.

Vygotsky's (1978) notion of scaffolding is that mediated instruction can extend the cognition of a person in his zone of proximal development (Dogar & Shah, 2024). AI can be used appropriately as this scaffolding and help students develop and internalize high-level writing strategies over time. However, if students use the tool excessively without using critical thinking, it could turn into cognitive substitution.

While the literature on AI assisted writing is growing exponentially across the globe, limited research exists on the same in the context of under-graduates in Pakistan. Most of the available studies have been conducted in a western or east Asian context (Hsu et al., 2023), while a few of them conduct controlled experiments to compare AI-assisted writing with the traditional writing environment. Considering the high levels of AI usage by the students of the university in Lahore, it is somewhat urgent to investigate whether these tools actually lead to better writing accuracy and fluency and enhance the learner's prominence over the digital systems, or the fact that they make them more dependent on the digitalization.

Problem Statement

Many EFL undergraduate students in universities are using AI tools in academic writing but they do not know if this is actually helping them learn or it hinders their learning and impacts their writing skills (Shahzad & Zaman, 2025). There is a concern that instead of developing their own writing skills, students might be using AI as a "shortcut." The aim of this research is to investigate how far the AI tools improve writing skills. The main objective of the study is to investigate whether AI-based writing assistance tools have any effect on developing EFL learners' writing accuracy and fluency. Hence, the study focuses on the following research question:

RQ1: What is the impact of AI-based writing tools on writing accuracy and fluency of EFL learners?

Significance

The rising use of artificial intelligence (AI) in academic writing has changed the face of academic writing, especially in the English as a Foreign Language (EFL) setting. The AI generation algorithms like Chat-GPT can generate, edit, and reformat text in a manner far beyond a standard grammar-checking program. The field of language education has become optimistic as well as concerned about this development. Although AI can provide instant feedback and revision methods, researchers doubt that this technology will improve writing competency and learner autonomy or result in cognitive dependence (Zhai, 2022).

Thus, the present investigation is relevant in meeting a topical pedagogical and theoretical question in the Pakistani higher education environment. On the pedagogical level, the research offers empirical information about the efficacy of AI-assisted writing to enhance the relative accuracy, fluency, or genre awareness of writing in students. Even though the advantages of technology-mediated feedback have long been

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highlighted in research concerning Computer Assisted Language Learning (CALL) (Chapelle, 2001; Warschauer and Healey, 1998), generative AI is a very different variant of technological intervention due to the fact that it not only identifies mistakes but also is more like a content-generation approach. Using a one group pre-test post-test experimental design, such a study goes beyond conducting surveys based on perception and provides controlled data to answer whether AI tools do indeed improve quantifiable performance of writing.

Another aspect of the study is its theoretical importance due to the establishment of AI-assisted writing within the frameworks of learner autonomy and sociocultural theory. Henri Holec (1981), defines learner autonomy as having the ability to be in charge of personal learning. Likewise, in his research, Lev Vygotsky (1978) also highlights the importance of scaffolding when providing support to learners in their Zone of Proximal Development (ZDP). This study, through an analysis of whether AI is a scaffold that will encourage or inhibit independent revision strategies or a substitute that will reduce learner agency, brings theoretical debates to the emerging field of generative AI. It is one of the contributions to the modern discussions on whether AI enhances or deteriorates the growth of autonomous language learners. The vast majority of existing studies on AI in EFL writing have been based on self-reported attitudes (Hsu et al., 2023), and scanty support of experiments in South Asian situations. The study offers localized data, which increases the contextual relevance of the research and improves the empirical rigor by performing a controlled intervention in a university in Lahore.

The findings can guide institutional decision-making on the AI integration of Pakistani universities at the policy level. With academic integrity, digital literacy, and technology control becoming a challenge to higher education institutions, solutions to the problems are desperately required. This research can help teachers and policy makers to create systematic and morally responsible structures on the use of AI instead of taking poles on either extreme of banning their application or endorsing their use unconditionally. Considering the undergraduate EFL students in Lahore, this study becomes part of the global discussion of AI-mediated learning based on the underexplored context. It provides the understanding of the interaction between technological innovation and learner autonomy in shaping educational conditions, and, therefore, contributes both local and international significance to the growing body of research on the application of AI in language education.

Research Gap

Although many researches in Pakistan have studied the role of AI in academic writing and learner autonomy (e.g., Rao et al., 2026; Khan et al., 2026; Shah & Samo, 2026), none have used the Vygotsky's scaffolding framework along with Holec's learner autonomy in a controlled classroom environment. This confirms the novelty of the current study and its contribution to close the research gap in the Pakistani higher education context.

Contextually, while global studies have examined the role of AI in EFL writing in Western and East Asian context (Hsu et al., 2023), local evidence from Pakistan remains underrepresented and limited to wide perceptions rather than controlled interventions. No study has been conducted to investigate EFL undergraduate students' writing accuracy and fluency through essay writing in Lahore using a mixed-methods research design including one group pre-test/post-test experimentation with qualitative interviews. This absence of theory-driven, intervention-based research in Pakistan creates a methodological, theoretical and contextual gap, which the current study addressed by locating its inquiry in a private university in Lahore.

Rationale of the study

In the present study, this need is met by an experimental evaluation of results of writing, which integrates direct investigation of the perception of authority and decision-making of learners. The groundbreaking uses of AI are

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being studied worldwide, but there is still significant work to be done in understanding the potential impact this technology has on students in Pakistan. Studies most often are theoretical and do not delve into the real "worker" in the classroom. To address this, this research will involve a controlled experiment in a classroom at a university in Lahore to determine the impact of tools like Chat-GPT and Gemini on the writing process.

In particular, the study proposes to investigate the question of whether AI is becoming a "helpful ladder" that enables students to learn more effectively, or whether it is a "permanent crutch" that is negatively impacting student independence. By focusing on this underrepresented context, the study will provide clear evidence on whether technology is helping students master their own writing or if they are simply losing their authority to the machine.

Theoretical Framework

This work is supported by two complementary theoretical frameworks, which elaborate how technology support can be applied in interaction between the learner and the technological support in the learning process. The first theory is the Learner Autonomy Theory as suggested by Holec (1981) and the second one is the Sociocultural Theory, that is, the notion of scaffolding by Vygotsky (1978). Collectively, these frameworks offered a conceptual background to the analysis of how writing tools built with artificial intelligence (AI) capabilities can impact the autonomy and growth of students when they are engaged in academic writing exercises.

Learner autonomy was first formally developed by Holec, (1981) who described autonomy as the capacity of learners to be able to assume responsibility for their learning. This incorporates the ability to identify the learning objectives, choose suitable learning strategies, monitor the progress and assess the learning outcomes. In language teaching, learner autonomy has been popularly considered as a critical component to successful language acquisition since autonomous learners, by far, engage themselves in the process of learning, and, to a large extent, make informed choices on how to enhance their language (Little, 1991). Learner autonomy in the context of writing development is the capacity of the students to plan, draft, revise and evaluate their written texts without relying too much on external directions.

Research Paradigm & Design

This study implements a Pragmatist Paradigm; pragmatic paradigms are the engagement to pursue new knowledge on problems prioritizing practice over philosophy. The best basis for assessment of AI tooling is through quantified language metrics, and pragmatism provides just the way to deliver a quantifiable metric.

In order to measure fluctuations in writing accuracy and fluency, the current research adopted a quantitative One-Group Pre-Test/Post-Test Experimental Design as proposed by Bhattacherjee (2012):

$$O_1 \rightarrow X \rightarrow O_2$$

Cohen et al. (2007) also emphasized, this design is predominantly suitable in educational research for documenting change within a specific group of learners when a control group is not feasible. In this model, the pre-test ($O1$) set the baseline for writing accuracy and fluency with no digital support, (X) was the pedagogical treatment with the AI tool, and the post-test ($O2$) was used to detect changes over time and conducted in the same manner as the pretest but in the presence of AI.

Participants

This research was conducted on 27 undergraduate students in the 8th semester of a university in Lahore. The average age of the cohort was 21-22 years. This group of students was identified using purposive sampling as they were already part of an advanced academic writing program and had the language proficiency and maturity to critically engage with generative technology.

Research Procedure and Pedagogical Intervention

The study lasted for a total of five weeks in order to provide a controlled situation for measuring

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the writing outcomes. The first week was spent preparing students to take the pre-test in which they were asked to write a 250–300 words argumentative essay without using any digital support or grammar checkers. Students were provided with answer sheets alongside test sheets for attempting the test.

The pedagogical intervention phase was for the next 3 weeks. In the second week, the researcher presented the theoretical differences between dependency and scaffolding with slides that communicated the metaphor of a "ladder vs. crutch". During the 3rd week, the focus was on prompt engineering, which involved students' practice of formulating a specific and contextually appropriate prompt in Chat-GPT and Gemini. The fourth week focused on feedback interaction, in which students had to reflect on the suggestions made by AI instead of taking them for granted. At this stage, the researcher explicitly instructed students to ask the AI "why" to make sure that the feedback would be used to facilitate their future learning. The fifth week consisted of giving the post-test on the same topic after pedagogical involvement and in AI presence. During the post-test students advised to use AI writing tools as assistants and no copy pasting was favored.

Data Collection Instruments

The main quantitative instrument used was a writing assessment based on the topic "The Impact of Social Media on face-to-face communication", which was used as an essay prompt. The tests were checked by two assistant professors of linguistics for its appropriateness at the academic level of the 8th semester.

All the quantitative data obtained from the students' writing tests were analyzed by using the Statistical Package for the Social Sciences (SPSS, Version 26.0). A paired-samples t-test was conducted using the procedures outlined in the SPSS Survival Manual: Julie Pallant (2010), for comparing the means of a single group. This was a statistical test to see if the difference between mean of pre-test and post-test was statistically significant at p-value less than .05.

Ethical Considerations

The researcher always maintained high standards of ethics in order to protect the rights, privacy and academic welfare of the subjects. A formal Instructor Authorization and Consent Form was signed before the beginning of the research, and the teacher gave permission to conduct the research during her classes at university. This ensured that research was being a part of the current curriculum and was not disrupting students' learning. This is to ensure informed consent, which was provided in a detailed briefing to the twenty-seven participants in the first week. They were told that they could not be forced to participate in the study and that they had the right to stop at any time without it having a negative consequence on their course grades or on their relationship with the university. Once they agreed to take part in the tests and in the interviews, the experiment was begun. Confidentiality and anonymity maintained.

Descriptive Demographics and Tool Profiles

A descriptive analysis was first performed to determine the compositional properties of the active sample, (N = 27). The categorical distributions analyzed are the distribution by gender of the sample, as well as by tool type among the various Generative AI writing tools chosen, and an intersecting cross-tabulation to identify user preferences.

Table 4.1 shows the gender proportion of the undergraduate EFL class group. The 27 valid participants consisted of 9 male participants (33.3%) and 18 female participants. (66.7%). To assess the latent effects of gender representation and/or unique digital socialization responses on the adoption of digital intervention tools within this specific educational context, it is this baseline of structural composition important to document.

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Table 4.1
Frequency Distribution of Sample by Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Valid: Male	9	33.3	33.3	33.3
Valid: Female	18	66.7	66.7	100.0
Total	27	100.0	100.0	

Table 4.2 shows the distribution of the technological selection chosen by the undergraduate students. In the pedagogical intervention phase, participants were given the freedom to select their main writing helper. The data shows that 22 students (81.5%) selected Chat-GPT as their writing tool for coordination, while 5 students (18.5%) chose Google Gemini for the purpose. By mapping this split, secondary aspects of the research goals are addressed as to determining the platform preference trends within the cohort.

Table 4.2
Frequency Distribution of Preferred Generative AI Writing Tools Selected by Students

AI Tool Selection	Frequency	Percent	Valid Percent	Cumulative Percent
Valid: Chat-GPT	22	81.5	81.5	81.5
Valid: Gemini	5	18.5	18.5	100.0
Total	27	100.0	100.0	

Table 4.3 shows the cross tabulation of the gender of participants and their chosen AI tool. For the males (n = 9), 7 students chose Chat-GPT, and 2 students chose Gemini. In the female group (n = 18), 15 chose Chat-GPT, and 3 chose Gemini. This demonstrates that the cohort as a whole preferred a uniform profile with Chat-GPT being the most popular choice, regardless of gender. A Pearson Chi-Square test was used to test the independence of these choices giving a result of $x2(1) = .123$ that is non-significant (p = .726); two-sided Fisher's Exact Test (p = 1.000). This statistically proves that gender has no relationship to the choice of generative AI software by students.

Table 4.3
Gender and AI Tool Crosstabulation

Gender	Chat-GPT	Gemini	Total
Male	7	2	9
Female	15	3	18
Total	22	5	27

Inferential Statistics: Evaluation of Pre-Test and Post-Test Performance

A Paired-Samples t-test was used to address the central quantitative research question of whether a statistically significant difference exists between students' writing performance before and after the pedagogical intervention using the Artificial Intelligence (AI) scaffolding. This is a direct comparison of paired metric means from the same group at two time points (baseline pre-test and final post-test). The paired t-test assumes that the dependent variable is measured on a continuous scale, and that each individual has two related scores, e.g., pre-test and post-test scores. The differences of these paired scores should be normally distributed, and they should not have any extreme values that could make the results inaccurate. In addition, all pairs of observations should be independent of each other and the sample should be randomly selected for generalizability. When these assumptions are met, the paired t-test can properly determine if the difference in performance from one condition to the other is

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significant as outlined in the SPSS Survival Manual: Julie Pallant (2010). Table 4.4 shows the descriptive statistics for the writing assessments at the two assessment points. The baseline pre-test score mean was recorded at M = 5.648 (SD = 1.1914, SE = .2293). After the instructional intervention that students participated in, the writing performance mean rose to M = 7.500 (SD = .9507 *and* SE = .1830). A descriptive inspection shows that there has been a clear increase in academic writing scores after the intervention.

Table 4.4
Paired Samples Statistics for Pre-Test and Post-Test Essay Scores

Measurement Phase	Mean	N	Standard Deviation	Std. Error Mean
Pair 1: Post Test Result	7.500	27	.9507	.1830
Pair 1: Pre Test Result	5.648	27	1.1914	.2293

To compare the consistency of the linear relationship between participants' initial and final testing parameters, the Paired Samples Correlation coefficient is calculated and recorded in Table 4.5. The analysis resulted in a correlation coefficient of r = .662 and a two-tailed significance at p = .000. This indicates a strong positive, highly significant linear relationship overall (p<. 001), although the overall scores of the students increased over the duration of the study due to the AI instruction, the individuals' performance on the scores remained stable and consistent throughout the study.

Table 4.5
Paired Samples Correlations between Testing Phases

Paired Measurement View	N	Correlation	Significance (p-value)
Pair 1: Post Test Result & Pre Test Result	27	.662	.000

The most important of these values is the two-tailed significance value, which is reported explicitly at (p = .000). The observed value of the significance level (p-value) is far below the widely accepted academic level of significance (α = 0.05, and even below the α = 0.001 level) so the null hypothesis that the technological intervention has no effect can be safely rejected. Statistically, this validates that this improvement in students' writing was not random, but extremely valid from the pre-test to the post-test phase.

Table 4.6
Paired Samples Test Matrix for Performance Difference

Pair Details	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval (Lower / Upper)	*t*	*df*
Post Test - Pre Test	1.8519	.9074	.1746	1.4929 / 2.2108	10.605	26

This result is significant for the overall question that the study was designed to address. To convert this coefficient into an easily interpretable effect size, the value must be squared to determine the Eta-squared (η^2) value:
$\eta 2 = (0.067)2 = 0.004489 \approx 0.0045$
The .0045 Eta-squared value reflects that about 0.45% of the students' academic writing scores are accounted for by gender classification and the generative tools they prefer. An effect size of less than 1% shows that gender differences and technical interface differences had very little effect on students' achievement in this intervention. There was no significant difference in growth between male or female students, no matter which they used, Chat-GPT or Google Gemini. This shows that the structured design of the educational system, and not the age of the

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students, nor any particular characteristics of the software, was the key factor in enabling the students to improve their writing.

Discussion

The current findings can be interpreted in the light of the research questions formulated in this study, allowing the identification of the empirical and pedagogical implications of the intervention. From the perspective of statistical measures, such as t-statistics obtained through the application of the paired-samples t-test in Table 4.4 and Table 4.6, there is a very strong evidence of an extremely significant improvement in students' scores after the intervention stage, answering to the research question related to the effects of AI-based writing tools on the accuracy and fluency of EFL learners' writing. In fact, the mean score of the group in the pre-test and post-test increased significantly, with a critical t-statistic value proving that this change cannot be a result of randomness or familiarity with the test itself. These results correlate well with the findings of Li et al. (2023) in regard to the effects of AI-based feedback on the improvement of lexical density in EFL learners' writing, providing additional empirical evidence to the conceptual claims made by Ahmed (2025), according to which AI-based feedback increases the accuracy of student writing. Unlike Ahmed (2025) who formulated the theoretical model without experimental verification, the results of the current study proved the model's validity in practice. Furthermore, the findings correlate well with the empirical results obtained by Azennoud (2024) in regard to Moroccan EFL learners whose writings became more accurate and lexically sophisticated due to the use of AI-based writing tools.

Yet, when individual student profiles are looked at in detail, the raw test scores mask a considerable amount of structural irregularity, especially in relation to the use of explicit cohesive markers like linking words. A clear, non-linear trend appeared when the use of these transition devices in the pre-test and post-test essays was compared. Two students who had used linking words manually in their pre-test essays gave up using them completely in the post-test, indicating that the easy access to the AI interface temporarily replaced their existing manual cohesion strategies. This pattern supports the concerns about overreliance that Zulkefli and Ismail (2024, 2025) raised, since they warned that a convenience-based use of AI can result in shallow processing of feedback and a deterioration of the learners' own compositional habits. It also shows exactly the risk pointed out by Kukulska-Hulme and Shield (2008): instead of helping and guiding the students' thinking, the tool seems to have taken the place of a skill which they had already partly internalised, something that Stockwell (2016) also noted, namely that the benefit of technology for learning depends greatly on how it is used, not just on its availability.

Three of the students formed another subgroup showing an inverse pattern of development and performed significantly less well in the post-test than in the pre-test. The fact that their performance declined implies that, for these learners, the automated system increased rather than decreased the amount of mental processing required after the external support had been taken away. When this group's deterioration is considered in light of Benson's (2011) definition of autonomy as active control over one's own resources rather than passive dependence on support, it becomes clear that they had not attained autonomous control over the language structures to which the AI had exposed them; instead, the tool seems to have created a mismatch between the complexity of its output and the learners' established level of competence, which is in line with the convenience-versus-cognition trade-off mentioned by Zulkefli and Ismail (2025).

On the other hand, there was a group of five students who consistently used linking words in a stable manner under both testing conditions, showing that they had a well-balanced structural foundation which remained unchanged whether or not the writing task was assisted by digital means. This pattern is most in line with the autonomous and self-regulated use of AI tools as described in the wider review by Zulkefli and Ismail (2024), in which learners were able to use

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AI feedback to revise and evaluate their own writing without giving up control of the underlying process. Two further students also showed almost identical performance, structure, and scores in both conditions, suggesting that the software served them merely as a passive interface, similar to a spellchecker, and did not cause any significant change in their writing style or level of competence. This result supports the argument put forward by Ng and Ridzuan (2025), based on the Theory of Planned Behavior, that the degree to which learners engage with AI is influenced by factors other than the tool itself, such as individual characteristics and classroom norms; the kind of passive, low-level use observed here may indeed be an example of the shortcut-oriented, non-internalizing behaviour that, according to Holec's (1981) concept of autonomy, leaves the learning process essentially untouched and therefore also unimproved.

Every one of the remaining sub-groups demonstrated a positive change from the pre-test to the post-test, although there was no consistent use of explicit linking words. In the absolute majority of cases, the post-test essays showed a marked improvement in language use, clearer organizational patterns, and a clear progression from simple sentence structures to more advanced and complex academic sentence structures. These improved essays also used punctuation marks accurately and precisely and featured a highly formal vocabulary that was appropriate for academic purposes, differing from the kind of vocabulary found in informal, conversational writing. This trend is in line with the scaffolding function that Azennoud (2024) assigns to AI writing tools, in that exposure to AI-generated structures enables learners to gradually internalise more sophisticated syntactic patterns, and it also supports Ahmed's (2025) claim that automated feedback can improve learners' grammatical and lexical choices even in the absence of direct teacher involvement. The complexity of this empirical distribution shows how the presence or absence of explicit transition words can serve as a structural feature that acts as a defining criterion for structural development: while most students used the generative system to enhance their vocabulary and syntax in a way that reflected real autonomous improvement, for some students the explicit inclusion of transition markers meant that they placed too much emphasis on surface-level vocabulary choices. This difference supports the general observation by Abbas et al. (2024) that the effects of AI-assisted writing are not the same for all learners but depend on the way in which individual learners interact with the tool within the context of their own academic situation, thus reinforcing the idea that the pedagogical value of AI in EFL writing is conditional on the learner's critical engagement with the tool rather than being an inherent feature of the technology itself.

Strategic Variations in Cohesive Layouts and Student Performance Profiles

From the results, it is clear that the students responded in a different manner to the computer-assisted writing support system since there were no consistent responses within the entire sample group. The five sub-groups demonstrate the impact of the technology on the students based on their language proficiency, learning styles, and the critical approach towards using it. Sub-group one (2 students) employed transitional expressions such as "however," "furthermore," and "consequently" in their pre-test composition but did not use them in the post-test. Due to the intervention by the technology, the students were able to produce cohesive paragraphs and hence had no reason to manually develop links. In the absence of the technology in the post-test, they simply omitted the links leading to non-cohesive paragraphs although their vocabulary was impressive.

Sub-group two (3 students) performed less well in the post-test compared to pre-test performance. This is an indication of cognitive overload since the technology was producing writing that was too complicated for them to comprehend fully. The learners accepted the complexity of multi-clause sentences but did not grasp the underlying rules. Consequently, in the absence of the technology in the post-test, they ended up producing run-on sentences and unclear writing.

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In the third sub-group (5 students) the usage of linking words was consistent in both tests. The group possessed a solid grammatical background and managed to work with the software without giving away its unique style. Unlike the second sub-group, in the course of the test, the participants did not resort to the tool, but rather checked and polished their ideas using it. In the fourth sub-group (2 students), the performance level was similar in both tests and revealed low engagement and resistance to change. The participants used the tool in the same way as they would use a simple dictionary or spellchecker, and did not experiment with their phrasing. Therefore, the writing process remained untouched, and there were no changes in their results. Finally, the fifth and the biggest sub-group (15 students) demonstrated the greatest improvement as far as sentence construction is concerned. While in pre-test essays only simple and repetitive and informal sentences were presented, during the intervention period, the participants were consistently exposed to the example of complex sentences with subordinate conjunctions, relative pronouns, and appropriate punctuation marks. In post-test, they were able to replicate the pattern and write formal academic sentences with proper punctuation marks.

Conclusion

The research findings conclude that pedagogical integration of AI-powered writing technologies has a highly statistically significant impact on writing accuracy and fluency (RQ). The baseline pre-test mean score increased from M = 5.648 (SD = 1.1914) to a post-test mean score of M = 7.500 (SD = .9507) and was found to be statistically significant using paired-samples t-test. The critical t statistic was 10.605 with an exact two-tailed significance value of (p = .000). The null hypothesis was rejected and the results indicated that the structured interaction with the AI interfaces led to real improvements in syntax and vocabulary. From test sheets it was recorded that 55.6% of the cohort were able to successfully move from writing anxiety to self-regulated academic structures. Non-linear structural changes were observed, though 11.1% of students' performance decreased because of cognitive overload and 7.4% of the students did not make use of cohesive linking words after the intervention. The technology therefore functions as a 'ladder' toward independent recognition of genres only when the students selectively filter out outputs, and without the boundaries of metacognition, it becomes a 'crutch' that prevents active processing of syntax.

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