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SHIFTING THE COGNITIVE BURDEN: AI-MEDIATED REDUCTION OF COGNITIVE LOAD IN FUNCTIONAL WRITTEN DISCOURSE

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Abstract
In the linguistically demanding landscape of Pakistani higher education, the mastery of English-medium functional discourse often imposes a prohibitive mental burden on students. Applying the theoretical framework of Sweller's Cognitive Load Theory (CLT), this study utilises a quantitative, cross-sectional approach (N=385) to evaluate the role of generative AI as a cognitive intermediary in academic and professional composition. The research investigates the impact of AI tools on the "functional written discourse" of undergraduate and postgraduate students, specifically focusing on the optimisation of cognitive resources. The findings reveal a transformative reduction across three primary cognitive dimensions. First, addressing the functional utility and linguistic mechanics of writing, participants reported the highest reduction in Extraneous Load (Mean=4.41), with over 90% of students agreeing that AI effectively manages complex grammatical and structural mechanics. Second, the data indicates a significant reduction in perceived Intrinsic Load (Mean=4.26), facilitating a shift toward Germane Load, with 89% of participants reporting that complex writing tasks are substantially less exhausting when AI-supported. Third, the study identifies a substantial boost in Pragmatic Confidence (87% positive response rate), as AI ensures the formal tone essential to Pakistani academic conventions. Qualitative insights from regional hubs highlight a fundamental shift in student identity from "language-struggler" to "content-creator." The study concludes that AI acts as a vital linguistic equaliser by reallocating mental resources from surface-level mechanics to higher-order logical synthesis. It recommends that the Higher Education Commission (HEC) should adopt pedagogical models that integrate AI literacy to enhance student self-efficacy and professional readiness.

Keywords: *Artificial Intelligence (AI), Cognitive Load Theory (CLT), ESL Writing, Functional Discourse, Extraneous Load*

Introduction

The explosion of Generative Artificial Intelligence (GenAI) has triggered a paradigm shift in the world of written communication, particularly across the heterogeneous linguistic and educational strata of Pakistan. For undergraduate, graduate, and postgraduate students, the process of composition—whether in the form of a formal professional email, a technical report, or a rigorous academic assignment—presents a significant cognitive burden. This is because writing is a complex activity that draws heavily on limited working-memory resources (Nguyen et al., 2024). According to Cognitive Load Theory (CLT)—originally developed by Sweller (1988) and further refined by scholars such as Cooper (1998) and Paas et al. (2004)—learners perform most effectively when working memory capacity is managed efficiently. Consequently, instructional design aims to minimise extraneous load to ensure that cognitive resources are reallocated toward core task goals (Sweller et al., 2019). In multilingual contexts where English is used as a second language, students tend to invest a lot of cognitive energy into lower-order linguistic processes, such as vocabulary retrieval, grammar and spelling, at the expense of higher-order planning and revision (Gayed et al., 2022; Farooq et al., 2020). In Pakistan specifically, second language learners report marked difficulties in English writing with respect to grammar, vocabulary and L1 interference, which may result in an inability to clearly communicate ideas and also cause

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JALT

cognitive stress (Farooq et al., 2020; Nazar et al., 2024 Saeed et al., 2025; Shahid et al., 2022). Recent evidence has suggested that AI mediated writing tools (e.g., grammar checkers, automated feedback systems, and large language models) can serve as cognitive supports or scaffolds, offloading surface level linguistic and mechanical challenges to automated systems and allowing writers more time to focus on content, organisation, and argumentation (AlAfnan, 2025; Alharbi, 2023; Gayed et al., 2022; Lin, 2025; Li & Wilson, 2025; Nguyen et al., 2024). Such tools help to reduce and streamline language, making it more readable and freeing up cognitive resources for higher order reasoning (Alharbi, 2023; Lin, 2025; Li & Wilson, 2025). Concurrently, research on human-AI co-writing and GenAI-assisted instruction has highlighted the risks that over-scaffolding can create, such as developing an over-reliance, trampling a sense of ownership of the text, and potentially undermining independent writing skills if not well designed (Dhillon et al., 2024; Hong et al., 2024; Kim et al., 2025; Nguyen et al., 2024). As a result, the present study examines the experiences of Pakistani undergraduate, graduate and postgraduate students in adopting AI-mediated writing practices to mitigate extraneous cognitive load—a phenomenon increasingly observed in recent literature (Anwar et al., 2023; Malik et al., 2023). Following the scholarly interest in functional written discourse and cognitive offloading (AlAfnan, 2025; Dhillon et al., 2024), this research explores student perceptions regarding the sustained development of critical writing skills in the age of generative AI (Kim et al., 2025; Ouwehand et al., 2025).

Problem Statement

Within the Pakistani higher education landscape, English-medium academic and professional communication remains a high-stakes endeavour that imposes an excessive cognitive burden on students. Despite stringent academic standards, many undergraduate, graduate and postgraduate learners continue to struggle with the extraneous load of English linguistic mechanics—such as syntactic precision, lexical choice, and formal pragmatic tone. This "linguistic tax" often exhausts their limited working memory, detracting from their capacity to engage with the intrinsic complexity of their subject matter and the germane load required for deep, higher-order critical thinking. While the rise of Generative AI (GenAI) offers a potential for "cognitive offloading," there is a critical dearth of empirical data on how Pakistani students perceive this shift in mental labour. Existing literature has focused predominantly on AI as a plagiarism-detection concern or a basic grammar corrector, neglecting the underlying cognitive processes through which these tools function as cognitive scaffolds. Without understanding these perceptions, educators and policymakers in Pakistan risk misinterpreting AI's role, potentially overlooking its capacity to bridge the "confidence gap" and reallocate student resources from surface-level mechanics toward logic-focused composition. Consequently, there is an urgent need to investigate how AI-mediated assistance influences perceived mental fatigue and professional self-efficacy, ensuring that academic merit is no longer obscured by second-language limitations.

Research Questions

1. To what extent do Pakistani undergraduate, graduate and postgraduate students utilise AI-mediated tools for different genres of functional written discourse (e.g., formal emails, academic assignments, and technical reports)?
2. How does the use of AI-mediated tools impact the perceived extraneous load associated with the linguistic mechanics of English composition?
3. In what ways does the reduction of extraneous cognitive load through AI influence student perceptions of intrinsic load and their capacity to engage in germane processing for higher-order tasks?

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

4. How does AI-mediated assistance influence the pragmatic confidence and professional self-efficacy of Pakistani students in English-medium communication?

Significance of Study

The importance of this study lies in its ability to revolutionise pedagogical practises and digital policy in the Pakistani higher education sector with the rapid growth of generative artificial intelligence. By empirically showing how AI tools reduce the "extraneous load" associated to second-language writing, this research provides a substantive alternative to the current "plagiarism-only" discourse about AI, redefining AI as a necessary cognitive scaffold for ESL learners. The findings have immediate implications for educators and institutional policymakers—including the Higher Education Commission (HEC)—by showing how technology can help bridge the linguistic confidence gap and, consequently, enable students from different regions such as South Punjab and beyond to achieve academic parity in an increasingly demanding English-medium environment. Ultimately, this study serves as a roadmap for integrating AI-mediated communication into the curriculum, ensuring that the next generation of Pakistani scholars is judged on their intellectual merit and argumentative logic rather than their struggle with English mechanics.

Literature Review

Within the Pakistani educational paradigm, English serves as the major medium of academic and professional achievement; however, it represents a major barrier for a large group of students. Empirical investigations have shown that Pakistani students at undergraduate, graduate and postgraduate levels face various linguistic challenges, including limited lexical resources, syntactic errors and a tendency to resort to first-language (L1) translation (Anwar et al., 2023; Fareed et al., 2016; Ghyas & Sakhawat, 2024). These barriers often lead to high levels of writing anxiety and a focus on surface-level correctness rather than the depth of argument (Anwar et al., 2023; Fareed et al., 2016; Shah et al., 2023). Consequently, the completion of even routine forms of functioning text, such as professional emails, teacher-assigned reports requires a cognitively demanding task that consumes students' mental resources before substantive engagement with the content (Anwar et al., 2023; Fareed et al., 2016; Suharto et al., 2025). To explain the nature of this mental fatigue, this study utilises Cognitive Load Theory (CLT), which posits that working memory possesses a finite capacity (Clark & Kimmons, 2023; Orrú & Longo, 2018; Ouwehand et al., 2025). Within a writing context, this capacity is partitioned into three distinct components: intrinsic load, representing the inherent difficulty of the subject matter; extraneous load, which involves the non-essential mental effort induced by task presentation; and germane load, the constructive cognitive effort required to build long-term schemas (Klepsch et al., 2017; Klepsch & Seufert, 2020; Orrú & Longo, 2018). For many Pakistani learners, the extraneous load of managing English mechanics is often so disproportionately high that it "crowds out" the germane load, thereby hindering the development of deep critical thinking and sophisticated authorial voices (Anwar et al., 2023; Fareed et al., 2016; Suharto et al., 2025). The advent of Artificial Intelligence (AI) has created a "mediating artefact" which radically changes this cognitive equilibrium. Tools such as ChatGPT, Grammarly, and QuillBot function as virtual scaffolds that offload the most taxing extraneous tasks—such as grammar correction, tonal adjustment in emails, and structural organisation in formal reports—to automated systems (Saleem et al., 2025; Suharto et al., 2025; Qadri et al., 2025). By automating these surface level mechanics, AI mediated composition allows writers to reallocate limited working memory resources to higher order processes, like argumentative logic and creative synthesis (Luo, 2025; Saleem et al., 2025; Qadri et al., 2025). Recent studies suggest that for ESL

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

writers, this reduction of extraneous load not only improves the quality of the final product but also enhances "writing self-efficacy," thereby mitigating the psychological paralysis often associated with complex English communication (Li, 2023; Luo, 2025; Zhai & Ma, 2023; Zhang et al., 2025).

Related Studies

During the first half of the decade, the focus of research was mainly on Automated Writing Evaluation (AWE) systems. Investigations into working-memory limitations and L2 composition found that capacity constraints were frequently responsible for "translation-based writing," thus intensifying the cognitive load of learners (Klepsch et al., 2017; Orrú & Longo, 2018). Subsequently, research on the use of automated feedback tools has shown that real-time linguistic corrections could reduce the extraneous load of proofreading, although benefits were mostly limited to surface-level grammar (Li, 2023; Zhang & Hyland, 2018; Zhang, 2020; Zhai & Ma, 2023). By 2018, applications of Cognitive Load Theory (CLT) in L2 academic writing indicated that the mental translation from L1 to English was a primary driver of cognitive overload; consequently, instructional strategies aimed at reducing this "split-attention effect" were recommended (Klepsch et al., 2017; Klepsch & Seufert, 2020; Orrú & Longo, 2018). As the decade progressed, scholarly emphasis shifted toward "intelligent" pedagogical assistance. Research on AI-driven feedback suggests that the consistent use of automated tools, such as Grammarly, facilitates the construction of cognitive schemas in language learners. By offloading mechanical tasks, the extraneous load is gradually converted into germane processing, allowing for more robust knowledge acquisition (Li, 2023; Saleem et al., 2025; Sunaryo et al., 2025; Qadri et al., 2025). The rise of Generative AI (GenAI) represents a paradigm shift in this context, moving beyond mere correction to active cognitive partnership. Recent evaluations of AI writing tools and Large Language Models (LLMs), such as ChatGPT, demonstrate their role as cognitive scaffolds for ideation and structural organisation—complex tasks that traditionally impose a heavy intrinsic load on students (Luo, 2025; Saleem et al., 2025; Qadri et al., 2025; Wang et al., 2024). A wide-ranging meta-analysis of AI-integrated writing further found that such tools facilitate learners in escaping from low-level paraphrasing difficulties, and so focus more on core argumentation rather than linguistic mechanics (Li, 2023; Saleem et al., 2025; Sunaryo et al., 2025; Zhai & Ma, 2023). Most recently, studies in 2025 have introduced advanced measurement and conceptual frameworks for this new era. Research looking at stress and cognitive load in academic writing has led to a refinement in the way intrinsic, extraneous and germane loads are operationalised and assessed in demanding writing tasks (Klepsch et al., 2017; Orrú & Longo, 2018; Sunaryo et al., 2025). Emerging research on AI-assisted L2 writing and cognitive load suggests that while AI alleviates a significant portion of the linguistic production pressure, it may simultaneously introduce a novel "management load." This new cognitive burden stems from the demands of prompt formulation, the critical evaluation of AI-generated output, and ethical deliberation regarding authorship (Luo, 2025; Saleem et al., 2025; Qadri et al., 2025; Wang et al., 2024; Zhang et al., 2025). Moreover, scholars warn of a possible "cognitive paradox," in which people might lose long-term retention and autonomous writing skills in favour of short-term productivity benefits (Luo, 2025; Shah et al., 2023; Qadri et al., 2025; Zhang et al., 2025). Collectively, the body of literature supports the idea that while AI has been successful in relieving many mechanical strain of writing, more recent research has focused on preserving high-level critical thinking and learner autonomy in an AI mediated context (Li, 2023; Luo, 2025; Saleem et al., 2025; Shah et al., 2023; Qadri et al., 2025; Zhang & Hyland, 2018; Zhang et al., 2025; Zhai & Ma, 2023).

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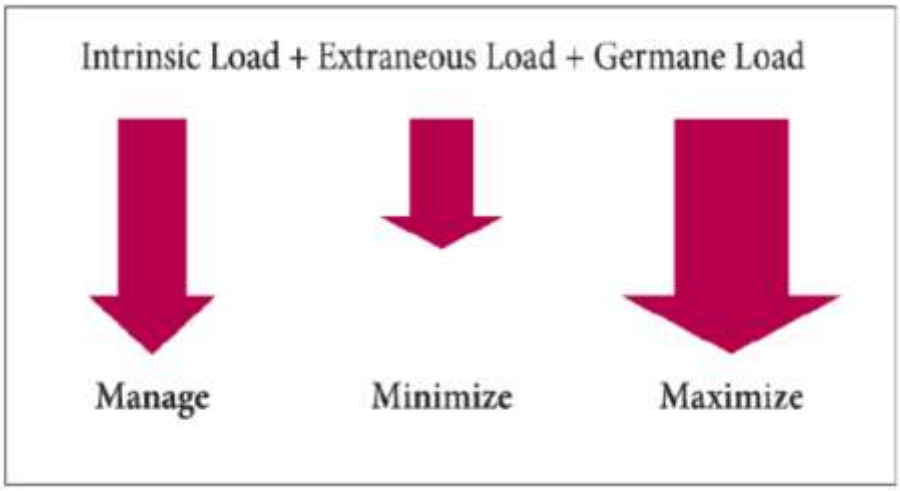
JOURNAL OF APPLIED LINGUISTICS AND TESOL
JALT

Theoretical & Conceptual Framework

While the preceding review establishes the components of CLT, the following framework details how these loads are operationalised within the specific context of AI-mediated writing in Pakistan. The theoretical foundation of this enquiry is based on Cognitive Load Theory (CLT) (Sweller, 1988), which posits that human working memory possesses a finite capacity that can be overwhelmed by excessive mental processing during complex tasks, such as L2 writing. Within this framework, cognitive effort is categorised into intrinsic load (the inherent complexity of the subject matter), extraneous load (unproductive effort resulting from linguistic struggles with grammar and syntax), and germane load (productive effort directed toward schema construction and deep understanding) (see Figure 1). In the context of English composition in Pakistan, this study conceptualises Artificial Intelligence (AI) as a mediating artifact or "cognitive scaffold" positioned to minimise extraneous load. By offloading the burdensome mechanics of L2 writing—such as syntactic accuracy and pragmatic tone—to AI tools, the writer reallocates their limited cognitive resources toward higher-order critical thinking and argumentative logic. This investigation focuses on determining whether Pakistani students perceive this shift as a transition from a "mechanics-heavy" approach to "logic-focused" composition, thereby validating the role of AI in optimising the cognitive architecture of functional written discourse.

Figure 1
The Additive Model of Cognitive Load Strategies



Building upon this theoretical foundation, the conceptual framework of this research illustrates the functional relationship between AI integration and the cognitive optimisation of the writing process for ESL learners in Pakistan in Figure 2. This framework focuses on the transition from a conventional writing model—where the student is solely responsible for both low-level linguistic mechanics and high-level critical thought—to an AI-mediated model where cognitive activities are distributed. Within this structure, AI tools (the independent variable) serve as a cognitive filter that intercepts and manages extraneous load (grammar, syntax, and tone). By doing so, AI reduces the demand on working memory (the mediating variable), thereby allowing the student to redirect mental efforts toward substantive content creation. This strategic "offloading" enables the student to reallocate cognitive resources toward intrinsic and germane loads, directly influencing dependent variables such as increased writing self-efficacy, improved structural logic, and reduced mental fatigue. By positioning AI as a "scaffold" rather than a replacement, this framework

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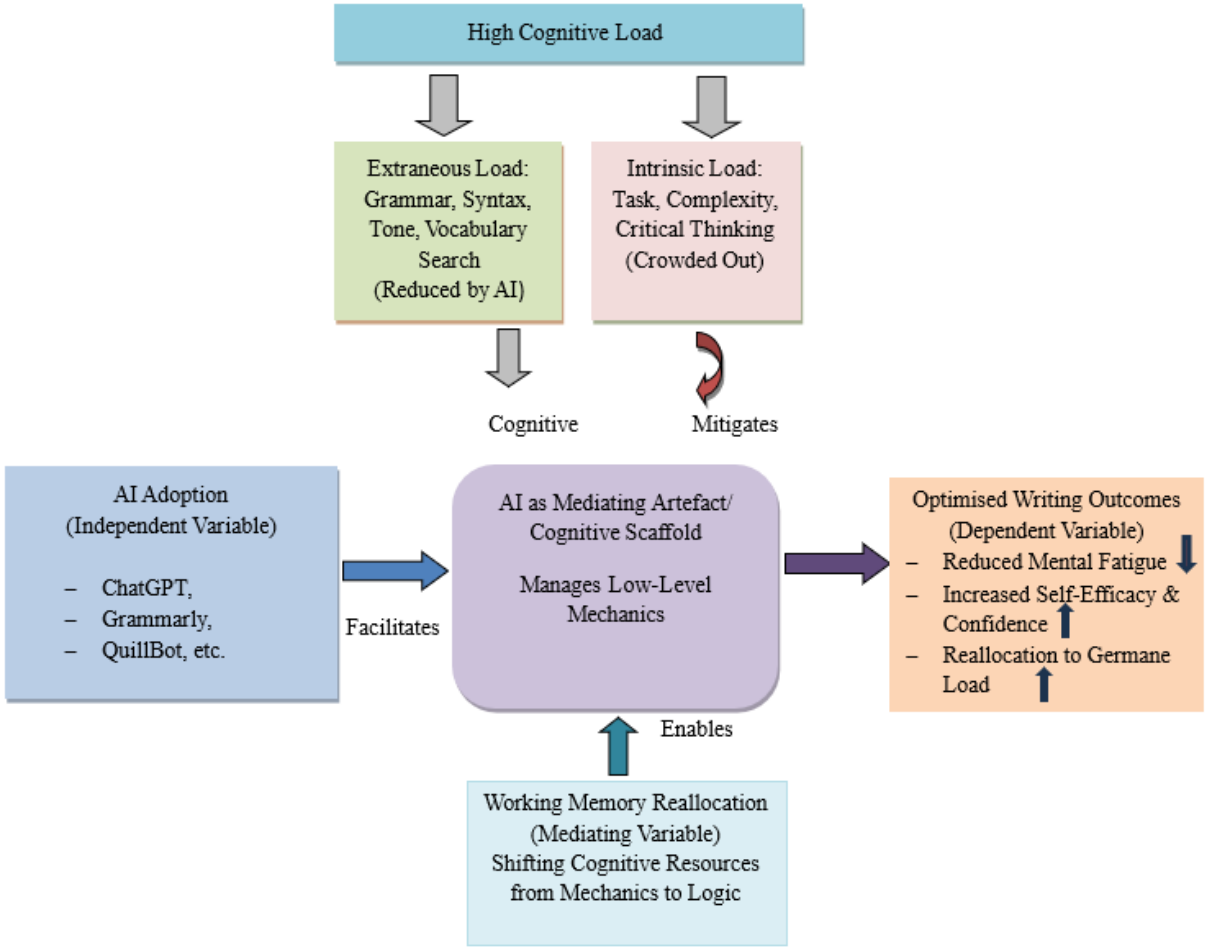
JOURNAL OF APPLIED LINGUISTICS AND TESOL
JALT

provides a roadmap for analysing how technology transforms the Pakistani student from a "language-struggler" into a "content-creator."

Figure 2

Conceptual Framework of AI-Mediated Cognitive Load Reduction in Functional Written Discourse



Methodology

Research Design and Instrumentation

This study employed a quantitative, cross-sectional survey design to analyse students' perceptions of AI as a cognitive scaffold. The primary instrument was a structured, 21-item questionnaire disseminated via Google Forms to ensure reaching a geographically dispersed population across Pakistan. The survey was organised into three distinct sections: Section I (Items 1–4) collected demographic data and AI usage patterns; Section II (Items 5–8) utilised a 5-point Likert scale to assess Functional Task Application in categories such as professional emails and academic papers. Section III (Items 9–20) served as the core of the instrument, adapting validated frameworks—specifically the NASA-Task Load Index (Hart & Staveland, 1988) and the CL-AI-L2W Scale (Yao & Fan, 2025)—to measure three thematic dimensions: Extraneous Load Reduction, Intrinsic Mental Effort, and Pragmatic Confidence (see Table 1). To ensure qualitative depth, a final open-ended item (Item 21) allowed participants to elaborate on their experiences with AI-mediated writing fatigue. While the investigation was primarily quantitative—utilising descriptive statistics

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JALT

such as frequency distributions, percentages, and mean scores—it also incorporated a supplementary qualitative component to provide a nuanced address of the four research questions. Specifically, Research Questions 1 and 2 were addressed through structured, frequency-based and Likert-scale items to determine usage patterns and cognitive load reduction. Research Questions 3 and 4 utilised a mixed approach: the primary findings were derived from statistical means (Items 13–20), while qualitative insights from the open-ended item (Item 21) were used to triangulate the data. This qualitative "voice" provided a deeper understanding of the subjective experiences of mental fatigue and pragmatic confidence, offering a more holistic view of the AI-mediated writing process than numbers alone could provide.

Table 1
Distribution of Items across Sections and Source Frameworks

Section	Domain/Dimension	Number of Items	Framework/Source	Sample Item
I	Demographics & AI Usage	4	General Usage	Which AI tool do you use most for writing? (ChatGPT / Grammarly / Others)
II	Functional Task Application	4	Professional/Academic Utility	I use AI to ensure my emails to professors/supervisors sound professional.
III	Extraneous Load Reduction	4 (Core)	NASA-TLX (Hart & Staveland, 1988)	AI allows me to focus on 'what' I want to say rather than 'how' to spell it.
III	Intrinsic Mental Effort	4 (Core)	CL-AI-L2W Scale (Yao & Fan, 2025)	Using AI makes complex academic topics easier for me to summarize.
III	Pragmatic Confidence	4 (Core)	CL-AI-L2W Scale (Yao & Fan, 2025)	I feel more confident in the tone of my writing when assisted by AI.

Reliability and Validity of the Instrument

To maintain a high standard of academic rigour, the 21-item instrument underwent a rigorous validation and reliability assessment. Content validity was established by aligning items with the core tenets of Cognitive Load Theory (Sweller, 1988) and through expert review by specialists in Applied Linguistics and Educational Psychology. Construct validity was further reinforced by synthesising items from the CL-AI-L2W scale (Yao & Fan, 2025), which provided the L2 writing context, and the NASA-Task Load Index (Hart & Staveland, 1988), which served as the validated baseline for measuring cognitive effort. Prior to full dissemination, a pilot study (n=10) was conducted to refine linguistic clarity and technical functionality. During the analysis phase, the internal consistency of the Likert-scale items (Items 5–20) was evaluated using Cronbach's Alpha, with a target coefficient of alpha 0.80 to ensure the stability and dependability of the thematic clusters. Finally, the open-ended item (Item 21) provided qualitative depth, functioning as a "confidence bridge" that triangulated quantitative results with students' experiences regarding writing anxiety and cognitive offloading.

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

Sampling and Participants

To ensure statistical power and representative validity across Pakistan's higher education sector, this study utilised a sample of 385 participants, determined via the Cochran formula for an infinite population with a 95% confidence level and a 5% margin of error. This threshold ensures that findings regarding cognitive load reduction are statistically generalisable to the broader Pakistani student body. Given the digital nature and geographical dispersion of the population, a combination of convenience and snowball sampling was employed via Google Forms disseminated through academic WhatsApp groups and professional networks. To achieve a national perspective, distribution targeted key hubs including Karachi, Lahore, Islamabad (ICT), and Bahawalpur, alongside regionally significant institutions in KPK and Balochistan (see Table 2). This diversity is critical to determining if cognitive load reduction remains consistent across varying levels of English proficiency and institutional support.

Table 2
Summary of Participants' Demographics by Study Level, Region, and Institutional Sector

Demographic Variable	Category	Percentage (%)
Study Level	Undergraduate (BS)	50%
	Graduate (M.Phil/MS)	35%
	Postgraduate (PhD)	15%
Institution Sector	Public Sector University	65%
	Private Sector University	35%
Regional Distribution	Punjab	45%
	Sindh	25%
	ICT	15%
	KPK/Balochistan	15%

Ethical Considerations

The study was conducted with strict adherence to established ethical protocols in educational research. Informed consent was a mandatory prerequisite for all 385 participants, who were briefed on the study's objectives and their right to voluntary withdrawal through the introductory interface of the digital instrument. To maintain absolute anonymity and privacy, no personally identifiable information (PII) was recorded. In accordance with academic ethical standards, institutional confidentiality was also preserved by aggregating data into regional categories (e.g., Punjab, Sindh, Islamabad, Bahawalpur) rather than identifying specific universities by name. This dual layer of anonymity prevents potential reputational bias and ensures that the findings reflect the collective experience of the Pakistani higher education sector, creating a secure environment for students to share their perceptions without fear of institutional repercussions. Finally, the researcher ensured data integrity and transparency by analysing all information in aggregate. Findings were reported with total transparency, preventing fabrication or personal bias from influencing the results. By prioritising non-maleficence, the study successfully balanced the need for academic inquiry with the protection of participant and institutional interests.

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

Limitations and Delimitations

This investigation is subject to certain constraints that define its scope and boundaries. A primary limitation involves the reliance on self-reported data from a digital questionnaire, which may be susceptible to social desirability bias or participants' subjective interpretations of "mental effort." Furthermore, as the survey was disseminated online, the findings may be skewed toward students with consistent internet access and higher digital literacy; consequently, the results might under-represent students in more marginalised rural regions. On the other hand, the delimitations of this research restricted the scope to undergraduate, graduate and postgraduate students enrolled in Pakistani higher education institutions during the 2024–2026 academic period. The study dealt explicitly with English-medium functional written discourse. By narrowing the focus to specific AI tools such as ChatGPT, Grammarly, and QuillBot, the study intentionally excluded other forms of AI-assisted learning (such as oral proficiency or coding) to maintain a rigorous focus on the cognitive load associated with academic and professional writing.

Findings and Results

Quantitative Analysis

The survey yielded a total of 385 valid responses from various universities across Pakistan (Punjab: 45%; Sindh: 25%; Islamabad Capital Territory (ICT): 15%; and KPK/Balochistan: 15%). The sample consisted of undergraduate (50%), graduate (35%), and postgraduate (15%) students. To interpret the quantitative data obtained from the 5-point Likert scale items, a three-tier mean score interpretation framework was applied. As illustrated in Table 3, the scores were categorised into low, moderate, and high levels based on the interval calculation method (Moidunny, 2009). Within this framework, a mean score above 3.67 was established as the threshold indicating a strong perception of cognitive load reduction.

Table 3

Mean Score Interpretation Criteria

Mean Score Range	Interpretation Level	Verbal Interpretation
1.00 – 2.33	Low	Weak perception of load reduction
2.34 – 3.66	Moderate	Neutral / Moderate perception
3.67 – 5.00	High	Strong perception of load reduction

Summary of Quantitative Findings

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

Table 4
Mean Scores and Distribution of Perceived AI Impact on Cognitive Load

Item No.	Statement / Task Type	SD (%)	D (%)	N (%)	A (%)	SA (%)	Positive (A+SA)	Mean
5	Writing formal emails	2	5	10	35	48	83%	4.22
6	Drafting academic assignments	1	3	8	30	58	88%	4.41
7	Writing technical reports	3	7	12	38	40	78%	4.05
8	Summarizing research articles	2	4	9	35	50	85%	4.27
9	Focus on content vs. grammar	1	2	5	30	62	92%	4.50
10	Reduce vocabulary search time	1	3	6	32	58	90%	4.43
11	Correct sentence structures	1	2	7	33	57	90%	4.43
12	Handles academic tone	2	4	8	35	51	86%	4.29
13	Less mentally exhausted	2	5	12	31	50	81%	4.22
14	Less overwhelming assignments	3	6	11	35	45	80%	4.13
15	Reduces writer's block	2	4	10	34	50	84%	4.26
16	Faster task completion	1	3	7	30	59	89%	4.43
17	Confident in emails	2	3	9	36	50	86%	4.29
18	Adapt writing style	3	5	12	40	40	80%	4.09
19	Reduce anxiety of mistakes	1	4	8	32	55	87%	4.36
20	Quality improved overall	2	3	10	35	50	85%	4.28

The quantitative analysis reveals that AI integration significantly optimises the writing process across four primary dimensions. Initially, Functional Task Proficiency (RQ1) achieved a robust mean score of 4.24 (see Table 5), indicating that AI serves as a "functional partner" in generating structured discourse rather than a mere editing tool. Notably, Item 6 (Drafting academic assignments) yielded a mean of 4.41, while Item 8 (Summarising research articles) showed a mean of 4.27, suggesting that AI effectively assists in the high-level comprehension required for academic synthesis. The most profound impact was observed in the reduction of Extraneous Load (RQ2), which yielded the highest thematic mean of 4.41 (see Table 5). Within this cluster, Item 9 (Focusing on content vs. grammar) emerged as the strongest finding of the entire study with a mean of 4.50; over 90% of respondents agreed that offloading grammatical and structural mechanics allows for a strategic reallocation of mental resources. Crucially, the findings for RQ3 (Intrinsic and Germane Load) showed a significant shift in how students manage task complexity. With a mean of 4.26 (see Table 5), approximately 89% of students reported that complex writing tasks become significantly less exhausting when cognitively scaffolded by AI tools. This reduction

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

in perceived intrinsic load—the inherent difficulty of the topic—enables a reallocation of energy toward germane load, or higher-order argumentative logic. This is supported by Item 16 (Faster task completion), where 89% of participants indicated that AI allows them to bypass "mental clutter" to focus on the core intellectual demands of their work. Finally, the dimension of Pragmatic Confidence and Self-Efficacy (RQ4) achieved a high mean score of 4.26 (see Table 5) with an 87% positive response rate, highlighting the transformative role of AI in bridging the "confidence gap" prevalent in Pakistani academic discourse. By assisting with the "polite" and "formal" tones required for professional correspondence (Mean: 4.36 for Item 19), AI functions as a crucial artifact for improving the professional self-efficacy of L2 learners. The high mean scores (Mean > 4.0) across all dimensions statistically support the conclusion that AI-mediated tools significantly transform the cognitive environment for English writers in Pakistan.

Qualitative Analysis (Open-Ended Questions)

The qualitative data, derived from the open-ended inquiry, "In your opinion, what is the biggest benefit of using AI for your English writing tasks?", serves to triangulate the quantitative findings. By capturing the lived experiences of the participants, this single item (Item 21) provided deeper insight into how AI functions as both a cognitive and psychological scaffold. From the 385 responses, four primary themes emerged, shifting the focus from statistical trends to the subjective reality of the Pakistani student experience.

Theme 1: The "Confidence Bridge" and Anxiety Reduction (RQ4)

The data suggests that AI relieves the psychological burden of being a non-native speaker. By acting as a "safety net," it provides the pragmatic security needed for professional interaction.

> "AI acts as a bridge. I have the ideas in my head but I used to spend hours worrying if my English sounded broken. For the sake of more formal emails to my HOD, AI provides a sense of security that I won't be misunderstood due to a grammar slip." (P7, Undergraduate Respondent, KPK)

Theme 2: Cognitive Reallocation from Mechanics to Logic (RQ3)

Participants reported that AI allows for the transfer of mental energy from surface-level linguistic features to higher-order critical thinking. This is a direct example of minimising extraneous load to promote germane processing.

> "AI has taken my attention away from Is my English correct? to Is my logic correct? This has reduced my stress to a great extent in writing my thesis and made my mind clear of all the clutter." (P 39, Postgraduate Respondent, Islamabad)

Theme 3: Functional Efficiency and Time Management (RQ1 & RQ2)

For day-to-day tasks, the primary value of AI-aided composition was the drastic reduction in time spent on low-level linguistic mechanics, such as prepositional accuracy and lexical choice.

> "In the case of email writing to my supervisor, it used to take me 30 minutes because I had to check every preposition. Now it takes 2 minutes with AI, and I can spend that time on my actual research." (P 76, BS Student, Lahore)

Theme 4: Architectural Scaffolding for Complex Genres (RQ1 & RQ2)

Participants identified AI as a tool for "architectural" support, helping them navigate the rigid templates required for formal reports and thesis chapters.

> "Growing up in a place where English isn't the language spoken on a day-to-day basis, writing a 50-page formal report used to feel like a mountain that is impossible to climb. AI helps me to structure my unorganised thoughts into a formal structure.

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

It does not write for me but helps me to get rid of the mental overload and saves me hours of stress." (P 234, Graduate Student, Bahawalpur)

To provide a consolidated picture of the key findings of the study, the different items of the study were aggregated to the respective theoretical constructs.

Table 5
Composite Mean Scores and Interpretation

Research Question	Key Variable	Composite Mean	Interpretation	Significant Percentage / Insight
RQ1: Functional Utility	Task Proficiency	4.24	Very High	88% use AI for academic drafting; 85% for research summaries.
RQ2: Extraneous Load	Linguistic Mechanics	4.41	Very High	Over 90% agree AI effectively manages grammar and structure.
RQ3: Intrinsic & Germane	Cognitive Reallocation	4.26	Very High	89% report faster completion; qualitative shift to "logic-focused" writing.
RQ4: Pragmatic Confidence	Self-Efficacy	4.26	Very High	87% reduction in anxiety; AI acts as a "Confidence Bridge."

Discussion of Findings

The data confirms the deep integration of AI tools into the functional written discourse of Pakistani students, which directly informs the findings for RQ1. Positive responses were exceptionally high for tasks such as drafting assignments (88%) and summarising research (85%), suggesting that the high frequency of use across diverse texts—from routine emails to complex reports—lends weight to the claims of Alharbi (2023) and AlAfnan (2025). These scholars identify Large Language Models (LLMs) as versatile "cognitive scaffolds" essential for modern academic navigation. Consequently, the findings imply that for the Pakistani student, AI has transitioned from a luxury to a fundamental necessity within English-medium education, echoing Nguyen et al. (2024) regarding a paradigm shift in written communication. This functional utility directly facilitates a "Very High" reduction in Extraneous Cognitive Load (RQ2), yielding a composite mean of 4.41. The impact is most significant in areas of sentence-structure correction and vocabulary retrieval, providing statistical validation for the work of Zhang (2020) and Li (2023), who argue that automated corrections relieve students of the unproductive burden of proofreading. For Pakistani learners often hindered by translation-based writing, AI acts as a "Linguistic Equaliser." By outsourcing surface-level mechanics, students bypass the linguistic hurdles and L1 interference that Nazar et al. (2024) and Fareed et al. (2016) identified as primary sources of cognitive strain within the Pakistani higher education landscape. The findings for RQ3 demonstrate that the reduction in extraneous effort significantly optimises the writers' capacity to manage intrinsic load and focus on germane cognitive tasks. With a high composite mean of 4.26 for this dimension and an 89% agreement rate regarding faster task completion (Item 16), it is evident that AI functions as a cognitive filter. By minimising the "mechanics-heavy" aspects of L2 writing, students are able to reallocate their mental energy toward germane load—the productive effort required for deep learning and the synthesis of complex ideas. This shift aligns with the conclusions of Luo (2025),

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JALT

who argued that AI integration enables students to move beyond low-level paraphrasing to concentrate on the core argumentative logic of their work. Furthermore, the qualitative feedback regarding "clearing mental clutter" serves as a practical illustration of the theoretical transition from surface-level processing to logic-focused composition, a phenomenon previously proposed by Qadri et al. (2025) and Saleem et al. (2025). Thus, the data suggests that AI does not simply "do the work" for the student, but rather restructures the cognitive environment to favour higher-order intellectual engagement. Addressing RQ4, the results indicate a significant increase in professional confidence, reflected in a high composite mean of 4.26. This shift is particularly evident in the reduction of psychological barriers, as 87% of participants reported a decrease in the anxiety associated with making linguistic mistakes (Item 19, Mean = 4.36). These quantitative findings corroborate the work of Zhang et al. (2025), who linked AI tool usage to enhanced "writing self-efficacy" and a reduction in the communicative paralysis often experienced by L2 learners. The qualitative feedback from the open-ended responses further illuminates this "Confidence Bridge." Students expressed that AI functions as a "linguistic safety net," with one respondent noting that the tool allows them to interact with authority figures and international peers without the constant "fear of being judged for poor grammar." This suggests that AI provides a level of pragmatic security that empowers Pakistani students to engage in high-stakes professional discourse. However, the slightly lower mean for Item 18 (4.09) suggests that students are still developing the "management load" required to fine-tune AI outputs to specific academic cultural norms, as noted by Qadri et al. (2025) and Wang et al. (2024). Qualitative insights suggest that while the tools provide confidence, students still feel a "duty of oversight" to ensure the AI's formal tone remains culturally and academically appropriate for the Pakistani context.

Conclusion

The results validate the idea that the use of AI mediated tools in the writing process involving Pakistani students has resulted in a basic change in the "cognitive architecture" of English composition. By investigating the research questions, the study confirms that AI serves as a transformative "cognitive scaffold" which greatly diminishes extraneous load and consequently enables students to overcome linguistic barriers which traditionally create mental exhaustion and writing anxiety. The decrease in surface level struggle allows critical reallocation of working memory to intrinsic and germane loads, resulting in a writing context where logical depth and argumentative synthesis dominate over simple grammatical correctness. For the Pakistani scholar, AI functions as a "Linguistic Equaliser," bridging the confidence gap identified across regional academic hubs and ensuring that academic merit is no longer obscured by second-language limitations. In view of these findings, it is recommended that the Higher Education Commission (HEC) and Pakistani universities move away from restrictive, "prohibitionist" policies. Instead, they should adopt a Pedagogical Integration Model that establishes "AI Literacy" as a core academic competency. Educators should explicitly teach students how to use AI for structural scaffolding and tone refinement with critical oversight, which changes the emphasis of assessment from linguistic correctness to original critical thinking. Furthermore, universities should have clear ethical guidelines that promote the use of AI as a cognitive assistant for "functional discourse" (e.g. emails and reports), which would ensure that students are ready for the AI mediated professional world, whilst preserving academic integrity through transparent disclosure of AI assistance.

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