INTERNATIONAL JOURNAL OF SOCIAL SCIENCES BULLETIN
ISSN: (E) 3007-1917 (P) 3007-1909
Volume 4, Issue 3, 2026

EXAMINING THE EFFECTIVENESS OF AI-ASSISTED METACOGNITIVE INTERVENTIONS IN IMPROVING ACADEMIC LANGUAGE PROFICIENCY IN HIGHER EDUCATION

Dr. Nighat Khurshid[*1], Maleeha Nazim[2], Samyyia Ishaque[3]

[*1]*Assistant Professor Department of English University of Poonch (Rawalakot)*
[2]*Lecturer, University of Management and Technology, Lahore*
[3]*Lecturer, Department of Education, Women University of Azad Jammu and Kashmir, Bagh*

[*1]nighatkhurshid@upr.edu.pk, [2]maleeha.nazim@umt.edu.pk, [3]samyyiaishaque123@gmail.com

Corresponding Author: *
Dr. Nighat Khurshid
DOI: https://doi.org/10.5281/zenodo.18977828

Received	Accepted	Published
12 January 2025	24 February 2026	12 March 2026

ABSTRACT

With a fast growing development of artificial intelligence (AI) technologies, new opportunities are born in terms of improving higher education teaching and learning. This paper has discussed the effectiveness of ChatGPT and Grammarly, which are AI-assisted metacognitive interventions, in enhancing the level of academic language proficiency in college students. The research design used is quantitative quasi-experimental research design based on pretest-posttest control group design. Sixty undergraduate students in one of the Pakistani public sector universities took part in the research where 30 of the students formed an experimental group, and 30 students formed a control group. In the experimental group, ChatGPT and Grammarly were used to provide metacognition assistance of the importance of AI in writing tasks, whereas the control group was provided with the standard approach to teaching writing. Academic writing test made up of a pretest and posttest was used as a source of data collection and a questionnaire was used to measure metacognitive engagement. Independent and paired samples t-tests showed that the experimental group showed significant improvement in academic language proficiency than the control one. Besides, the research findings showed that during the use of AI tools, the students were actively involved in metacognitive strategies related to planning, monitoring, revising, and evaluating their writing. It is concluded that the combination of AI-assisted tools with metacognitive learning strategies can prove to be effective at improving academic language proficiency in students. The results are sound implications to the teachers who want to use artificial intelligence technologies to teach academic writing in colleges and universities.

Keywords: *Artificial Intelligence, Academic Language Proficiency, Metacognitive Strategies, ChatGPT, Grammarly, Higher Education.*

INTRODUCTION

Background of the Study

The fast emerging artificial intelligence (AI) has greatly changed the nature of education especially in the higher education settings where digital technologies are being made more relevant in learning and teaching activities. Neurocomputer technologies are intelligent tutoring systems, generative AI chatbots, automated writing assistants, and adaptive learning systems are becoming more common in helping students learn language, as well as develop skills in academic skills. These systems offer feedback which is personalized, adaptive teaching resources, interactive learning environments that improve the engagement and learning autonomy of students. Recent studies

have revealed that AI-mediated educational technologies can be used to aid language learning in the form of real-time feedback, pronunciation instructions, and automatic writing assistance that help learners to perfect linguistic accuracy and academic writing (Albedah, 2025; Chen et al., 2023; Zhai and Nezakatgoo, 2025). What is more, the AI tools can make the learning process more accessible and flexible, allowing learners to train language skills throughout the day when they are out of the classroom. This tendency makes the exploration of the possibilities offered by AI technologies by higher education institutions increasingly popular to support the improvement of the academic level of language proficiency and foster the development of effective learning strategies among the students of universities (Ishaque et al., 2026).

Language skills in academics are one of the basic necessities to succeed in the advanced education since students are expected to comprehend complicated academic readings, take part in academic conversations, and write academic papers in a proper format. Nevertheless, a good number of college students, especially those that study a second or foreign language, struggle considerably to satisfy the linguistic requirements of academic situations. The features of academic language include special vocabulary, complicated structure of grammar, conventions of discourse peculiar to the field of study which need the high level of linguistic competence and the use of language strategy. The literature on applied linguistics attests to the fact that the academic level of language proficiency is strongly connected with the academic capacity of students to achieve proficiency in analyzing, synthesizing, and communicating multiple intricate ideas (Hyland, 2019; Zhai and Nezakatgoo, 2025; Ramli et al., 2024). Moreover, the shortcomings of academic language analysis have been reported to lower understanding, academic writing, and overall grade of the students. Thus, enhancing academic language skills has emerged as a major objective of institutions of higher learning worldwide especially in multilingual learning institutions where English is the medium of instruction.

The concept of metacognition has been known to play a crucial role in successful learning and acquisition of language. The metacognition concept is the awareness and control in cognition processes among learners such as the capability of planning, monitoring and evaluating their learning processes (Flavell, 1979). As learning initiatives, metacognitive strategies will help learners to control their learning programs and assume more favorable strategies to academic workload. In the case of language learning, metacognitive awareness enables the learners to recognize their strengths and weaknesses, choose the right strategies and measure the effectiveness of their learning activities. Studies have indicated a positive correlation between high proficiency levels and academic performance in the language of study and active metacognitive strategy use among the learners (Mahadi et al., 2021; Raoofi et al., 2014; Zimmerman, 2002). Such strategies meet the independence of learners and encourage the power of self-guided study, which are fundamental skills among students that deny the ability to complicate academic settings. Metacognitive strategy teaching has therefore emerged as significant in language teaching.

Metacognitive interventions have pervaded learning institutions in an attempt to improve the learning behaviors and performance of the student. These interventions are normally based on systematic activities where the learners are urged to think about how they think, establish objectives on what they want to learn, track what they have already learned, and analyze their learning outcomes. Research findings have shown that the metacognitive training can help learners enhance their understanding, problem solving and academic performance in the learning process. Metacognitive interventions can be used in the context of language learning to enable students to establish more efficient reading comprehension, academic writing and vocabulary learning strategies (Mahadi et al., 2021; Wenden, 1998; Raoofi et al., 2014). These interventions can also raise the motivation and confidence of learners because they get the ability to have more power in controlling the learning processes. With the growing heights of independent and self-regulated learning being more and more prominent in the sector of higher education problems, the introduction of metacognitive strategies in the process of

teaching language has turned into a valuable aspect of successful lingual teaching processes.

The recent advances in the field of AI technologies have provided an opportunity to introduce new possibilities of integrating metacognitive strategies in the digital learning organization. Educational systems based on AI can instruct learners to engage in reflective processes of learning by presenting prompts, feedback and scaffolding that promotes metacognitive interactions. One case is that AI writing aides and generative AI chatbots have the capability to scan the writing of students, recognize linguistic issues and propose methods of improvement in grammar and vocabulary, as well as structure. These devices are in support of encouraging students to read and reread their assignments, thus encouraging the process of reflection and self-assessment along the way. It has been found out that language teaching through AI can boost the engagement of the learners, their autonomy, and their self-regulated learning practices, due to the personalized and interactive feedback provided (Albedah, 2025; Chen et al., 2023; Frontiers in Psychology, 2023). It is under these processes that AI technologies can be used as cognitive companions which help learners in shaping metacognitive consciousness and academic language proficiency.

The development of AI-based metacognitive interventions is one of the promising methods of improving language learning in the context of higher education. The interventions are a combination of the adaptive AI technologies and the instruction strategies aimed at fostering metacognitive self-awareness and self-regulator learning. As an example, the AI systems will be able to assist learners in the process of structured learning which includes planning learning activities, tracking understanding and assessment of the learned materials. Empirical studies show that, by using AI-assisted metacognitive scaffolding, it is possible to enhance students with regard to reflective thinking, academic writing, and overall language learning performance (Chen, 2024; Lai et al., 2025; Zhai and Nezakatgoo, 2025). With the help of AI-driven interventions, students can grow to be more strategic and autonomous learners by offering timely feedback and tailor-made advice to them. Such combination of AI technologies and metacognitive learning provides thus new possibilities to achieve better academic language proficiency by students in university.

Although topics on AI-assisted learning are becoming popular nowadays, the outcomes of AI-helped metacognitive interventions in enhancing language proficiency in academics is a new field of study. Although the advantages of AI technologies in language learning have been studied by many researchers, not many studies have explored the effect of AI tools on the application of metacognitive strategies and language development in the learners. According to the researchers, successful implementation of AI demands the formulation of powerful pedagogical systems that encourage students to actively learn and think instead of depending on automated resources (Sweet and Sutton, 2025; Chen et al., 2023; Zhai and Nezakatgoo, 2025). In the absence of proper teaching support, the tools of artificial intelligence will be exploited by the students as an outreach to get assignments over and done with instead of a help of knowledge and creation of skills. Consequently, additional studies are necessary to investigate the opportunities of the effective implementation of AI-assisted metacognitive interventions in the context of higher education.

In addition to this, there have been concerns over the dangers that may be posed by too high dependence on AI technologies in academic learning settings. Other researchers claim that, in case students rely on AI-generated responses too much and do not use critical thinking and learning processes, they can get superficial knowledge or even false mastery. The given phenomenon demonstrates the significance of implementing metacognitive strategies that prompt students to become more critical of the information produced by AI and become more reflective about the process of learning (Gasevic and Yan, 2026; Ramli et al., 2024; Sweet and Sutton, 2025). Metacognitive interventions, based on the development of critical awareness and reflection learning, may help students to utilize AI technologies, becoming more responsible and useful. Consequently, the problem concerns the effectiveness of AI-assisted metacognitive interventions that need to be investigated to have a comprehensive approach

to the utilization of these technologies to facilitate natural learning and enhance academic language proficiency in higher education.

Statement of the Problem

The academic language proficiency is an important skill of higher education students since it allows them to comprehend academic texts, engage in academic conversations, and write organized academic papers. Nonetheless, a significant percentage of students of universities have a problem with the development of linguistic and cognitive capabilities that allow them to successfully communicate during academic procedures, especially when they study using English. It is also shown that difficulties in academic writing, vocabulary, and discourse structuring tend to hamper the student in the process of proving what they know (Hyland, 2019; Ramli et al., 2024). Although traditional teaching methods are mainly based on linguistic competency, they frequently ignore metacognitive dynamics that assist the learners to control their ideas, to track their strides in addition to evaluating their learning strategies, which is crucial to achieving the academic language proficiency (Oxford, 2017; Zimmerman, 2002).

Recent innovations of artificial intelligence (AI) technologies have brought emerging opportunities of facilitating learning via AI-assisted learning aid. AI technologies can be used together with metacognitive teaching practices that may help to increase the metacognitive engagement of students in their language learning activities with the help of interactive feedback system, reflective prompts, and personalized instructions (Chen et al., 2023; Zhai and Nezakatgoo, 2025). Although AI is beginning to gain popularity in the educational sector, the advancement of AI in education has yet to receive much empirical studies on the effectiveness of AI-assisted metacognitive intervention as an educational tool to enhance academic language proficiency in learners at higher education institutions. This is why there is a necessity to research the role AI-assisted metacognitive interventions can play in the enhancement of academic language proficiency of students in a higher educational context.

Rationale of the Study

The growing application of artificial intelligence (AI) in higher education has brought new opportunities about the ability to assist with the learning process of the students, especially in building academic language proficiency. As AI-based programs can assist students with personalized feedback, interactive prompts, and the chance to practice language continuously, they can help them attain a better score in academic writing and communication (Chen et al., 2023; Zhai and Nezakatgoo, 2025). Simultaneously, metacognitive strategies allow learners to control their learning by plan, monitoring and assessing their academic assignments, which are crucial to the enhancement of language proficiency and academic achievements (Oxford, 2017; Zimmerman, 2002). A combination of AI technologies and metacognitive-based instruction can thus offer a viable solution in enhancing the academic language proficiency of the students. Nevertheless, the effectiveness of the use of AI-aided metacognitive interventions in improving academic language proficiency in higher education students has been limited empirical studies. Thus, the paper at hand is carried out to explore the possibility of the AI-assisted metacognitive interventions to play a crucial role in enhancing academic language proficiency of a student in a higher education setting.

Research Objectives

1. To determine the role of AI-supported metacognitive interventions in the improvement of academic language proficiency in higher education students.
2. To examine the association between application of AI-aided metacognitive strategies with academic language proficiency in Pakistani universities.

Research Questions

1. How AI supported metacognitive skills can play role in in the advancement of academic language proficiency in Pakistan higher education students?
2. Is there a significant association between applications of AI-aided metacognitive strategies with academic language proficiency?

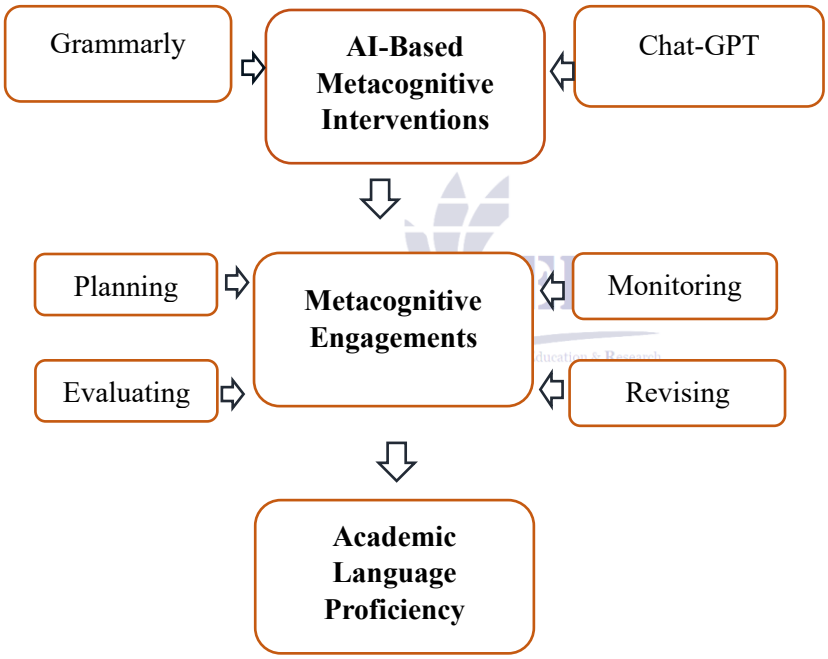
Significance of the Study

The research is important in that it can be added to the extensive academic literature concerning artificial intelligence (AI) application in higher education, specifically, language learning and academic communication. In Pakistan, due to

the presence of fairly large number of university students, the problem of developing academic language proficiency among this group occurs, as it is a necessary requirement regarding academic writing, scientific work, and engagement in academic dialogue. Through an analysis of the usefulness of AI-mediated metacognitive interventions, the current study will help understand how AI technologies with reflective learning strategies could assist students in enhancing their academic language. The results can guide the educators and language teachers to relate to the way new technological tools can be used to manage language teaching to empower learning among students.

Moreover, the research can have a practical implication on the institutions of higher learning and the Pakistani policymakers who need effective ideas on how to enhance the quality of language pedagogy. The study can be used to guide curriculum teaching, instruction, and online learning programs in Pakistani universities by revealing how AI-assisted methods of metacognition can be used to develop academic language proficiency. Its findings can also make teachers embrace the use of technology-enabled learning processes that facilitate self-managed learning and critical thinking by the learners to become ready to engage in academic and professional communication in the ever-increasing digital and knowledge based world.

Conceptual Framework



REVIEW OF LITERATURE

Introduction

Teaching and learning in tertiary education has been impacted in a massive way by the rapid development of technologies related to artificial intelligence (AI). Over the past years, technologies based on AI, like ChatGPT and Grammarly and other automated writing assistants, have increasingly found their way into the academic setting. The technologies offer the learners real-time feedback, language support, and individual support when engaging in a writing task. Due to this, teachers and scholars have started to study the role of AI tools in developing academic writing and language skills in students. The academic language competence is a significant condition of university students since they can express ideas or form logical arguments to address the scholarly discourse. Nevertheless, linguistic constraints, lack of feedback opportunities, and learning strategies are some of the factors that make many students to lack these skills. As a result, the combination of AI-based learning application with metacognitive learning strategies has been proposed as a promising measure to achieve academic proficiency in language among higher education learners.

Higher Education Artificial Intelligence.

Coming into play as a significant constituent of the current technological means of education, artificial intelligence provides progressive solutions on how the processes of teaching and learning can be enhanced. Ample data and feedback can be produced, and AI systems can personalize learning experiences to individual students. AI tools are also adopted in the educational field of higher learning to facilitate language learning, writing, and the evaluation procedure. It has also been found that the use of writing AI can enable students to get instant feedback on their grammar, sentence structure, coherence and vocabulary, which, to a large extent, could improve the writing process (Ding, Zou, and Kohnke, 2025). They allow the students to make their work more effective and gradually build their academic writing skills.

Adaptive learning environments in which learners can get personalized feedback depending on their unique learning requirements also promote the use of AI in education. Through such tools, learners are able to detect their flaws and work on their writing skills by engaging into repeated writing processes. Research on the idea of AI usage on academic writing indicates that students usually express that AI writing assistants are helpful in enhancing grammatical precision, writing precision, and general text quality (Alshahrani, 2025). The adoption of AI technologies can hence count as a significant change in the manner the teaching of writing is conducted in higher education.

Academic Writing Aids based on AI.

AI-based writing tools have received significant prominence as learning resources that help students undertaking an academic writing process. The tools have automated feedback, language alternatives, and writing support features that are capable of enhancing the overall standard of written text. Two of the most popular AI-driven writing assistants include ChatGPT and Grammarly, though they have subtle features that are aimed at helping students throughout the writing process. The AI writing assistants are able to process text and give suggestions about grammar, coherency, vocabulary, tone, and formatting of citations, enabling the students to enhance the writing performance by continuously revising the text (Tikhonova & Raitskaya, 2025).

Empirical studies conducted recently have shown that many students when using AI-assisted writing applications had improved academic writing performance in a variety of areas such as structure, clarity, grammar and vocabulary. To illustrate, one of the study types, experimental studies, was used to demonstrate that AI-assisted learning may considerably positively influence students with regard to their writing and motivation compared to traditional methods of teaching (Kohnke, Moorhouse, and Zou, 2023). These results indicate that AI technologies can have a significant role in the academic language development in case they are introduced into educational contexts.

ChatGPT in Academic Writing

ChatGPT is one of the AI programs developed by Open-AI that have received the most extensive discussion in the educational field. The tool has the ability to produce text, answer questions, and to give explanations on a broader academic subject matter. Due to its capacity to aid students in written responses, ChatGPT faced great interest and is currently used as a writing assistant due to its coherent written answers. Studies on the application of ChatGPT in language learning settings posit that the technology has potential to offer useful feedback when doing writing assignments and assist learners in enhancing the grammar, tone, and general writing skills (Khampusaen, 2024).

The results of studies that investigate the adoption of ChatGPT into the teaching of academic writing suggest that the tool can be employed by students to brainstorm, create outlines, draft, and improve the clarity of their sentences. It is also conducted that ChatGPT can be viewed as the formative feedback tool, which assists students in the writing process, especially when used with the assistance of instructor feedback (Ding et al., 2025). Nevertheless, researchers underline that it is necessary to use ChatGPT carefully with the help of pedagogy so that students could be actively involved into the learning process.

Writing Assistant Grammarly as an Artificial Intelligence.

Another popular AI-based writing aid is Grammarly that is supposed to enhance the accuracy of grammar, clarity in writing, and style. The device employs natural language processing algorithms to identify the mistakes and give recommendations on how to refine a written communication. Grammarly has also been widely utilized by students in the academic world as a tool to perfect their writing and prevent instances of grammatical mistakes.

Studies have suggested that automated writing scoring systems such as Grammarly can be used to give direct and written feedback that assists in the revision process. These tools assist the students in detecting language mistakes and also correct their writing using the opportunity of repeat editing. Research on the topic of automated writing assessment technologies indicates that they are capable of greatly enhancing the quality of writing, vocabulary use, and comprehension of the entire text when integrated into the process of writing through a review of the research (Liang, Yan, and Gasevic, 2024). In addition, AI-powered writing tools can assist learners pay more attention to patterns and grammatical forms of language which can lead to the development of language in the long term.

Metacognition Learning in a Language Instruction.

Metacognition basically involves the consciousness and control of the cognitive processes of the learner in the course of learning activities. In language acquisition, metacognitive strategies allow the students to strategize their learning endeavor, track their learning, and reflect on their learning. The strategies are especially critical in writing academic work since writing involves complex cognition processes like generation of ideas, organization, revision and critical reflection.

It has been proved that students who apply metacognitive techniques to learning perform better in activities connected with language. Mental control strategies prompt learners to consider the writing processes, learners to recognize weaknesses, and improvement of works. Researchers postulate that the metacognitive instructions encourage the autonomy of the learners and improve the capacity of the students to control their learning processes in complicated educational situations (Yang et al., 2024). As a result, a critical interest in the works of language education research has been to incorporate metacognitive learning strategies in the instruction of writing.

Metacognitive Learning with the aid of AI.

The recent research has also started looking at the combination of the artificial intelligence tools with the metacognitive learning strategies. The processes of metacognition may be facilitated with the help of AI systems, which can offer feedback, encourage reflection, and take learners through the process of structured writing. As learners are presented AI tools when performing writing, they usually become involved in metacognitive processes, including analyzing feedback, revising drafts, and concurrently monitoring the quality of writing.

Studies that analyze the aspects of AI-assisted writing behavior show that students encouraged to correct AI-generated recommendations and cognitively assess the feedback seem to have a higher positive impact on writing quality than those who are passive receivers of AI-generated text (Yang et al., 2024). The results indicate that the combination of AI technologies and metacognitive learning techniques is vital to provide the students with an opportunity not to passively consume the writings but be engaged in the process.

Academic Writing AI Problems and Concerns.

Despite this, AI-assisted writing tools have numerous advantages, and a number of concerns have been voiced regarding their application in education. Other scholars believe that overuse of AI-generated material can decrease the critical thinking and writing skills of students. It has also raised some concerns about academic integrity and plagiarism and the unhealthy possibilities of AI tools in academic testing (Khalifa and Albadry, 2024).

The other issue that accompanies the utilization of generative AI tools is that there is a risk of poor or fake information generated by language models. Researchers have demonstrated that there are conditions when AI systems produce the wrong references or untrustworthy material that can influence the honesty of academic papers in case students use AI-generated results without additional checks (University of Mississippi Study, 2024). The given issues demonstrate that integrating AI solutions in the educational process should be responsible and

that students should be taught to utilize AI tools importantly and ethically.

Research Gap

Although there has been an increasing research on artificial intelligence in the education field, there are still gaps in research. Numerous studies have investigated the advantages of AI tools in educational contexts generally, writing assistance or language learning, however comparatively few items have investigated the combinations that AI tools display with metacognitive learning strategies to enhance academic language competence. Moreover, having no objective outcomes on measuring the effectiveness of AI-assisted interventions using experimental designs, the majority of existing studies concentrated on how students perceive AI technologies.

More so, there has been limited research that has been carried out with respect to developing nations specifically in universities within Pakistan. When compared to Western settings, the educational learning environment in developing countries is usually not the same, as it can be associated with technological access, digital literacy and teaching methods. Hence, additional studies should be conducted to determine how AI-based metacognitive interventions can be used to facilitate academic language proficiency in such settings among university students.

Summary

The chapter has analyzed the literature that is available concerning artificial intelligence in education, AI-assisted writing software, ChatGPT, Grammarly, metacognitive learning strategies, and the combination of AI and metacognitive instruction. According to the literature, AI technologies can be used to assist in academic writing and learning a language by facilitating automated feedback and providing personalized learning opportunities. Nevertheless, the successful implementation of the tools is dependent on the way in which they are incorporated into pedagogical systems that promote active learning and metacognitive processes. Another weakness of the reviewed article was to offer some gaps in the literature, especially concerning the concomitant application of AI-based interventions and metacognitive strategies in the context of universities. It is on the basis of these gaps that the current study seeks to explore the effectiveness of AI-assisted metacognitive interventions towards enhancing academic language proficiency among students in higher learning institutions.

RESEARCH METHODOLOGY

Research Design

In the study, the research design applied was a quantitative quasi experiment with pretest-posttest control group. Quasi experimental research designs are common in research in the educational field where the researcher wishes to study the effectiveness of a given intervention but lacks the capacity to completely randomize subjects. This research involved two groups of students that were used in the study. The experimental group was assigned AI-assisted metacognitive interventions with the help of ChatGPT and Grammarly, the control group was taught to write in the traditional way without any artificial intelligence devices. A pretest was conducted on both the groups to determine their baseline academic language competence prior to the intervention. The use of a posttest was done at the end of the intervention period to ascertain whether there was any improvement in the academic language proficiency of the students. The posttest and pretest scores of the two groups compared made this researcher to conclude on the effectiveness of AI-assisted metacognitive interventions in increasing the academic language proficiency among the university students.

Research Approach

The current research method was quantitative method due to the research objective to quantify the correlation between AI-facilitated metacognitive interventions and academic language proficiency with the help of numerical data and statistical tools. The quantitative research enables the researcher to study the patterns, relationship, and differences between variables in terms of objective measurement and statistical methods. In this paper academic language proficiency of students was evaluated based on structured writing tests and the data obtained were evaluated statistically to establish the effects of the intervention. The quantitative research was deemed suitable due to the fact that

it gives empirical data regarding the success of the intervention and can be generalized to other similar educational settings.

Population of the Study

The population of this research was constituted by undergraduate students who study in public sector universities in Pakistan where English is an instructional language. Academic writing activities like essays, reports and research assignments of the undergraduate level often involve high level of writing in terms of academic language proficiency. Nevertheless, a variety of students encounter problems in their skills to write effective academic papers and use the right language. This is why the population chosen by the researchers was undergraduate students who can be regarded as a suitable group to researches using the power of AI-assisted metacognitive interventions in enhancing academic language proficiency.

Sample and Sampling Method.

The target sample was extracted from university of Poonch Rawalakot. Sixty undergraduate students were taken as a sample in the study. The participants were grouped into two with 30 students in each group. One group was given the status of an experimental one and received the AI-assisted metacognitive intervention where they used ChatGPT and Grammarly and the other was the group that was the control one and received the traditional writing instructions. Purposive sampling was used to select the participants since students studying courses that involved academic writing were deemed to be more important towards the goals of this study. Purposive sampling has helped the researcher to sample individuals, who were directly engaged in academic writing tasks and could experience the benefits of AI-aided metacognitive intervention, as adopted in the study.

Variables of the Study

The research problem was the investigation of the correlation between the use of AI-based metacognition interventions and academic language proficiency. The study independent variable was AI-aided metacognitive intervention, the use of ChatGPT and the Grammarly as the learning tools to help sufferers of metacognitive writing. The dependent variable was academic language proficiency which is the capacity of the students to apply correct grammar, vocabulary, coherence, and academic discourse in their writing assignments. The study also had a mediating factor which is metacognitive engagement whereby the intervention was meant to make the students plan, monitor, revise, and assess their writing processes using artificial intelligence tools.

Research Instruments

The main tool that was applied in the present study was an academic language proficiency test that was meant to assess the writing skills of students in an academic environment. The test involved the students being given a systematic scholarly writing exercise where they gave a short essay on a specified subject. The feedback on the responses provided by the students was assessed with a standardized rubric that included the determination of grammar accuracy, the use of vocabulary, coherence and organization, and clarity of the expression. To incur reliability and validity, the evaluation criteria were modulated to traditional academic writing assessment models that are generally well known. The writing test was conducted at the time of intervention and after it in order to evaluate whether there was a progress in the academic language proficiency of the students.

AI-Assisted Metacognitive Intervention.

The intervention that was to be used in this study combined the artificial intelligence tools with metacognitive learning interventions to promote the growth of academic language proficiency. The experimental group utilized ChatGPT and Grammarly as AI-based tools when doing academic writing tasks. Students were provided with assistance in generating ideas, creating outlines, and making the writing more understandable using ChatGPT. The feedback was provided in Grammarly to check the grammar, structure of a sentence, vocabulary, and the quality of the writing. It was used to help the students engage in metacognition through planning their writing activities, tracking progress, revising writing, and reviewing their writing based on suggestions given by the AI instruments. The intervention was six weeks in duration, where students were

to be assigned a number of writing tasks through the AI-linked metacognitive approach.

Data Collection Procedure

Data collection was divided into a number of phases. To begin with, a pretest was also done on both the experimental and control groups to determine their level of academic language mastery before the experiment. After the pretest, the participants of the experimental group underwent the AI-assisted metacognitive intervention in six weeks, whereas the members of the control group proceeded with the conventional writing instruction without any artificial intelligence tools. Throughout the intervention time, the students of the experimental group utilized ChatGPT and Grammarly to assist in their writing activities and undergo processes of reflective learning. The posttest was conducted on both groups after the intervention period by a similar academic writing task. The pretext and posttest results were compared and used to evaluate the effectiveness of the AI-assisted metacognitive intervention.

Data Analysis Techniques

The data were collected examined with the help of the Statistical Package of Social Sciences (SPSS). The initial statistics applied in the study to summarize the performance of the students was done through the use of descriptive statistics whereby the mean scores and the standard deviations were used to describe the performance. Paired sample t-tests, which would involve investigating the changes in academic language proficiency of the students in each group during the pretest and posttest were employed. The posttest scores of experiment and control groups were compared using independent sample t-tests to make a conclusion whether the AI-assisted metacognitive intervention exerted a statistically significant influence on the academic language proficiency of the students. The magnitude of the impact of intervention was also determined by means of the effect size analysis.

Ethical Considerations

In the conducting of the research, there were various ethical aspects that were adhered to so that the research was actually done in a responsible and respectful manner. The sample used was volunteered as students were informed of the study aim and research processes and then accepted to participate in the research study. The personal information and academic data of the study participants was engulfed in secrecy within the study. It was guaranteed to the participants that the data collected would be applied in academic research only. Moreover, the participants were provided with the opportunity to pull out of the research at any point without having to incur any form of negative repercussion.

RESULTS

The area describes the results of the statistical procedures that were performed to determine the efficacy of AI-aided metacognitive interventions with the help of ChatGPT and Grammarly in enhancing academic language proficiency in students of higher learning. Statistical Package of Social Sciences was used to make the analysis. The outcomes are summarized under descriptive statistics, comparison of pretest scores, within-group comparison of pretest and posttest scores, between-group comparison of posttest scores and metacognitive engagement of students.

Descriptive Statistics

Descriptive statistics was calculated to provide a summary of the scores of the performance of the experimental and control groups in terms of academic language proficiency prior to and following the intervention. The mean scores and standard deviations were determined in order to investigate general trends of student's performance in writing. The findings show that both groups were similar in terms of their academic language proficiency at the start of the study. Nevertheless, mean scores of the experimental group got significant improvement after the intervention period compared to the control group.

Table 1 Descriptive Statistics of Academic Language Proficiency Scores

Group	Test	N	Mean	SD
Experimental	Pretest	30	10.33	2.07
Experimental	Posttest	30	16.05	2.14
Control	Pretest	30	10.18	2.03
Control	Posttest	30	11.52	2.09

Table 1 shows the descriptive statistics of the academic language proficiency scores between the experimental and the control group of the pre-test and post-test. The experimental sample received a pretest mean score, M = 10.33 (SD = 2.07), which went up to M = 16.05 (SD = 2.14) in the post-test, which is a significant improvement following the intervention. The control group, in its turn, has the pretest mean score of M = 10.18 (SD = 2.03) and the post-test mean score of M = 11.52 (SD = 2.09), which is only slightly higher. The fact that the pretest scores were similar in both the experimental and control group indicates that the academic language proficiency of the two groups was similar at the start of the study. Nevertheless, the greater effect size of the mean score of the experimental group shows that students that were affiliated with the AI-assisted metacognitive intervention with ChatGPT and Grammarly improved academic language proficiency more than the traditional instruction.

Comparison of Pretest Scores

An independent samples t-test was conducted to determine whether there was a statistically significant difference between the experimental and control groups prior to the intervention.

Table 2 Independent Samples t-Test for Pretest Scores

Group	N	Mean	SD	t	p
Experimental	30	10.33	2.07	0.29	.773
Control	30	10.18	2.03		

Table 2 provided outcome of the independent samples t-test applied on the pretest scores of experimental and control groups. The mean score of the experimental group was M = 10.33 (SD= 2.07 and the mean score of the control group was M = 10.18(SD= 2.03). The outcome of the statistical analysis was that the two groups did not differ significantly (t = 0.29, p = .773). The p-value exceeded the amount of significance level of 0.05, and this implies that there was no significant difference between the two groups prior to the intervention. The finding proves that the academic language proficiency of the two groups at the beginning of the study was similar, which guarantees the equivalence of the participants in the baseline. As such, the fact that the posttest scores have improved can be accredited to the AI-enhanced metacognitive intervention instead of the fact that differences between the groups were present in the pretest.

Within-Group Comparison for the Experimental Group

A paired samples t-test was conducted to examine whether students in the experimental group demonstrated significant improvement after the AI-assisted metacognitive intervention.

Table 3 Paired Samples t-Test for Experimental Group

Test	N	Mean	SD	t	p
Pretest	30	10.33	2.07	-9.12	< .001
Posttest	30	16.05	2.14		

Table 3 illustrated a result of paired samples t-test done in the experimental group to investigate the variability in pretest and posttest academic language proficiency scores in the post-AI-assisted metacognitive intervention. The findings show that the mean score of the experimental group rose with (M = 10.33SD = 2.07) in the pretest phase to (M = 16.05SD = 2.14) in the posttest. This statistical analysis indicates that this was statistically significant (t =

-9.12, p < .001). As the p-value does not exceed the level of significance equalizing 0.05, it proves the fact that the difference between the pretest and the posttest scores is significant. This result implies that the metacognitive intervention with the help of AI based on ChatGPT and Grammarly specifically influences academic language proficiency of students significantly and positively. The findings show that, students who used AI tools in planning, monitoring, revising, and assessing their writing recorded significant success in performance of their academic writing.

Within-Group Comparison for the Control Group

A paired samples t-test was also conducted to examine improvement within the control group during the same period of traditional instruction.

Table 4 Paired Samples t-Test for Control Group

Test	N	Mean	SD	t	p
Pretest	30	10.18	2.03	-1.72	.090
Posttest	30	11.52	2.09		

Table 4 shows the paired samples t-test findings of the control group that was done to check whether there was any difference in academic language proficiency improvement upon the traditional writing instruction. The pretest mean score of the control group is M = 10.18 and SD = 2.03 whereas the posttest mean score was slightly higher at the end of the experiment with M = 11.52 and SD = 2.09. The t-test generated a t = -1.72 that has a p =.090 level. The difference between the pretest and the posttest score is not significant given that the p-value exceeds the significance level of 0.05. This means that as there was a small gain in the mean score that is not statistically significant. Thus, the results indicate that the conventional writing instruction was not statistically significant to enhance the academic language proficiency of students within the study period, and especially in comparison with those obtained in the experimental group offered the AI-based metacognitive intervention.

Comparison of Posttest Scores between Groups

An independent samples t-test was conducted to compare posttest scores between the experimental and control groups.

Table 5 Independent Samples t-Test for Posttest Scores

Group	N	Mean	SD	t	p
Experimental	30	16.05	2.14	8.21	< .001
Control	30	11.52	2.09		

Table 5 gives the outcome of the independent samples t-test program carried out to compare posttest results of the experimental and control groups. The means of the M = 16.05 with a standard deviation of SD = 2.14 was obtained by the experimental group and the control group achieved the means of M = 11.52 and SD = 2.09. The result of the statistical analysis gave a t-value t = 8.21 and a significance level of p =.001. However, the p-value is smaller than the significance level of 0.05 that means that the difference between the two groups is statistically significant. This means that the students in experimental group were much better performers than the students in control group in the post-test. The findings thus reveal that there is a substantial beneficial impact of the AI-mediated metacognitive intervention with ChatGPT and Grammarly on the academic language performance of students in comparison to the conventional writing strategy. These results indicate that artificial intelligence tools, when applied in combination with metacognitive learning strategies, can affect the academic writing performance of students in higher education settings in a very significant way.

Metacognitive Engagement Results

Descriptive statistics were also calculated to analyse students' metacognitive engagement during the intervention period.

Table 6 Mean Scores of Metacognitive Engagement Dimensions

Dimension	Mean	SD
Planning	4.18	0.57
Monitoring	4.09	0.54
Revising	4.24	0.51
Evaluating	4.01	0.58

Table 4.6 display the descriptive statistics of metacognitive engagement dimensions among the students who follow AI-assisted metacognitive intervention after being involved to the experimental group. The results indicate that the greatest mean score was Revising (M = 4.24, SD = 0.51) which implies that students often revised their text having received the feedback with ChatGPT and Grammarly. The Planning dimension had a mean value of M = 4.18 (SD = 0.57), which means that the students were also proactive in utilizing AI tools to formulate concepts and plan their essay by planning to write them. Monitoring dimension was associated with a mean of M = 4.09 (SD = 0.54) which implied that students were routinely involved in checking grammar, vocabulary and clarity during the writing process. Evaluating dimension registered an M = 4.01 (SD = 0.58) implying that having completed the writing assignments, students gave consideration to the quality of final drafts. Generally, the findings reveal that metacognitive engagement levels of students were high when they used AI tools, which may assume that the intervention stimulated learners to plan, monitor, revise, and evaluate their academic writing processes.

Summary of Results

Statistical analysis of this research show that the metacognitive intervention with the help of the AI helped students achieve better proficiency in academic language. The descriptive statistics revealed that the experimental group registered significant means score improvement between the pretest and posttest, whereas the control group registered only slight improvements. The pretest independent samples t-test showed that there was no significant difference in the two groups at the start of the study, which shows that there was balance at the baseline. Nonetheless, paired samples t-test comparing the experimental group demonstrated an improvement of the statistics that was statistically significant after the intervention and control group did not show any statistically significant improvement. Moreover, the posttest analysis of the experimental and the control groups revealed sufficiently high difference to support the experimental group, indicating the effectiveness of the intervention. Frontal results of the metacognitive engagement questionnaire were also the same in that students actually undertook planning writing, monitoring writing, revising writing and evaluating writing in the process of using AI tools. Altogether, the results indicate that ChatGPT and Grammarly when used along with metacognitive learning techniques may be used to improve academic language proficiency in higher education learners.

Findings and Discussion

The study results show that the metacognition-based intervention supported by AI had a strong positive effect on the academic language proficiency of the students. As demonstrated in the descriptive statistics and inferential analyses, the experimental group was found to improve significantly in the score of academic language proficiency between pretest and posttest as opposed to the control group. The t-test of independent samples carried out on the pretest scores on the scores of both groups showed that the levels of academic language proficiency were similar in the initial stage of the study. This baseline equivalence also made sure that the positive changes experienced in the experimental group were as a result of the intervention and not as a result of a preexisting difference between the participants. The high increase in the level in the experimental group indicates that introducing ChatGPT with Grammarly into writing instruction can in effect aid students to improve grammar correctness, vocabulary selection, coherence, and organization in academic writing exercises. These results suggest the possibility of AI-

supported learning environments making students develop language learning in the context of higher education.

It was also found that students in the experimental group highly practiced metacognitive writing strategies, which included a plan to write, check writing, revision and evaluation of writing activities. From the metacognitive engagement questionnaire, it was noticed that the average scores of these dimensions were high indicating that students often participated in reflecting on their writing process when using AI tools. Specifically, the revising dimension had the greatest mean score, this shows that students were utilizing AI feedback to repeat the polishing of their drafts limiting and enhancing writing quality. This observation indicates that the introduction of AI-powered tools can get learners to become more reflective and self-regulated when it comes to writing. Once students get instant feedback in tools like ChatGPT and Grammarly, they will be more inclined to assess the use of languages critically and carry out the required changes. The improvement of language and increased exposure to the art of writing seem to have occurred as a result of the intervention.

The comparison of the experimental and control groups also proved the effectiveness of the AI-assisted metacognitive intervention. The control group recorded slight increase in the score on the posttests but that was not significant meaning that traditional teaching of the writing may not be very effective in offering the necessary help in the improvement of academic language proficiency in a brief instructional cycle. The positive results of the experimental group, on the other hand, showed significant statistical significance in posttest scores, which further emphasizes the importance of AI tools in learning. The obtained results indicate that artificial intelligence technologies can be used to support metacognitive learning strategies to ensure that students have planned, monitored, revised, and evaluated their writing more efficiently. Thus, AI-based writing assistant implementation in the educational courses can be relevant in the context of the academic writing development, as well as contributing to the orientation of the learning process among the college students towards the more autonomous learning.

Conclusion of the Study

The current research paper has discussed the efficacy of AI-assisted metacognitive intervention with the ChatGPT and Grammarly in enhancing academic language proficiency among students in higher education. The study results showed that the students involved in the metacognitive intervention mediated using AI exhibited a significant better improvement in academic language proficiency than the students taught in traditional writing. The experimental group made significant improvement on the areas of grammar accuracy, vocabulary use, coherence and the general structure of the writing. These enhancements indicate that a learning support system based on artificial intelligence applications and metacognitive learning techniques can be developed to improve academic writing abilities of students. The findings further showed empirically that students who have been involved in the active metacognitive processes of planning, monitoring, revising and evaluating their writing in the presence of AI tools led to the students improved performances.

Additionally, the paper indicates the opportunities of AI technologies to contribute to the development of the language and writing in higher education. The ChatGPT and Grammarly allowed students to receive feedback and reflect right away so that they could propose the strengths and weaknesses of their writing and post-rewrite their work to achieve more successful outcomes. The results indicate that metacognitive strategies, coupled with the use of AI-assisted learning tools, can empower more independent, in addition to reflective learning behavior by students. Thus, the integration of AI-aided metacognition interventions into the academic writing instruction can provide a promising practice of enhancing academic language and equip students with lingual language requirements of college-level studies.

Recommendations of Study

Relying on the results of this research, it is suggested to recommend the following:

- Teachers are urged to implement AI-aided writing equipment like ChatGPT and Grammarly within academic writing teaching to aid its learners in enhancing grammar,

vocabulary, coherence, and writing overall. These are tools that are able to offer instant feedback and help in developing academic language proficiency.

- Instructors are supposed to promote use of metacognitive skills by students in their writing assignments that include planning, monitoring, revising, and evaluating their writing activities. By combining AI tools with these strategies, it is possible to make students more reflective and self-regulated learners.
- To provide teachers and students with the theory of effective and responsible application of AI technologies in studying academic programs, universities are expected to arrange training and workshops. The proper guidance will assist students in utilizing AI tools as the supportive learning tools, avoiding making them use them in order to fill their assignments.
- The institutions of higher education should formulate clear policies and guidelines on the application of AI tools in academic writing in an ethical manner. These policies can be used to achieve academic integrity in addition to students being able to use the cases of technological development.
- Future scholars will need to examine the long-term effects of AI-assisted learning tools on the academic writing process and language proficiency of students in various contexts of learning.
- Future studies are to investigate the effective negative effects of the overuse of AI such as a lack of critical thinking, overreliance on the work of automated software, and lack of creativity in writing.
- In higher education, scholars need to address plagiarism and the use of artificial intelligence as well as ethical concerns related to generative AI technology usage.
- Future studies may investigate the effects of AI-mediated metacognitive interventions on learning outcomes in other academic fields than language classes and writing classes.

REFERENCES

Albedah, F. (2025). Artificial intelligence in language education: A systematic review of multilingual applications and emerging challenges.

Alshahrani, S. (2025). Artificial intelligence in education: Applications and implications for academic writing. *Education Sciences*, 15(3), 214.

Chen, X., Zou, D., Xie, H., & Cheng, G. (2023). Artificial intelligence-based learning tools in higher education: A systematic review. International Journal of Educational Technology in Higher Education, 20(1), 1–21. https://doi.org/10.1186/s41239-023-00362-9

Ding, L., Zou, D., & Kohnke, L. (2025). ChatGPT as an automated writing evaluation tool: How students perceive it and how it affects their writing. *Education and Information Technologies*, 30, 26777–26799.

Hyland, K. (2019). Second language writing (2nd ed.). Cambridge University Press.

Ishaque, M. F., Khurshid, D. N., & Akbar, S. (2026). The Effectiveness of AI-Based Vocabulary Learning Platforms in Enhancing Academic Lexical Competence of University Students in AJK, Pakistan. *Inverge Journal of Social Sciences*, *5*(1), 291–301. https://doi.org/10.63544/ijss.v5i1.241

Khampusaen, D. (2024). The impact of ChatGPT on academic writing skills and knowledge: An investigation of its use in argumentative essays. *LEARN Journal: Language Education and Acquisition Research Network*, 18(1), 963–988.

Kohnke, L., Moorhouse, B., & Zou, D. (2023). Enhancing academic writing skills and motivation through AI-assisted instruction. *Frontiers in Psychology*.

Liang, Z., Yan, L., & Gašević, D. (2024). AI-assisted academic writing and learning analytics in highereducation. *Computers & Education*.

Mahadi, T. S. T., et al. (2021). Metacognitive strategies in English language learning.

Oxford, R. L. (2017). Teaching and researching language learning strategies: Self-regulation in

context (2nd ed.). Routledge. https://doi.org/10.4324/9781315206647

Ramli, N. F. M., Rusli, R., Tazijan, F., Zakaria, S. F., & Mahmud, M. M. (2024). Harnessing artificial intelligence in language learning: Student purposes and metacognitive strategies in higher education. Education and Information Technologies. https://doi.org/10.1007/s10639-024 12418-6

Sweet, S., & Sutton, F. (2025). Leveraging AI and metacognitive strategies for transformative learning in higher education. ACBSP Journal.

Tikhonova, E., & Raitskaya, L. (2025). The role of artificial intelligence in academic writing: Impacts on writing skills and critical thinking. Societies, 15(9), 247. https://doi.org/10.3390/soc15090247

Wenden, A. (1998). Metacognitive knowledge and language learning. Applied Linguistics, 19(4), 515 537.

Yang, K., Raković, M., Liang, Z., Yan, L., & Gašević, D. (2024). Modifying AI, enhancing essays: How active engagement with generative AI boosts writing quality. *Learning Analytics Research.*

Zhai, Y., & Nezakatgoo, B. (2025). Evaluating AI-powered applications for enhancing undergraduate students' metacognitive strategies and motivation in English language education. Scientific Reports, 15, 19118. https://doi.org/10.1038/s41598-025-19118-z

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory Into Practice, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2