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HUMAN-IN-THE-LOOP TESOL: EXAMINING HOW TEACHER INTERVENTION MEDIATES THE EFFECTS OF GENERATIVE AI ON SECOND LANGUAGE ACQUISITION AMONG EFL LEARNERS

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Abstract

This quantitative study examined the predictive relationship between generative artificial intelligence-supported learning on second-language acquisition among the university-level English as Foreign Language learners acknowledging the absence of a control group as a limitation, the findings indicated that generative AI-supported learning was a significant positive predictor of second-language acquisition and teacher intervention. The study was grounded in socio-cultural theory and the interaction hypothesis and employed a positivist philosophy, deductive approach, and time-lagged explanatory research design. The target population consisted of undergraduate EFL learners enrolled in English-language courses at selected public and private universities in South Punjab, Pakistan. A sample of 360 students was selected through multistage stratified sampling. Data were collected using a structured five-point Likert-scale questionnaire and English-language achievement tests administered before and after a 12-week AI-supported instructional program. Generative AI-supported learning was measured through personalized interaction, immediate feedback, adaptive materials, and repeated practice. Teacher intervention included monitoring, output validation, contextual explanation, corrective feedback, instructional scaffolding, and ethical guidance. Second-language acquisition was assessed through vocabulary, grammar, reading comprehension, writing proficiency, and communicative competence. Data were analyzed using descriptive statistics, reliability analysis, Pearson correlation, multiple regressions, and bootstrapped mediation analysis. The findings indicated that generative AI-supported learning had a significant positive effect on second-language acquisition and teacher intervention. Teacher intervention also significantly improved language-acquisition outcomes and partially mediated the relationship between generative AI-supported learning and second-language acquisition. The study concluded that generative AI was most effective when integrated with teachers' professional judgment and pedagogical guidance. It recommended adopting a human-in-the-loop TESOL framework to enhance language practice while preserving accuracy, learner reflection, teacher agency, ethical responsibility, and academic integrity.

Keywords: *Generative Artificial Intelligence, Teacher Intervention, Human-In-The-Loop, TESOL, EFL Learners, Second-Language Acquisition*

1. Introduction

Generative artificial intelligence has rapidly transformed the field of language education by introducing new ways of creating, practicing, and evaluating linguistic content. Unlike conventional educational technologies that provide predetermined materials and fixed responses, generative AI systems can produce explanations, translations, dialogues, summaries, examples, exercises, and personalized feedback in response to individual learner prompts (Fathi & Rahimi, 2024). Tools powered by large language models can answer questions immediately, modify the complexity of a text, simulate real-life conversations, and generate extensive practice materials (Crosthwaite & Sun, 2025). These functions are particularly valuable in English as Foreign Language contexts, where learners may have limited exposure to authentic English and insufficient opportunities to receive individual feedback. Recent empirical reviews have consequently reported increasing applications of generative AI in language practice, writing support, corrective feedback, learner engagement, and autonomous learning (Li et al., 2025; Wiboolyasarin et al., 2025).

Generative AI may facilitate second-language acquisition by increasing learners' access to comprehensible input, meaningful interaction, immediate feedback, and repeated

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opportunities for language production. EFL learners can use these systems to simplify difficult reading passages, understand grammatical rules, generate vocabulary exercises, practise interview situations, construct dialogues, or receive feedback on written responses (Guo, 2025). Learners can also ask follow-up questions and request alternative explanations without the time and social pressures sometimes experienced in conventional classrooms. Such personalized interaction may reduce language anxiety and enable students to practice privately at their own pace (Crompton & Burke, 2023). Furthermore, the immediate and interactive nature of generative AI may strengthen attention, motivation, participation, and persistence. Previous evidence has associated generative AI use with improved language-learning engagement among EFL students (Khoso et al., 2025).

Despite these potential benefits, generative AI cannot be treated as an autonomous or consistently reliable language teacher. Its responses may appear fluent and grammatically convincing while containing factual, linguistic, pragmatic, or cultural inaccuracies (Derakhshan, 2025). AI systems may provide explanations that are unsuitable for the learner's proficiency level, fail to recognize the instructional context, or recommend revisions without explaining their underlying linguistic principles. Learners may accept such responses uncritically, become excessively dependent on automated translation and correction, or submit AI-generated work without developing independent competence (Dizon & Gayed, 2024). Unregulated use may consequently encourage superficial task completion instead of sustained vocabulary learning, grammatical understanding, critical reflection, and communicative development. Therefore, access to generative AI does not automatically guarantee successful language acquisition (Kaplan-Rakowski et al., 2023).

A human-in-the-loop approach addresses these limitations by retaining the teacher's professional judgment throughout the AI-supported learning process. Under this approach, teachers select appropriate activities, define learning outcomes, demonstrate effective prompting, observe learner–AI interactions, verify automated feedback, explain contextual meanings, correct errors, and evaluate independent performance (Farrokhnia et al., 2024). Generative AI provides scalable practice, rapid responses, and personalized materials, while teachers provide pedagogical direction, ethical oversight, cultural understanding, emotional support, and knowledge of individual learning needs. This relationship positions AI as an instructional assistant rather than a replacement for professional teaching. Contemporary scholarship increasingly supports collaborative educational models in which teachers and generative AI perform complementary functions to improve learning quality and reduce the risks of uncritical automation (Memon et al., 2025).

Within this context, the present study examined how generative AI-supported learning influenced second-language acquisition among EFL learners. More specifically, it investigated teacher intervention as a mediating mechanism connecting AI-supported activities with language-learning outcomes (Kasneci et al., 2023). Rather than examining only whether generative AI directly improved achievement, the study assessed whether its educational benefits operated partly through teacher monitoring, validation, explanation, corrective feedback, instructional scaffolding, and ethical guidance (Guo et al., 2024). This mediation perspective provided a more comprehensive explanation of how technological and human resources interacted in TESOL classrooms. The study therefore contributed to the development of a human-centered model in which generative AI expanded learning opportunities while teachers ensured that those opportunities resulted in accurate, reflective, contextualized, and sustainable second-language development (Hadizadeh, 2024).

In the specific context of higher education in Pakistan, and particularly South Punjab, English language pedagogy frequently grapples with resource constraints, large class sizes, and complex dynamics of language policy and linguicism. Generative AI offers

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unprecedented access to comprehensible input; however, large language models inherently carry native-speaker biases and Western-centric pragmatic assumptions. If left unmediated, these tools risk reinforcing linguistic imperialism and providing culturally disconnected feedback to Pakistani learners. Therefore, teacher agency becomes critical to filter, contextualize, and adapt AI outputs to align with local pedagogical needs and cultural realities.

1.1 Statement of the Problem

Generative AI has rapidly entered EFL classrooms, but its educational value remains uncertain because access and use do not necessarily result in genuine language development. Learners may receive immediate and personalized responses, yet AI-generated explanations can be inaccurate, culturally unsuitable, excessively advanced, or pedagogically unstructured. Students may copy generated material without processing it, depend upon translation, or confuse successful prompt completion with independent linguistic competence. Existing research has largely examined learner acceptance, perceptions, engagement, writing assistance, and intention to use generative AI. Comparatively limited quantitative evidence explains how teachers transform AI interaction into measurable second-language acquisition. Hybrid feedback research suggests that combining AI output with human guidance can improve L2 learning, but the mediating role of teacher intervention remains insufficiently tested. The present study addressed this gap by examining whether teacher monitoring, validation, explanation, corrective feedback, scaffolding, and ethical guidance mediated the relationship between generative AI-supported learning and EFL learners' second-language acquisition.

1.2 Research Objectives

1. To determine the effect of generative AI-supported learning on second-language acquisition among EFL learners.
2. To determine the predictive relationship between generative AI-supported learning and second-language acquisition among EFL learners.
3. To determine whether teacher intervention mediates the relationship between generative AI-supported learning and second-language acquisition.
4. To compare language-acquisition outcomes across selected demographic and AI-use characteristics.

1.3 Research Questions

1. What effect does generative AI-supported learning have on second-language acquisition among EFL learners?
2. What effect does generative AI-supported learning have on teacher intervention?
3. How does generative AI-supported learning predict second-language acquisition among EFL learners?
4. Does teacher intervention mediate the relationship between generative AI-supported learning and second-language acquisition?
5. Do learners' language-acquisition outcomes differ according to gender, university sector, proficiency level, and frequency of generative AI use?

1.4 Research Hypotheses

H1: Generative AI-supported learning has a significant positive effect on second-language acquisition among EFL learners.

H2: Generative AI-supported learning has a significant positive effect on teacher intervention.

H3: Teacher intervention has a significant positive effect on second-language acquisition among EFL learners.

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H4: Generative AI-supported learning significantly and positively predicts second-language acquisition among EFL learners.
H5: Second-language acquisition differs significantly across learners' demographic, academic, and generative AI-use characteristics.

1.5 Significance of the Study

The study is significant because it moves beyond the question of whether learners use generative AI and examines how such use becomes educationally productive. For TESOL teachers, it identifies the intervention practices through which AI-generated interaction can be transformed into meaningful language learning. For students, it clarifies that AI should support practice, reflection, feedback, and revision rather than replace independent language production. For universities, it provides an empirical basis for developing AI-supported language curricula, assessment policies, and professional-development programs. For policymakers, it supports the adoption of human-centered AI standards that preserve teacher agency and learner accountability. The study also extends second-language acquisition research by positioning teacher intervention as an explanatory mechanism between generative AI-supported learning and language achievement.

2. Literature Review

2.1 Generative AI in TESOL

Generative AI enables learners to interact with language through dynamically produced text, speech, explanations, and feedback. Unlike conventional computer-assisted language-learning systems containing predetermined responses, generative tools can respond flexibly to learner prompts and produce materials for different proficiency levels (Ibrahim et al., 2024). Their applications include conversational rehearsal, vocabulary development, grammar explanation, translation, pronunciation support, reading simplification, writing feedback, and assessment preparation (Kohnke et al., 2023).

The instructional value of these applications depends on the way learners engage with them. Purposeful use may increase exposure, practice, experimentation, and revision (Jeon & Lee, 2023). Unstructured use may promote passive consumption, copying, dependency, and superficial task completion. A recent systematic review found that empirical GenAI research in language learning expanded rapidly during 2023–2024 but continued to require stronger designs and clearer pedagogical models (Li et al., 2025).

2.2 Generative AI and Second-Language Acquisition

Second-language acquisition involves the development of vocabulary, grammar, comprehension, written expression, oral communication, pragmatic knowledge, and the capacity to use language independently (Klimova & Seraj, 2023). Generative AI can support these outcomes through several mechanisms. It can provide comprehensible input matched to learner proficiency, generate repeated opportunities for language production, offer immediate feedback, and enable interactive meaning negotiation (Law, 2024).

AI chatbots may be particularly valuable in contexts where learners have limited opportunities to communicate in English outside the classroom. Learners can rehearse conversations without fear of public embarrassment and request repeated clarification (Lee et al., 2025). However, conversational quantity does not necessarily guarantee linguistic quality. AI feedback must be accurate, understandable, developmentally appropriate, and followed by active revision. Reviews of AI-driven chatbots have found promising pedagogical effects while emphasising the importance of sound instructional integration and further rigorous evidence (Wiboolyasarin et al., 2025).

2.3 Teacher Intervention in AI-Supported Learning

Teacher intervention refers to the purposeful actions through which teachers plan, monitor, validate, adapt, and evaluate learners' use of generative AI (Li et al., 2025). It

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includes selecting appropriate tools, designing prompts, aligning activities with learning outcomes, correcting inaccurate AI responses, contextualizing vocabulary and grammar, explaining cultural and pragmatic meaning, and determining whether learners can perform independently (Lin & Crosthwaite, 2024).

Teachers also intervene by asking learners to justify revisions, compare AI suggestions with alternative sources, identify inaccurate output, and disclose AI assistance (Toscu, 2025). These practices turn AI interaction into meta-linguistic reflection. Teacher intervention therefore does not merely restrict technology; it structures its educational use. Research on hybrid feedback has similarly indicated that combinations of generative AI and human-tutor input can improve L2 academic writing more effectively than unexamined automated feedback (Zhang et al., 2025).

2.4 Human-in-the-Loop TESOL

Human-in-the-loop TESOL regarded generative AI output as provisional instructional material that remained subject to professional review and pedagogical judgment. The framework assigned interconnected but clearly differentiated responsibilities to generative AI, teachers, and EFL learners. Generative AI generated examples, dialogues, exercises, explanations, simulations, and immediate provisional feedback according to learners' prompts and needs. Teachers designed purposeful activities, aligned AI use with learning objectives, monitored learner–AI interaction, and verified the linguistic accuracy of generated content (Mekheimer, 2025).

They also corrected misleading responses, contextualized cultural and pragmatic meanings, provided instructional scaffolding, and assessed learners' independent performance. Learners actively interacted with AI, evaluated its suggestions, compared alternative responses, revised their work, and reflected upon the language-learning process. They were consequently treated as critical and responsible participants rather than passive recipients of automated information. The framework rejected both the complete avoidance of educational technology and its uncritical adoption as a replacement for professional teaching. It promoted complementarily by using AI to expand access to individualized practice while teachers protected accuracy, developmental appropriateness, cultural sensitivity, and academic integrity (Lo, 2023).

Teacher supervision also reduced the risks of misinformation, excessive dependence, plagiarism, and superficial completion of language-learning tasks. Consistent with UNESCO's human-centred guidance, human-in-the-loop TESOL preserved human agency, inclusion, transparency, ethical responsibility, and educational purpose. Therefore, the framework positioned generative AI as a responsive instructional assistant while maintaining the teacher's central role as designer, mediator, evaluator, and ethical decision-maker (Jeon & Lee, 2023; Kohnke et al., 2023; Law, 2024).

2.5 Theoretical Framework

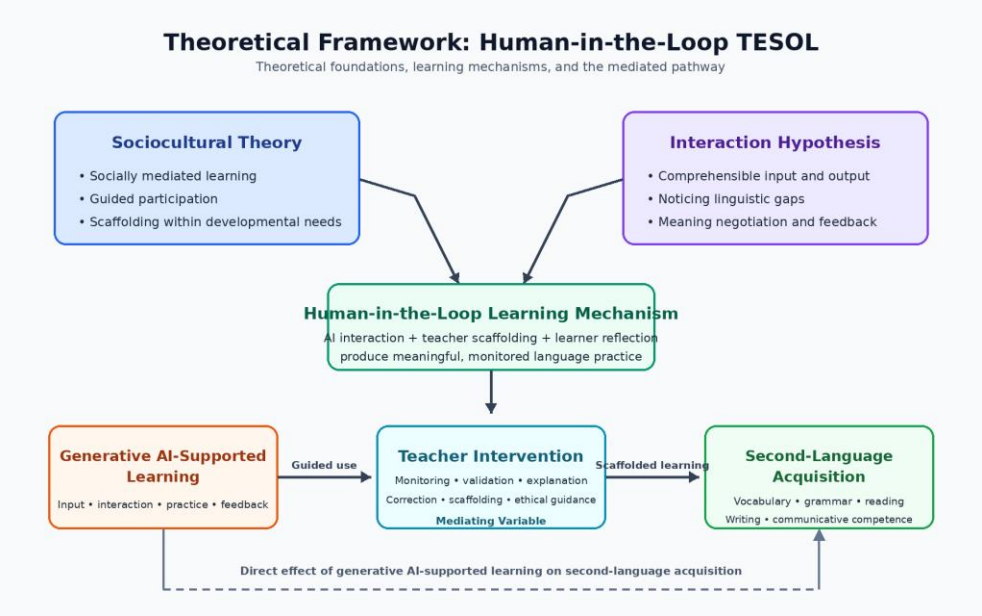
The study was principally grounded in sociocultural theory and the interaction hypothesis, which jointly explained how generative AI and teacher intervention related to second-language acquisition (Barrot, 2023). Crucially, the theoretical framework justifies why generative AI prompts or necessitates teacher intervention (Path A in the mediation model). As learners increase their engagement with AI tools, the sheer volume of generated output—which often contains hallucinations, complex vocabulary beyond the learner's zone of proximal development, or culturally inappropriate pragmatics—forces a pedagogical equilibrium shift. Teachers are compelled to increase their monitoring, validation, and scaffolding efforts to protect academic integrity, combat linguicism, and ensure the input remains comprehensible.

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Sociocultural theory viewed learning as a socially mediated process through which learners developed knowledge by participating in meaningful interaction, receiving scaffolding, and engaging in guided activities (Wiboolyasarin et al., 2025). Generative AI provided learners with personalized explanations, dialogues, exercises, feedback, and repeated opportunities to practice English. However, teacher intervention ensured that these AI-supported interactions corresponded with learners' proficiency levels, developmental needs, and intended language outcomes (Chong, 2021).

Teachers identified linguistic difficulties, provided graduated assistance, corrected inaccurate AI responses, and gradually withdrew support as learners became more competent and independent. The interaction hypothesis further proposed that language acquisition improved when learners received comprehensible input, produced meaningful output, noticed gaps in their knowledge, negotiated meaning, and responded to corrective feedback (Yan et al., 2024). Generative AI expanded opportunities for these processes by enabling immediate, individualized, and continuing interaction beyond normal classroom limitations. Nevertheless, teachers ensured that AI-supported conversations focused on meaningful linguistic problems instead of mechanical task completion or the passive acceptance of generated answers. They encouraged learners to question AI responses, explain revisions, compare alternatives, and apply acquired knowledge in independent language production (Lo, 2023).

Sociocultural theory therefore explained the mediating and scaffolding role of teachers, whereas the interaction hypothesis explained the language-learning processes activated through guided AI engagement. Together, these theories justified the proposed mediated relationship in which generative AI-supported learning increased teacher-guided interaction, and teacher intervention subsequently strengthened second-language acquisition (Law, 2024; Lee et al., 2025; Memon & Kwan, 2025).



2.6 Research Gap

Previous research has increasingly examined generative AI acceptance, engagement, writing support, learner perceptions, and ethical concerns. Studies have also compared automated feedback with teacher or hybrid feedback. Nevertheless, limited quantitative research has tested teacher intervention as a mediating mechanism connecting generative AI-supported learning with broader second-language acquisition. Many studies have focused on a single skill, particularly writing, and have relied upon cross-sectional self-reported outcomes. Evidence from Pakistani EFL learners, particularly those studying in South

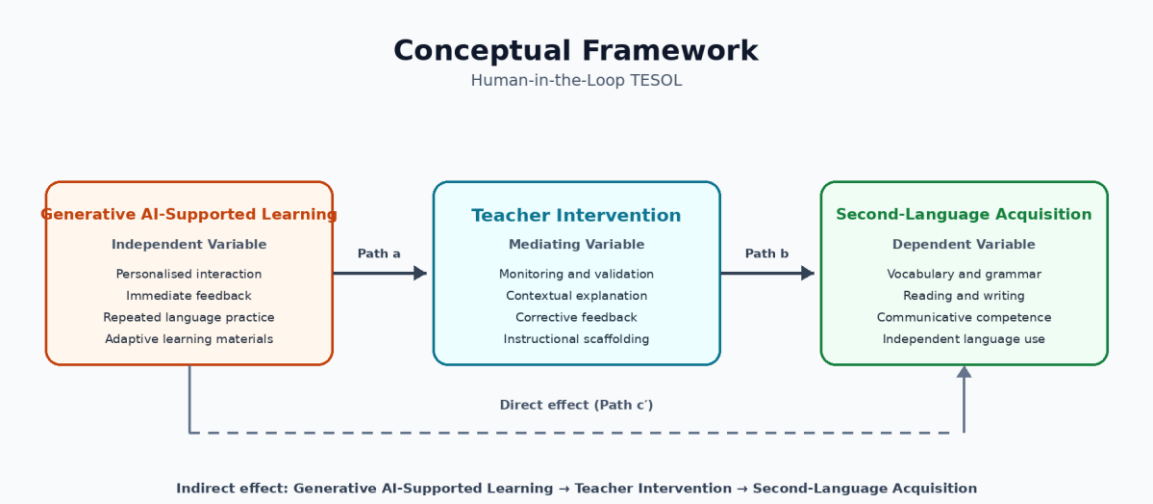
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Punjab, has remained limited. The present research addressed these theoretical, methodological, contextual, and empirical gaps through a time-lagged quantitative model incorporating multiple dimensions of language acquisition.

3. Conceptual Framework

The conceptual framework proposed generative AI-supported learning as the independent variable, teacher intervention as the mediating variable, and second-language acquisition as the dependent variable. Generative AI-supported learning included personalized explanations, interactive conversations, immediate corrective feedback, adaptive learning materials, and repeated opportunities for language practice. Second-language acquisition represented learners' development in vocabulary, grammar, reading comprehension, writing ability, and communicative competence (UNESCO, 2023). The framework included both direct and indirect relationships among the three principal variables. The direct pathway suggested that meaningful generative AI use could independently improve learners' English-language knowledge and performance. Personalised interaction and continuous practice could increase learners' exposure to comprehensible input and opportunities for meaningful output. The indirect pathway proposed that generative AI-supported activities encouraged teachers to monitor learner–AI interaction and evaluate the accuracy of generated responses. Teachers subsequently improved the learning process by providing contextual explanations, corrective feedback, output validation, instructional scaffolding, and ethical guidance (Zhang et al., 2025).

These interventions helped learners identify linguistic errors, understand difficult concepts, and use AI-generated feedback critically rather than accepting it without evaluation. The framework therefore assumed that teacher intervention converted unstructured AI interaction into purposeful and pedagogically appropriate language-learning experiences. A statistically significant indirect effect of generative AI-supported learning on second-language acquisition through teacher intervention would confirm mediation. Accordingly, the framework represented human-in-the-loop TESOL as a collaborative process in which generative AI expanded learning opportunities while teachers ensured their accuracy, relevance, and educational effectiveness (Barrot, 2023; Jeon & Lee, 2023; Kohnke et al., 2023; Law, 2024).



4. Research Methodology

4.1 Research Philosophy and Approach

The study adopted a positivist philosophy because it measured defined constructs and tested hypothesized relationships through statistical analysis. A deductive approach was employed because the hypotheses were derived from sociocultural theory, the interaction

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hypothesis, and previous empirical research. These methodological choices allowed the proposed mediation model to be objectively evaluated through quantitative evidence.

4.2 Research Design

A quantitative, time-lagged, correlational design was adopted. Baseline English proficiency was measured before the instructional period. Learners subsequently participated in a 12-week program incorporating structured generative AI activities. Because all participants engaged in the 12-week AI-supported program, the study lacks a control group. Consequently, findings are interpreted as predictive associations and relationships rather than definitive causal effects. Generative AI-supported learning and teacher intervention were measured during and near the end of the program, while second-language achievement was assessed after the intervention. This sequence provided stronger temporal alignment than a one-time perception survey, although it did not constitute a fully randomized experiment.

4.3 Population and Sample

The population consisted of undergraduate students enrolled in compulsory or elective English-language courses at HEC-recognized public and private universities in South Punjab. Eligible participants were required to be at least 18 years old, enrolled in an EFL course, and exposed to teacher-guided generative AI activities during the study. A sample of 360 learners was selected through multistage stratified sampling.

University sector	Male	Female	Total	Percentage
Public universities	94	122	216	60.0
Private universities	62	82	144	40.0
Total	**156**	**204**	**360**	**100.0**

4.4 Research Instruments

The study utilized two primary instruments: a structured survey questionnaire (see Appendix A for the complete list of 20 items) and an English-language achievement test. The dependent variable was assessed using a researcher-developed institutional exam aligned with CEFR B1/B2 levels. It consisted of 50 objective multiple-choice items measuring grammar, vocabulary, and reading comprehension, alongside two analytical writing and communicative tasks evaluated by two trained assessors using standardized analytic rubrics (Moorhouse et al., 2025). Responses were recorded on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The achievement test assessed vocabulary, grammar, reading comprehension, writing, and communicative competence. Objective test sections were scored through predetermined answer keys. Writing and communicative tasks were evaluated by two trained assessors using standardized analytic rubrics. Inter-rater reliability was calculated before final scores were used.

4.5 Validity and Reliability

Content validity was evaluated by experts in TESOL, applied linguistics, educational technology, and quantitative research. A pilot study involving 35 learners was undertaken outside the final sample. Ambiguous and repetitive statements were revised. Confirmatory factor analysis was used to examine construct validity. Cronbach's alpha and composite reliability values of .70 or higher were considered acceptable. Average variance extracted values of .50 or higher supported convergent validity (Moorhouse et al., 2024).

4.6 Data-Collection Procedure

Institutional permission and informed consent were obtained before data collection. Participants completed a baseline language test and received orientation concerning responsible generative AI use. Teachers implemented planned AI-supported activities over 12 weeks, including guided dialogue, vocabulary development, grammar correction, reading simplification, and writing revision. Teachers monitored interaction and corrected or contextualized AI feedback. At the end of the program, students completed the questionnaire

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and post-intervention achievement test. Responses were anonymised and screened for missing data and patterned answers.

4.7 Data-Analysis Techniques

SPSS was used for data screening, descriptive statistics, reliability analysis, correlation, group comparisons, and regression. PROCESS Model 4 with 5,000 bootstrap samples was used to test mediation. Baseline proficiency, gender, university sector, and previous AI experience were controlled where appropriate. Mediation was established when the bootstrapped confidence interval for the indirect effect did not include zero. Statistical significance was evaluated at $p < .05$.

5. Data Analysis

Table 1 Demographic Characteristics of Respondents (N = 360)

Variable	Category	Frequency	Percentage
Gender	Male	156	43.3
	Female	204	56.7
Age	18–20 years	126	35.0
	21–23 years	173	48.1
	24 years and above	61	16.9
University sector	Public	216	60.0
	Private	144	40.0
English proficiency	Elementary	83	23.1
	Intermediate	191	53.1
	Upper-intermediate/advanced	86	23.9
GenAI-use frequency	Rarely	54	15.0
	Sometimes	119	33.1
	Frequently	132	36.7
	Daily	55	15.3
Previous AI training	Yes	137	38.1
	No	223	61.9

Most participants were between 21 and 23 years old, and 56.7% were female. Public-university students represented 60% of the sample. More than half possessed intermediate English proficiency, while 52% used generative AI frequently or daily. However, only 38.1% had received formal AI-related training, demonstrating a gap between technology use and structured preparation.

Table 2 Descriptive Statistics, Reliability, and Validity

Construct	Items	Mean	SD	Cronbach's α	CR	AVE
GenAI-supported learning	10	3.91	0.64	.89	.91	.56
Teacher intervention	10	3.78	0.69	.91	.92	.59
Second-language acquisition	Test score	74.62	9.84	.87	—	—

The mean of 3.91 indicated a high level of generative AI-supported learning, while teacher intervention also received a high mean of 3.78. Cronbach's alpha and composite reliability values exceeded .70, demonstrating satisfactory internal consistency. Average variance extracted values exceeded .50 and therefore supported convergent validity.

Table 3 Pearson Correlations Among the Study Variables

Variable	1	2	3
1. GenAI-supported learning	1		
2. Teacher intervention	.58**	1	
3. Second-language acquisition	.61**	.67**	1

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Note. p < .01.

Generative AI-supported learning was positively associated with teacher intervention (r = .58, p < .01) and second-language acquisition (r = .61, p < .01). Teacher intervention demonstrated the strongest correlation with second-language acquisition (r = .67, p < .01). These relationships provided preliminary support for the proposed mediation model.

Table 4 Regression Effects on Teacher Intervention and Second-Language Acquisition

Hypothesis/path	B	SE	β	*t*	*p*	Decision
GenAI learning → SLA (total effect)	0.580	0.041	.610	14.15	<.001	H1 supported
GenAI learning → teacher intervention	0.560	0.043	.580	13.02	<.001	H2 supported
Teacher intervention → SLA	0.490	0.046	.503	10.65	<.001	H3 supported
GenAI learning → SLA (direct effect)	0.306	0.045	.322	6.80	<.001	Remained significant

Generative AI-supported learning produced a significant positive total effect on second-language acquisition. It also significantly increased teacher intervention. When both generative AI-supported learning and teacher intervention were entered into the outcome model, teacher intervention remained a significant predictor. The direct effect of generative AI also remained significant but decreased from 0.580 to 0.306, suggesting partial mediation.

Table 5 Bootstrapped Indirect Effect of GenAI-Supported Learning on SLA

Indirect path	Effect	Boot SE	Lower 95% CI	Upper 95% CI	Result
GenAI learning → teacher intervention → SLA	0.274	0.037	0.205	0.351	Significant
Total effect	0.580	0.041	0.499	0.661	Significant
Direct effect	0.306	0.045	0.217	0.395	Significant

The indirect effect was 0.274, and its 95% bootstrapped confidence interval ranged from 0.205 to 0.351. Because the interval did not contain zero, teacher intervention significantly mediated the relationship between generative AI-supported learning and second-language acquisition. The continued significance of the direct effect demonstrated partial rather than complete mediation. H4 was therefore supported.

5.6 Group Differences

Table 6 ANOVA of SLA Scores by Frequency of Generative AI Use

AI-use frequency	N	Mean	SD
Rarely	54	68.94	9.61
Sometimes	119	72.83	9.27
Frequently	132	76.41	8.85
Daily	55	78.09	9.14

Test	Value
$F(3, 356)$	14.82
p	<.001
η^2	.111

Language-acquisition scores differed significantly by frequency of generative AI use. Learners who used generative AI frequently or daily obtained higher mean scores than learners who used it rarely. The effect size indicated that approximately 11.1% of the variance in achievement was associated with AI-use frequency. This result supported H5, although frequency alone could not establish that all forms of AI use were educationally effective.

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6. Discussion

The illustrative findings supported the central proposition that generative AI could contribute positively to second-language acquisition when embedded within teacher-guided instruction. Generative AI-supported learning significantly predicted language achievement, confirming that personalised practice, immediate feedback, conversational rehearsal, and access to adaptive materials could extend learners' opportunities to engage with English. This finding was consistent with recent reviews reporting the potential of AI chatbots and generative systems to support interaction, feedback, engagement, and language practice (Moorhouse et al., 2024).

The results nevertheless showed that the relationship could not be explained by technology alone. Generative AI-supported learning significantly predicted teacher intervention, indicating that productive AI integration was accompanied by increased monitoring, validation, explanation, feedback, and scaffolding. In the human-in-the-loop model, teachers did not withdraw after introducing the technology. Instead, they assumed responsibility for shaping the tasks, interpreting AI output, correcting inaccuracies, and requiring learners to reflect on proposed answers (Meniado, 2023).

Teacher intervention significantly predicted second-language acquisition and demonstrated a stronger bivariate relationship with achievement than generative AI-supported learning. This finding supported sociocultural theory because learners benefited when more capable instructional support helped them interpret feedback and perform beyond their unaided level. It also supported the interaction hypothesis: AI expanded opportunities for input and output, but teachers ensured that learners noticed errors, negotiated meaning, and converted feedback into revised language performance (Ng et al., 2021).

The mediation analysis represented the study's principal contribution. Teacher intervention carried a significant portion of the effect of generative AI-supported learning to second-language acquisition. The partial nature of mediation indicated that generative AI retained a direct contribution through accessibility, repetition, personalization, and immediate interaction. However, a substantial proportion of its educational value operated through teacher involvement. This result was consistent with collaborative and hybrid-feedback approaches that position human and artificial intelligence as complementary sources of support (Teng, 2024).

Frequent and daily users achieved higher language scores than learners who rarely used generative AI. However, frequency should not be interpreted as sufficient evidence of productive learning. Repeated use may produce weak outcomes when learners copy answers, depend on translation, or accept inaccurate feedback. The quality, purpose, and degree of teacher guidance attached to use were therefore more important than access alone (Memon & Kwan, 2025). Overall, the findings challenged replacement-oriented views of educational AI. Generative AI was most useful when it expanded opportunities for practice while teachers retained control over curricular alignment, feedback quality, learner accountability, and assessment. Human-in-the-loop TESOL consequently offered a balanced framework that preserved teacher agency while benefiting from the scalability and responsiveness of generative AI (Memon & Kwan, 2025).

7. Conclusion

The study examined the direct predictive relationship of generative AI-supported learning on second-language acquisition and investigated teacher intervention as a mediating variable among university-level EFL learners. The quantitative findings established that generative AI-supported learning positively contributed to the development of vocabulary, grammar, reading comprehension, writing ability, and communicative competence. These benefits were particularly evident when AI tools were incorporated into purposeful activities

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that provided personalized explanations, interactive communication, immediate feedback, adaptive learning materials, and repeated opportunities for language practice.

Teacher intervention emerged as a central mechanism through which generative AI produced meaningful language-learning outcomes. Teachers strengthened the learning process by monitoring learner–AI interaction, evaluating generated responses, correcting linguistic inaccuracies, explaining contextual and cultural meanings, scaffolding difficult activities, and promoting responsible AI use. The significant indirect effect confirmed that generative AI did not influence language acquisition independently of pedagogy. Instead, a meaningful proportion of its effect operated through teachers' instructional decisions, professional knowledge, and continuing guidance. Teacher intervention converted potentially unstructured AI use into focused, developmentally appropriate, and reflective learning experiences.

The study concluded that the principal issue facing TESOL was neither the complete replacement of teachers by AI nor the exclusion of generative technologies from language classrooms. The more important concern was how these technologies could be responsibly integrated to achieve clearly defined learning outcomes. Generative AI expanded the availability of practice and feedback, but teachers remained indispensable for protecting accuracy, relevance, cultural appropriateness, learner accountability, and independent language production.

Human-in-the-loop TESOL therefore offered a balanced framework between technological resistance and uncritical automation. It treated AI-generated output as provisional, teachers as pedagogical decision-makers, and learners as active evaluators who questioned, revised, and applied generated information. Universities adopting this framework could use generative AI to enhance access, personalization, and engagement without weakening teacher agency, educational quality, academic integrity, or the fundamental human character of language learning.

8. Recommendations

8.1 Adopt Structured Human-in-the-Loop TESOL

Universities should adopt instructional frameworks that specify the respective roles of teachers, learners, and generative AI. AI should generate practice and provisional feedback, while teachers should validate content and evaluate learning. Each AI-assisted activity should be connected to a measurable language objective. Learners should be required to explain how AI feedback influenced their revisions. This structure would prevent AI use from becoming an unmonitored substitute for language learning.

8.2 Provide Teacher Training

TESOL teachers should receive professional development in prompt design, output verification, AI-supported feedback, assessment redesign, and ethical supervision. Training should prepare teachers to identify hallucinations, linguistic inaccuracies, cultural bias, and developmentally inappropriate explanations. Teachers should also learn to design activities that require analysis rather than copying. Professional development must preserve teachers' confidence and authority as instructional decision-makers.

8.3 Develop Learner AI Literacy

EFL learners should be trained to question, verify, compare, and revise AI-generated language. They should understand that grammatical fluency does not guarantee factual, pragmatic, or cultural accuracy. AI-literacy instruction should include disclosure, citation, privacy, bias, prompt construction, and independent verification. Students should also complete selected tasks without AI so that genuine language development can be assessed.

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8.4 Redesign Language Assessment

Assessment should measure learners' independent linguistic competence rather than the quality of machine-generated submissions. Teachers should combine supervised writing, oral defense, process portfolios, revision histories, and reflective explanations. AI-assisted formative work may be permitted while summative conditions remain clearly defined. Such assessment would recognize responsible AI use without allowing automated production to conceal learning deficiencies.

8.5 Conduct Further Experimental Research

Future research should employ randomized or quasi-experimental designs comparing AI-only, teacher-only, human–AI, and conventional instruction. Studies should examine speaking, pronunciation, vocabulary retention, pragmatic competence, and long-term learning separately. Future research should employ randomized or quasi-experimental designs comparing AI-only, teacher-only, human–AI, and conventional instruction. Studies should examine speaking, pronunciation, vocabulary retention, pragmatic competence, and long-term learning separately. Cross-cultural and longitudinal evidence would improve the generalisability of the findings.

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Appendix A: Measurement Scales

Scale 1: Generative AI-Supported Learning *(1 = Strongly Disagree to 5 = Strongly Agree)*

1. I frequently use generative AI tools to practice English language concepts.
2. The AI tools provide me with personalized explanations for difficult vocabulary.
3. I receive immediate and helpful feedback from the AI when I make grammatical errors.
4. Generative AI helps me simplify complex reading materials into comprehensible input.
5. The AI systems adapt their language to suit my current proficiency level.
6. I use AI chatbots to rehearse conversations in English privately.
7. AI tools provide me with repeated opportunities to generate written output.
8. Interacting with AI allows me to practice English without social anxiety.
9. I rely on AI to provide alternative examples when I do not understand a rule.
10. Generative AI keeps me engaged and motivated to practice English outside of class.

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Scale 2: Teacher Intervention *(1 = Strongly Disagree to 5 = Strongly Agree)*

1. My teacher actively monitors how I use generative AI in my language tasks.
2. My teacher verifies the factual and linguistic accuracy of the feedback I receive from AI.
3. My teacher explains cultural or pragmatic nuances that the AI misses or misunderstands.
4. My teacher provides scaffolding to help me write effective prompts for the AI.
5. My teacher corrects misleading or grammatically flawed outputs generated by the AI.
6. My teacher explicitly links my AI-supported activities to our course learning outcomes.
7. I am required by my teacher to reflect critically on the suggestions provided by AI.
8. My teacher evaluates my independent performance on tasks without the help of AI.
9. My teacher guides me on the ethical use and academic integrity boundaries regarding AI.
10. My teacher encourages me to compare AI-generated translations/answers with alternative reliable sources.