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AI-DRIVEN ADAPTIVE FEEDBACK TOOL: IMPACTS ON STUDENT LEARNING OUTCOMES AND TEACHERS' PERCEPTIONS ACROSS EDUCATIONAL CONTEXTS

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ABSTRACT

This study investigates the impact of an AI-driven adaptive feedback tool on student learning outcomes and teachers' perceptions across primary, secondary, and tertiary education in both rural and urban contexts. Adopting a quasi-experimental mixed-methods design, the research engaged 60 students and 12 teachers across six institutions, integrating ChatGPT into English and Science classroom tasks to provide real-time adaptive feedback. Quantitative findings revealed significant improvements in students' post-test performance at all levels, with particularly strong gains at the university level. Comparative analyses indicated that while rural students lagged behind urban peers in absolute performance, the relative benefits of utilizing AI tool were consistent across contexts. Teacher surveys and interviews highlighted positive perceptions in terms of its usefulness and pedagogical value, though self-efficacy and ease of use were lower in rural settings due to infrastructural and digital literacy challenges. Thematic insights emphasized AI tool's role in supporting instruction, while also pointing to the evolving role of teachers as facilitators who guide students in critically engaging with AI tool. The findings affirm constructivist and sociocultural learning perspectives, while also supporting the Technology Acceptance Model in explaining adoption. The study concludes that AI holds promise as an equitable and effective feedback tool, provided contextual barriers and teacher preparedness are systematically addressed.

Keywords: Artificial intelligence, AI literacy, digital literacy, technology adoption, pedagogical integration

INTRODUCTION

Artificial intelligence (AI) is increasingly recognized as a transformative force in education, promising to personalize learning, support teachers, and enhance student engagement through adaptive systems and automated feedback. AI-powered tools have made it possible to design more dynamic pedagogical frameworks, with the swift advent of intelligent tutoring applications, generative language models, and other AI technologies (Holmes, Bialik, & Fadel, 2019). At the heart of these advancements is the ability of AI to provide adaptive feedback, customized responsive content in a personalised, contextually tailored manner to individual needs of the learner in real time. These mechanisms have the potential to bridge learning divide but especially

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in heterogeneous classrooms with different levels of student capability and digital preparedness (Naseer & Khawaja, 2025; Rincon-Flores, Guerrero Solis, Rodriguez Hernandez, Castillo Lara, & Aldape Valdes, 2024).

Not all of this progress is automatic and the successful use of AI in education will still ultimately rely heavily on the role of teachers, acting as intermediaries between technology and learners. Data show that teachers' beliefs, literacy, and trust play key role in their usage of AI tools (Segaran & Moltudal, 2025; Zhang, Schießl, Plößl, Hofmann, and Glaser-Zikuda, 2023). Yet AI literacy among teachers is unevenly spread, as evidenced by vast differences between urban and rural (Chaudhry & Kazim, 2022; Kalim, Kanwar, Sha, and Huang, 2025). The limited training opportunities, infrastructural and differing cultural views of AI lead to a cautious or uneven adoption. This is not only a cause for alarm, since teacher resistance and lack of confidence will interfere with AI even the most modern adaptive systems pedagogical capacity.At the same time, adaptive feedback mechanisms, though widely acknowledged as effective, do not work uniformly across learner populations. Research indicates that the design of feedback, its timing (immediate or delayed), specificity (general guidance or targeted instruction), and modality (text-based, visual, or multimodal), interacts strongly with students' digital literacy levels (Yaseen, Mohammad, Abusaimeh, Ali, and Sharabati, 2025; Kinder, Briese, Jacobs, Dern, Glodny, Jacobs and Leßmann, 2025). Learners with high digital proficiency tend to benefit from rich, multimodal feedback that challenges them to self-regulate, whereas those with lower digital literacy often require simplified and scaffolded feedback to avoid cognitive overload. These findings point to the critical role of digital literacy as a moderator in determining the effectiveness of AI-driven feedback.

Moreover, these problems are amplified by contextual divides. In urban contexts, institutions are better equipped to create and implement AI tools effectively (Kalim, Kanwar, Sha, and Huang, 2025), while rural institutions often find themselves operating under constraints of connectivity, access, and training. Thus, not only is the integration of AI-driven feedback a reflection of existing educational inequalities when contextual factors are ignored, the feedback may exacerbate them as well. So comparative studies conducted across rural and urban settings are needed to understand how AI literacy training and adaptive feedback design can be leveraged equitably.

This study was conducted among students chosen from primary, secondary and tertiary levels, focusing on English language and Science lessons. These institutions include rural and urban background representing varying degree of digital readiness and access. This kind of setting is important to reflect the digital divide, relating to the notion of equity in education. By comparing students and teachers with different backgrounds and settings, this study thus highlight the way learning contexts play significant role in determining the feasibility of implementation and impact of Ai-driven feedback tools in real classrooms.

Although several studies have looked into the integration of ChatGPT across multiple subjects in examining students' learning outcome and teachers' perception, the current study however provides new perspective as it explored through cross-level and cross-contexts design (primary, secondary and tertiary levels; rural and urban).

In response to these challenges, this study utilized ChatGPT as the AI tool and seek to find out a) how does the integration of ChatGPT as an AI-driven adaptive feedback tool influence student learning outcomes across English Language and Science in different educational contexts, and b) what are teachers' perceptions of ChatGPT as an AI-driven adaptive feedback tool, particularly in relation to its usefulness, ease of use, and integration into classroom practice? By

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investigating these questions across primary, secondary, and tertiary institutions situated in both rural and urban settings, this study offers a nuanced exploration of how contextual, pedagogical, and technological factors intersect. The contribution of this work lies not only in providing empirical evidence on the effectiveness of AI in teaching and learning but also in proposing context-sensitive strategies for equitable AI adoption in education.

LITERATURE REVIEW

Current research has indicated a rise of empirical interest in AI-driven adaptive feedback tools used particularly in schools and universities. Some studies confirmed that adaptive feedback technology has the capability to influence increased writing skills, conceptual understanding and also learning engagement (Hallmen Gietl, Hillesheim, Bauermann, Friedrich, and Andre, 2025; Yaseen, Mohammad, Abusaimeh, Ali, and Sharabati, 2025; Kinder, Briese, Jacobs, Dern, Glodny, Jacobs and Leßmann, 2025). Similarly, according to Kelley and Wenzel (2025), the use of technology such as AI-driven adaptive feedback tools also benefit teachers as it helps reduce their workload while improving students' autonomy and engagement. The integration of AI in education thus has attracted increasing scholarly attention over the past decade, particularly with the rise of adaptive feedback systems, teacher–AI collaboration, and the challenges surrounding AI literacy and adoption in diverse contexts. This section provides the synthesis of current related researches. Several themes were emerged and discussed in relation to the exploration into students and teachers' experiences with AI based feedback in varied educational levels and settings.

TEACHERS' BELIEFS, AI LITERACY, AND ADOPTION

Teachers' beliefs and attitudes have been extensively studied in educational contexts for various pedagogical purposes. This also includes looking into their acceptance of new technologies and its application in teaching and learning. According to Segaran and Maltudal (2025), teachers' beliefs significantly influence their thinking about designing lessons in including AI-driven feedback tools. Zhang, Schießl, Plößl, Hofmann, and Glaser-Zikuda (2023) revealed that AI acceptance by pre-service teachers was influenced in terms of its usefulness, ease of use and trust towards the technology tools. In addition, Kelley and Wenzel (2025) indicated that literacy in AI among the teachers develops when collaborative and professional supports are provided. Nonetheless, Kalim, Kanwar, Sha, and Huang (2025) stated that AI triggered challenges as gendered disparities in AI adoption higher education institutions, referring to structural and cultural obstacles. All of these findings indicate that the adoption of AI is more of socio-cultural rather than technological, in which training, digital literacy and institutional support are needed.

ADAPTIVE FEEDBACK AND STUDENT LEARNING OUTCOMES

An important aspect to consider over the adoption of AI in education is its capability to provide customized and adaptive feedback to the students. Several studies highlighted this aspect as being crucial since AI-driven adaptive feedback can mitigate the learning gaps among the mixed ability students. Rincon-Flores, Guerrero Solis, Rodriguez Hernandez, Castillo Lara and Aldape Valdes (2024) also pointed out this aspect as they found that adaptive strategies in the AI tools may influence teaching and learning positively by being able to align teaching content and students' learning profiles. Similarly, Yaseen, Mohammad, Abusaimeh, Ali, and Sharabati (2025) expanded this view further by indicating that personalized AI feedback may lead to increased student engagement. Furthermore, Kinder, Briese, Jacobs, Dern, Glodny, Jacobs and Leßmann

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(2025) demonstrated evidence of how adaptive feedback from AI-driven tools may enhance teaching and learning process. These researches highlight that AI driven adaptive feedback may benefit in addressing learner diversity issues although its effectiveness may depend on varying contextual factors such as prior knowledge, digital readiness, and teacher support.

CONTEXTUAL INFLUENCES: RURAL AND URBAN EDUCATIONAL SETTINGS

Although some researches have explored the application of AI in varying educational contexts, however, more studies examining the nuanced challenges across rural and urban settings are needed. Vygotsky's (1978) sociocultural theory provides a lens to interpret how local contexts mediate learning with new technologies. Current studies indicate that disparity in terms of access, infrastructure, and teacher readiness between rural and urban schools can influence the successful adoption and implementation of technology in teaching and learning. Chaudhry and Kazim (2022) assert that it is important to consider the adoption of AI in education not merely as technical innovation but also as a socio-political intervention shaped by structural inequities. These insights highlight the importance of comparative studies that look into AI implementation across different educational settings, the gap that this study is addressing, which is by including rural and urban institutions at primary, secondary, and tertiary levels.

AI LITERACY AND TEACHER EDUCATION

Educators in general may view the adoption of AI in teaching as empowering, but adhering to the need to develop AI literacy among the teachers ensures the successful successful use of AI tools. Holmes, Bialik, & Fadel (2019) revealed AI literacy as another aspect of teacher professionalism, which includes not only technical knowledge but also ethical, pedagogical, and curricular knowledge. Kelley & Wenzel (2025) pointed out that teacher education programmes can develop AI literacy through collaborative practice. Ding, Li, and Hui (2025), in a focus on teacher–AI collaboration, argued that AI will not replace teachers but enhance their engagement by providing suggestions in teaching practices and supports in available AI tool feedback models. Altogether, however, these studies provide indications that there is the need to revisit curricula and professional development programs to cater for AI literacy, ensuring that educators are not merely users, but also critical assessors and co-designers of AI tools.

BARRIERS, ETHICS, AND EQUITY IN AI ADOPTION

With all the promising advances that AI purports, nothing comes as perfect in nature as there are barriers to any kinds of change. This true as well in the adoption of AI tool in pedagogy. Kalim, Kanwar, Sha, and Huang (2025) identified systemic barriers to AI adoption among the women in higher education, pointing to gendered inequities in digital competence and institutional support. Moreover, ethical concerns are likewise prominent. According to Chaudhry and Kazim (2022), the issues of transparency, accountability, and bias in AI-driven systems are the main challenges that need to be taken cared of. Hallmen Gietl, Hillesheim, Bauermann, Friedrich, and Andre (2025) further revealed how AI-based counselling feedback for prospective teachers raises questions of privacy, fairness, and human–machine trust. This suggests that AI adoption cannot be evaluated mainly in terms of its efficiency or performance outcomes; however, equity, inclusion, and the broader ethical implications of deploying AI in learning environments must also be considered.

As a whole, the studies mentioned above point out that although the integration of technology such as the AI-driven adaptive feedback tools offer great benefits, their effectiveness however is very much dependent on its contexts. The present study thus builds upon these gaps by exploring

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into various education level and geographical settings, looking into students and teachers' adoption and outcomes of AI-driven feedback tools.

METHODOLOGY

Utilizing quasi-experimental mixed methods design, this study aims to investigate the effects of AI-driven adaptive feedback tool (ChatGPT) in English language and Science lessons in various educational levels. This study utilized pre- and post-test and survey instruments for the quantitative phase while teacher interviews for the qualitative design, in order to gauge the understanding of the application of ChatGPT in the teaching and learning process.

The participants include 60 students and 12 teachers from 6 different institutions. They were selected from two primary schools, two secondary schools, and two universities purposively, with one from rural and one from urban setting. Ten students and two teachers from each school or university were invited to participate in this study.

In the study, ChatGPT (OpenAI, 2023) was utilized as the intervention in the teaching and learning process through both web browser or mobile phones. During the lessons, students used ChatGPT to assist them in completing tasks such as writings essays, reading comprehension exercises, problem-solving tasks for science. In general, students prompted instructions to ChatGPT, and received feedback with diagnosed errors, as well as received recommended corrections. The feedback provided by ChatGPT was iterative and adjusted to students' prompts or responses throughout the experiment period. Learning processes were thus recorded enabling teachers to track the students' learning, and modify their instruction according to individual student needs.

Specifically, the lessons for both English language and Science subject were anchored by five instructional phases namely i) task introduction, ii) completion and submission, iii) ChatGPT feedback generation, iv) feedback revision, and v) review and discussion. Examples of standardized prompts were provided, such as:

- "Please check my writing and provide suggestions of good sentences for paragraph development" (English language lesson)
- "Please explain why my answer for question No.2 about amoeba is incorrect" (Science lesson).
- "Please show me how to improve my elaboration in paragraph 3" (English language lesson)
- "Please show me why my explanation for photosynthesis is incorrect" (Science lesson)

In order to measure the effectiveness of the intervention, several instruments were used. Pre- and post-tests for English language and Science were conducted once at the beginning of the intervention, and once at the end respectively. For teachers' perspective, two questionnaires were administered namely the Technology Acceptance Model by Davis & Bagozzi (1989) and the Teacher Artificial Intelligence Competence Self-Efficacy Scale by Chiu, Ahmad & Coban (2025). On top of that, students' perceptions were students' perceptions were analysed using an adapted form of the AI literacy questionnaire (Ng, Wu, Leung, Chiu, & Chu, 2024). Lastly, for the qualitative insights, twelve teachers provided their responses through semi-structured interviews.

The research was carried out over a period of 10 weeks. In Week 1, pre-tests were provided to determine a predetermined baseline level of English and Science proficiency. During weeks 2–7, however, students engaged in weekly classroom tasks guided by feedback from ChatGPT as teachers co-led the students in using ChatGPT. In Week 8, post-tests were administered, and both students and teachers completed their respective surveys. The last two weeks, Weeks 9 and 10, were spent researching and transcribing teacher interviews.

Data analysis followed both quantitative and qualitative strands. Quantitative data from pre- and post-tests were analysed using paired-sample t-tests to assess within-group improvements, and two-way ANOVA was employed to examine differences by educational level (primary, secondary, university) and geographical context (urban versus rural). Where significant effects were identified, ANCOVA was conducted to control for baseline differences, followed by Tukey's HSD post-hoc tests to determine group-specific variations. Effect sizes (Cohen's d and partial eta squared) were reported to interpret the magnitude of findings. Survey data underwent internal consistency testing using Cronbach's alpha, while exploratory factor analysis (EFA) established construct validity. Inferential analyses such as ANOVA and regression were then applied to explore differences and predictors of teacher and student attitudes. In parallel, qualitative interview data were analysed thematically following Braun and Clarke's (2006) six-phase approach, enabling the identification of emergent themes. Triangulation of test results, survey findings, and teacher reflections was employed to strengthen interpretive validity.

RESULTS AND DISCUSSION

This section presents the findings of the study in alignment with the two research questions, integrating both quantitative and qualitative evidence. The results are organized thematically by research question, with each subsection anchored by statistical outputs and its descriptions. Following each set of findings, a discussion situates the results within existing literature and representing the implications for the use of AI-driven feedback tool in education.

RQ1: How does the integration of ChatGPT as an AI-driven adaptive feedback tool influence student learning outcomes across English Language and Science in different educational contexts?

Table 1. Pre-test and Post-test Mean Scores by Educational Level and Subject

Level	Subject	Pre-test M (SD)	Post-test M (SD)	*t*(19)	*p*	Cohen's *d*
Primary	English	58.3 (10.2)	72.6 (9.4)	7.02	<.001	0.98
Primary	Science	55.1 (11.0)	68.4 (10.1)	6.47	<.001	0.91
Secondary	English	61.5 (9.7)	77.8 (8.9)	7.85	<.001	1.12
Secondary	Science	59.8 (10.4)	76.2 (9.3)	8.22	<.001	1.14
University	English	65.4 (8.5)	83.1 (7.9)	9.16	<.001	1.31
University	Science	63.9 (9.1)	81.7 (8.7)	8.77	<.001	1.28

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Students across all educational levels demonstrated significant improvements from pre-test to post-test in both English and Science. Primary school students improved from moderate proficiency levels (English *M* = 58.3; Science *M* = 55.1) to higher post-test scores (English *M* = 72.6; Science *M* = 68.4), with large effect sizes (*d* = 0.91–0.98). Secondary school students showed even greater gains, particularly in Science, with effect sizes exceeding 1.10. University students reported the largest improvements, with English (*d* = 1.31) and Science (*d* = 1.28), indicating very large effect sizes.

These results suggest that ChatGPT's adaptive feedback mechanisms substantially enhanced student learning outcomes. The strongest gains at the university level are consistent with prior research indicating that mature learners benefit more from AI-enhanced personalized feedback (Yaseen, Mohammad, Abusaimeh, Ali, and Sharabati, 2025; Zhang, Schießl, Plößl, Hofmann, and Glaser-Zikuda, 2023). However, the significant improvements at primary and secondary levels reinforce findings by Naseer and Khawaja (2025) that AI-driven tools can mitigate conceptual gaps in younger learners. The evidence strongly aligns with Vygotsky's (1978) sociocultural theory, where scaffolded feedback supports learners within their zone of proximal development.

Table 2. Two-Way ANOVA: Post-test Scores by Geographical Context and Level

Source	**df**	**F**	**p**	**η²**
Context (Urban vs. Rural)	1	6.82	.011	0.11
Level (Primary/Sec/Uni)	2	8.17	<.001	0.18
Context × Level	2	1.02	.368	0.02

The two-way ANOVA revealed significant main effects for geographical context and educational level. Urban students significantly outperformed rural students ($F(1, 54) = 6.82$, $p = .011$, $\eta^2 = 0.11$), and there were significant differences across levels ($F(2, 54) = 8.17$, $p < .001$, $\eta^2 = 0.18$). However, the interaction effect was non-significant, suggesting that the benefits of ChatGPT were consistent across rural and urban contexts, regardless of the level.

While ChatGPT improved outcomes in all settings, rural students consistently lagged behind their urban peers. This finding echoes Kalim, Kanwar, Sha, and Huang (2025), who highlighted infrastructural and digital literacy barriers in rural education contexts. Nevertheless, the absence of an interaction effect suggests that the AI tool provided comparable relative benefits to both groups. This underscores the potential of AI tools like ChatGPT to reduce, but not entirely eliminate, systemic inequities rooted in digital access and resource distribution.

On top of the two-way ANOVA and paired -sample *t*-tests, ANCOVA analyses were also conducted to adjust the baseline differences between groups. After adjustment, the means confirmed that the improvements in the post-test remained significant even when controlling for initial performance levels ($F(1, 57) = 7.94$, $p < .01$). Moreover, Tukey's HSD post-hoc tests revealed that university students' gains were significantly higher compared to the others ($p < .05$). These analyses ensured the robustness of the results hence validated the improvements across all contexts.

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RQ2: What are teachers' perceptions of ChatGPT as an AI-driven adaptive feedback tool, particularly in relation to its usefulness, ease of use, and integration into classroom practice?

Table 3. Teacher Survey Results (TAM and Self-Efficacy Scales)

Measure	M	SD	Cronbach's α	Notes
Perceived Usefulness	4.35	0.61	0.88	High across both rural and urban
Perceived Ease of Use	4.02	0.73	0.85	Some variability in responses
Intention to Use	4.21	0.66	0.86	Predicted by usefulness (β = .62)
AI Integration Self-Efficacy	3.81	0.66	0.87	Urban higher than rural (p = .037)

Survey results indicated that teachers perceived ChatGPT as highly useful (M = 4.35) and relatively easy to use (M = 4.02). Regression analysis confirmed that perceived usefulness strongly predicted teachers' intention to use the tool (β = .62, p < .001). Self-efficacy levels were moderate overall (M = 3.81), but urban teachers reported significantly higher confidence compared to rural teachers (p = .037). Reliability for all scales was high (α = .85–.88).

Teachers' positive perceptions align with the Technology Acceptance Model (Davis, 1989; Venkatesh & Davis, 2000), which posits that perceived usefulness is the strongest determinant of adoption. The lower self-efficacy in rural settings reflects concerns identified in Kelley and Wenzel (2025), where professional development and digital literacy gaps were noted as barriers to AI adoption. These findings reinforce the need for targeted teacher training and contextual support to ensure equitable integration of AI across different educational environments.

Table 4. Qualitative Themes from Teacher Interviews

Theme	Description	Sample Quote
Pedagogical Value	AI feedback supported differentiation and individualized learning pathways	"It gave weaker students hints and guided steps, while advanced learners got enrichment tasks."
Practical Challenges	Infrastructure and content accuracy issues occasionally disrupted use	"The internet connection was a barrier, and sometimes ChatGPT gave incomplete answers."
Evolving Teacher Roles	Teachers acted as facilitators, prompting critical engagement with AI	"I told my students: don't accept the machine blindly, ask why it says so."

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Thematic analysis of teacher interviews revealed three central themes: pedagogical value, practical challenges, and evolving teacher roles. Teachers emphasized ChatGPT's ability to differentiate learning by tailoring feedback to individual student needs. However, challenges such as unstable internet access and occasional inaccuracies in AI responses were cited. Notably, teachers noticed changing roles shifted toward facilitators who inspired students to engage with AI outputs rather than accepting them passively.

In line with Braun and Clarke's (2006) thematic approach, they share these qualitative findings, which also corroborate previous studies (Segaran & Moltudal, 2025; Hallmen Gietl, Hillesheim, Bauermann, Friedrich, and Andre, 2025), which described some of the pros and cons of AI-driven feedback. This transformation in teacher identity indicates a pedagogy that increasingly is AI-mediated, leaving human teachers to develop critical thinking and contextual judgement. This result corresponds with Holmes, Bialik and Fadel (2019), who cautioned against over-dependence on AI but recognized its potential to augment human teaching skills. The findings of this study provide converging evidence that ChatGPT, as an AI-driven adaptive feedback tool, significantly enhances student learning outcomes while also being perceived by teachers as pedagogically valuable and feasible for classroom integration. By analysing results across multiple educational levels and geographical contexts, the study advances understanding of both the efficacy and limitations of AI-mediated feedback in real-world settings. The followings summarize the overall results and findings of this study.

STUDENT LEARNING OUTCOMES

Quantitative analyses demonstrated large and consistent gains in post-test performance across English Language and Science, with effect sizes exceeding $d = 0.90$ in all cases and surpassing $d = 1.30$ at the university level. These findings suggest that the adaptive scaffolding provided by ChatGPT effectively supports conceptual understanding and language development. The benefits were consistent across rural and urban contexts, indicating the broad applicability of AI-driven feedback. However, rural students' lower absolute performance scores highlight persistent structural inequities, particularly in digital access and infrastructure.

TEACHER PERCEPTIONS

Overall, teachers considered ChatGPT relatively useful and moderately easy to use and perceived usefulness as the most significant predictor of their intention to integrate the tool into practice. Self-efficacy, on the other hand, was lower among rural teachers, indicating a technology adoption confidence gap. Qualitative themes emerged that teachers appreciated ChatGPT's ability to customize instruction but also stressed that they needed to stay as facilitators, with attention to generating critical responses following the outputs of AI. This mirror concerns in the literature that AI should not substitute for teacher agency but supplement it.

The synthesis of quantitative and qualitative findings suggests that student learning outcomes were enabled through teachers' readiness to adopt and mediate ChatGPT use in their classrooms. This parallels what we're seeing with more data from AI tools that supports students' performance and helps create positive teacher perceptions; when AI-based tools are built, students receive personalized feedback, teachers can keep an edge and adapt to their students. However, infrastructural challenges and lack of digital literacy in rural environments temper these results — a stark reminder of the importance of approach with special attention to local context.

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THEORETICAL AND PRACTICAL IMPLICATIONS

Theoretically, the findings support constructivist and sociocultural learning frameworks, in which scaffolded, adaptive feedback helps learners navigate their zones of proximal development. At the same time, the study affirms the Technology Acceptance Model, with perceived usefulness emerging as the key determinant of adoption. Practically, the results underscore the importance of professional development for teachers, particularly in rural contexts, and the need for policy-level interventions to address infrastructural inequities. If implemented equitably, AI tools like ChatGPT have the potential to narrow achievement gaps by providing individualized learning support at scale.

However, as far as the findings and results of the present study revealed, it is important to note that the quasi-experimental design that it utilized limits causal inference. The improvements revealed should not be conclusively attributed to ChatGPT alone, because factors such as teacher support and learner motivation might also have come into play. In addition, the initial introduction of ChatGPT in the classroom itself might have initiated a so called new-tool-effect phenomenon, or simply, aura, that may temporarily boost students' engagement, or excitement, during the lesssons.

Overall, the results indeed support the theoretical relationship purported by the Technology Acceptance model i.e. if the technology is perceived as user-friendly, it becomes more useful and hence more likely to be adapted by students and teachers. Likewise, when feedback provided provided through a technological tool such as ChatGPT is perceived as constructively and contextually aligned, it promotes deeper learning through active responses and consistent improvement.

CONCLUSION

This study examined the integration of ChatGPT as an AI-driven adaptive feedback tool across primary, secondary, and higher education contexts, with a focus on two research questions: the impact of AI-mediated feedback on student learning outcomes (RQ1) and teachers' perceptions of its usefulness, ease of use, and overall feasibility (RQ2). By drawing upon a diverse participant pool from both rural and urban settings, the study provides robust evidence that ChatGPT enhances student learning performance while being generally well-received by educators.

The results indicate that students exposed to ChatGPT's adaptive feedback experienced significant improvements in English Language and Science performance across educational levels, with particularly strong gains observed at the university level. These findings affirm the capacity of AI to provide meaningful scaffolding, adaptive corrections, and personalized learning pathways that complement traditional instruction. Teachers, in turn, perceived ChatGPT as a valuable pedagogical tool, particularly with regard to its ability to individualize instruction and streamline feedback processes. However, their self-efficacy and perceptions of ease of use were more variable, especially in rural contexts, highlighting persistent gaps in digital literacy and infrastructure.

The study contributes to both theory and practice by reinforcing the relevance of constructivist and sociocultural frameworks in AI-mediated learning, while also demonstrating the explanatory power of the Technology Acceptance Model in understanding adoption patterns. Practically, the findings suggest that successful implementation of ChatGPT in classrooms requires not only

technical access but also sustained teacher professional development and policy support to ensure equitable integration across contexts.

Nevertheless, limitations must be acknowledged. The scope of this was limited to limited number of participating schools and universities, and focuses only on English Language and Science subjects; additional research across broader subject domains is needed. Future research should also explore longitudinal effects of AI integration, comparative analyses with other AI tools, and deeper investigations into the ethical dimensions of AI-mediated instruction.

In conclusion, this study demonstrates that ChatGPT holds significant promise as an adaptive feedback tool capable of enhancing student learning outcomes while being pedagogically valued by teachers. However, its transformative potential can only be realized if challenges of access, equity, and teacher preparedness are systematically addressed. By situating AI as a complement to, rather than a replacement for, human instruction, this research underscores the importance of designing AI-enhanced learning environments that are equitable, contextually grounded, and oriented toward empowering both teachers and students.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest with respect to the research, authorship, and/or publication of this article.

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