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Leaving Behind the Red Pen: Transforming Teacher Feedback Literacy and Reflective Practices through Artificial Intelligence

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Abstract

While Artificial Intelligence (AI) tools show promise in enhancing educational feedback processes, research on pre-service teachers' readiness to incorporate these tools remains limited. This quasi-experimental study investigated how AI integration affects the development of feedback literacy and reflective practice skills among pre-service English teachers. The study involved 59 third and fourth-year English Language Teaching students divided into experimental (n = 29) and control (n = 30) groups. Both groups received identical theoretical training on feedback literacy; however, the experimental group used AI-tools like (ChatGPT 4o / Claude) during practice sessions, while the control group employed traditional paper-and-pencil methods. Data were collected through the Teacher Reflective Practice Scale and Foreign Language Writing Teacher Feedback Literacy Scale over a six-week intervention period. Non-parametric analyses revealed that while groups showed similar baseline scores based on pre-test comparisons, the experimental group demonstrated significantly higher gains across all dimensions of feedback literacy (perceived knowledge, values, skills) and reflective practice (interpersonal, intrapersonal, critical, behavioral, strategic). These findings suggest that integrating AI tools into feedback processes can considerably enhance pre-service teachers' professional development, offering implications for teacher education curricula.

1. Introduction

Artificial Intelligence (AI) is transforming feedback processes in education, reshaping how feedback is delivered, received, and used by both educators, teachers and students. The emergence of generative AI technologies, like ChatGPT/Claude/Gemini, has enhanced AI's influence on educational practices, leading to diverse responses from teaching professionals (Mishra et al., 2023). AI supports student learning and development while also making significant contributions to improving the quality, efficiency, and personalization of feedback (Hsia et al., 2023; Rashid et al., 2024; Villagran et al., 2024). Traditional feedback can be limited by subjective biases, delayed responses, and lack of detail, however, AI uses unique algorithms to analyze large data sets and provide comprehensive feedback on various aspects of student work, such as grammar, style, content accuracy, and coherence. For example, AI-powered tools such as Turnitin and Grammarly provide diagnostic feedback by identifying patterns in a student’s errors, helping them understand why certain answers are wrong and how they can correct them in the future (Zhang & Zhang, 2024). The ability of AI to provide such feedback consistently and in real time significantly improves the quality of feedback in education (AlGhamdi, 2024). Secondly, AI significantly increases the efficiency of the feedback process by automating many aspects of assessment and evaluation. Thus, in large classes where teachers may have difficulty providing individual feedback to each and every student, AI can help to scale the feedback process. AI’s capacity to provide instant feedback enables students to learn continuously and adjust their performance without waiting for traditional feedback loops. One other most transformative aspect of AI in feedback is its ability to provide highly personalized feedback that addresses the unique learning needs of each student (Coenen & Pfenninger, 2024; Evmenova et al., 2024; Hsia et al., 2023). AI-powered systems can track and analyze a student’s learning behavior, performance, and progress, tailoring feedback to individual strengths,

weaknesses, and learning styles. For example, AI tools like Duolingo are designed to provide adaptive feedback that evolves as a student progresses, offering personalized cues that adjust the level of difficulty and improve student engagement and learning outcomes (Kazu & Kuvvetli, 2024; Li & Bonk, 2023; Nasrul & Fatimah, 2023). In short, AI not only increases the quality, efficiency, and personalization of feedback, but also provides students with more meaningful, targeted support.

Feedback literacy in language teaching can be defined as the ability of both teachers and learners not only receive and evaluate feedback, but also to interpret it, to use critical thinking skills, and to apply this knowledge strategically in developing language skills (Chan & Luo, 2022; Wang et al., 2023). The term “feedback literacy” goes beyond the receipt of feedback in the language learning process and includes the process of the learner making sense of the feedback, identifying their own learning needs and developing action plans accordingly. The most basic components of feedback literacy can be listed as teachers' knowledge of different types of feedback (formative, summative, peer feedback, etc.) and their respective purposes, expressing feedback clearly and constructively, encouraging students to reflect on feedback by creating a learning environment in which feedback is integrated into the learning process, and at the same time guiding students in giving and receiving feedback constructively (Chen & Liu, 2024; Jiang & Yu, 202). Thus, while evaluating the constructive feedback they receive, students realize their deficiencies in areas such as grammar, vocabulary and communication skills, restructure their learning strategies in line with this awareness and take the necessary steps for continuous improvement. This process shows that feedback in language teaching is not only a correction tool, but also a tool that strengthens learning motivation, increases self-confidence and helps students to develop critical thinking skills (Jiang & Yu, 2021; Zhan, 2024).

It would be correct to define reflective practice in education as the process of teachers and educators analyzing their own teaching processes, classroom experiences and professional practices by thinking deeply. In this process, teachers evaluate from a critical perspective the experiences they have had, the strategies they have implemented and the difficulties they have encountered (Chien, 2021; Jara & Russell, 2023; Liu et al., 2024). They also evaluate past experiences by determining which methods are effective, which areas need improvement, and develop strategies to improve future teaching approaches (Karimi et al., 2024). In other words, it would not be wrong to say that the most basic components of reflective practice are critical thinking, self-evaluation, collaboration and joint strategy development. When the related literature on reflective practices, Baker (2014) showed that explicit modeling of reflective practices during a course significantly improved Emirati early childhood teachers' reflective awareness, influencing their child-centered teaching approaches positively. This approach not only supports the professional development of teachers but also contributes to continuous learning and self-renewal processes. Thus, classroom practices become more conscious, flexible and student-focused.

AI tools, which play an important role in improving both feedback literacy and reflective practices by providing data-based insights, can enable more personalized and adaptable teaching methods. These tools analyze student performance, detect learning patterns, and generate targeted feedback, encouraging deeper self-assessment among both students and educators (Li et al., 2021). By leveraging

natural language processing and machine learning, AI can detect misunderstandings, suggest improvements, and adapt teaching strategies to individual needs, thus promoting more effective pedagogical approaches (Luckin et al., 2018). Additionally, AI-powered analytics facilitate metacognitive awareness, helping teachers improve their methods based on real-time evidence rather than just intuition (Cukurova et al., 2020). Combining GenAI tools with human guidance in higher education significantly improved students' AI literacy, comfort with AI, and critical assessment of AI applications in educational contexts (Tzirides et al., 2024). This continuous feedback and adaptation cycle not only improves learning outcomes but also fosters a reflective teaching culture, ultimately improving the quality of education in a variety of learning environments.

Enhancing teachers' AI-assisted feedback literacy and reflective practices offers an innovative perspective on educational technology integration. As AI tools become increasingly prevalent in learning environments, developing pre-service teachers' capabilities in AI literacy, feedback mechanisms, and reflective practices has emerged as a critical priority in contemporary teacher education. This research aims to investigate, through experimental research, how pre-service teachers can develop the knowledge, skills, and attitudes necessary to effectively incorporate AI tools into their feedback and reflective practices. This approach not only prepares educators to navigate technological advancements but also empowers them to leverage AI tools for more meaningful feedback and professional. Teachers equipped with AI-enhanced feedback skills can provide more personalized feedback while critically reflecting on their practices through data-driven insights. Thus, the research is of great importance for a new generation of educators who are both technologically perceptive and committed to continuous professional development to realize the critical role of AI in bridging the gap between theoretical knowledge and practical application. Ultimately, this research addresses the urgent need to prepare teachers who can effectively integrate AI tools into their feedback practices while maintaining reflective pedagogical effectiveness.

2. Literature review

AI-Enhanced Feedback Literacy and Reflective Practice: Current Research and Challenges

Studies in the field of AI-supported feedback systems have shown that they improve both teaching effectiveness and student learning outcomes in a variety of ways. AI-supported peer feedback significantly improved both feedback quality and writing ability of EFL students, showing the potential of AI in writing instruction (Guo et al., 2024). Again, Guo (2024) in another study mentioned that EvaluMate, an AI-supported peer feedback tool, significantly improved the quality of peer feedback in writing, demonstrating the value of AI in enhancing students' learning and assessment. Recent research has explored student engagement with AI feedback systems. Zhan and Yan (2025) found students primarily used cognitive strategies when interacting with ChatGPT feedback, showing minimal emotional resistance but superficial behavioral engagement. Tam (2025) revealed that in L2 writing, ChatGPT feedback quality depended on learners' personal goals and self-regulation strategies, which directly influenced prompt quality. Additionally, Venter et al. (2024) found that while AI feedback systems for

accounting students generally followed effective principles, variability across feedback dimensions highlighted the need for rigorous human oversight to maintain quality. Emphasizing AI's role in guiding student learning, Afzaal et al. (2024) states that explainable AI-based feedback significantly enhanced self-regulated learning and academic performance, providing clear recommendations to help students plan and reflect on their learning strategies. EFL students' interaction with AI-programmed AWE, such as Pigai, gradually evolved from basic error correction to more meaningful feedback engagement, suggesting the potential of AI tools for deeper learning (Yang et al., 2024). An educational game using generative AI (ChatPDF) for instant feedback showed high student engagement and low anxiety, indicating AI's role in supporting interactive learning (Chien et al., 2024). Singh et al. (2024) found that AI integrated with learner-sourcing improves the quality of student-generated feedback and enhances critical thinking regarding large language models. Demonstrating AI's potential to enhance educational design, Pishtari et al., (2024) found that AI-driven feedback positively influenced the quality of teachers' learning designs.

In terms of technology-enhanced feedback literacy, several researchers have examined how feedback literacy functions across educational contexts, finding that its dimensions vary by discipline and are increasingly influenced by digital tools (Cui et al., 2023; Lee et al., 2023). Building on these findings, Schluer (2022) examined digital feedback literacy among pre-service teachers, noting significant enhancement in skills and attitudes toward digital feedback tools during the pandemic, suggesting the potential for AI integration in teacher preparation. de Kleijn's (2021) instructional model supporting feedback literacy through interactive activities offers a framework that could be augmented with AI-based scaffolding to further enhance feedback processes. Similarly, Esteban and Laborda (2018) demonstrated that technology-supported dialogic interactions enhance reflective practice among ELT teachers, improving self-image and reducing anxiety through performance review—a process that could be optimized with AI-based feedback systems. This finding aligns with research correlating reflective depth with improved self-efficacy, reinforcing the value of AI-assisted reflective practices in teacher training (Menon & Azam, 2021; Moradkhani et al., 2017). Novillo and Pujolà's (2019) analysis of e-tutoring strategies for fostering reflective practice indicates potential pathways for AI implementation in reflective e-portfolios. Additionally, AI tools could address challenges identified by Sunra et al., (2020), who found that while EFL teachers value reflective practice, they struggle with heavy workloads and insufficient knowledge on effective reflection techniques.

However, although they have many advantages, various challenges limit the widespread adoption of AI tools for feedback. For example, human-generated feedback was of higher quality than AI in most areas except criteria-based comments, indicating that while AI feedback is useful, it is not yet on the same level with human evaluation (Steiss et al., 2024). Excessive dependence on AI feedback may reduce students' critical thinking and problem-solving skills if they rely too much on automated suggestions (Tang et al., 2024). AI-based evaluation in argumentation training showed strengths in identifying claims and qualifiers but weaknesses in other elements, indicating the need for further AI improvements (Jho & Ha, 2024). This limitation connects to Carless's (2022) argument for student-generated internal feedback as crucial to learning, raising questions about how AI tools might support rather than supplant this

important cognitive process. Similarly, Benitt's (2019) research on how technology bridges theory and practice for pre-service teachers suggests potential for AI-enhanced video analysis in developing reflective capabilities, while highlighting the need for maintaining human guidance in these processes.

In This Present Study

The primary goal of this study is to explore the development of AI-assisted feedback literacy and reflective practice skills among prospective English teachers. This research aims to understand how these skills evolve when AI tools are integrated into feedback processes, specifically within a structured experimental research design. By adopting a quasi-experimental design, the study seeks to determine whether the integration of AI tools can significantly enhance feedback literacy and reflective practice compared to traditional methods. Based on this aim, the following research question was formulated to guide the investigation.

RQ: Is there a statistically significant difference between control group (using paper-pencil techniques) and experimental group (using AI-supported tools) of prospective teachers who received common theoretical training on feedback literacy, in terms of:

i) pre-test scores of feedback literacy and reflective practice,
ii) post-test scores of feedback literacy and reflective practice,

iii) pre-test to post-test score changes in feedback literacy and reflective practice?

3. Methods

3.0 Research Design

This study employed a quasi-experimental design with pre-test and post-test control group comparisons to investigate the effectiveness of AI-assisted tools in developing feedback literacy and reflective practice skills among pre-service English teachers. A quasi-experimental design was chosen as it allows for the examination of cause-and-effect relationships in educational settings where random assignment of participants to experimental and control groups is not feasible or ethical (Büyüköztürk, 2016; Fraenkel et al., 2022). This design involves comparing outcomes between two groups of participants: an experimental group that uses AI- tools and a control group that employs traditional paper-pencil techniques. Both groups receive the same theoretical training on feedback literacy, which ensures that the difference in outcomes can be attributed more directly to the method of feedback (AI-assisted vs. traditional) rather than differences in instructional content. Furthermore, the pre-test post-test control group design provides a strong framework for measuring the differential effects of the intervention while controlling for initial differences between groups.

3.1 Participants

The study was conducted with 59 pre-service English teachers enrolled in an English Language Teaching (ELT) department at a state university in Türkiye during the 2023–2024 academic year. The selection of participants followed specific criteria to ensure the validity of the study. First, all participants were required to be regular third-year or fourth year undergraduate students who had successfully completed prerequisite methodology course of "Teaching Practice”, a compulsory component of their teacher education program. Students who had previously failed or repeated the Teaching Practice course were excluded from the study to maintain homogeneity in prior teaching experience. The sample consisted of two classes that were assigned as experimental (n = 29) and control (n = 30) groups.

To ensure equivalence between groups, preliminary analyses were conducted comparing participants' academic achievement scores from previous teaching methodology courses, English proficiency levels, and basic demographic characteristics. No statistically significant differences were found between the experimental and control groups in these aspects ($p > .05$), indicating successful group matching. A comprehensive overview of participants' demographic characteristics, including gender distribution, academic performance, technology proficiency, and AI-related experience, is presented in Table 1. The data reveals balanced distribution across groups, with particular emphasis on participants' self-reported technology and AI competencies, which are crucial factors for this study's implementation.

Table 1

Demographic Characteristics and Group Equivalence Analysis of Control and Experimental Groups

		Groups				p
		Control		Experimental		
n	**%**	**n**	**%**			
Gender ***	Female	23	76,7%	22	73,3%	0,86
	Male	7	23,3%	8	26,7%	
Class/grade ***	Junior/3rd year	16	53,3%	17	56,7%	0,21
	Senior/4th year & (± 5)	14	46,7%	13	43,3%	
Technology proficiency for educational purposes? ***	High	17	56,7%	11	36,7%	0,08
	Moderate	11	36,7%	18	60,0%	
	Very high	2	6,7%	1	3,3%	
GPA**	X ± s.s.	3,28 ± 0,31		3,20 ± 0,33		0,55
Prior AI	Yes	30	100.0%	28	96.7%	0.33
Experience *	No	0	0.0%	1	3.3%	
AI Educational Use Proficiency ***	Advanced	4	13.3%	4	13.8%	0.57
	Intermediate	15	50.0%	11	37.9%	
	Basic	11	36.7%	14	48.3%	

****Chi-square test, **Mann-Whitney U test, *Fisher's Exact Test*

Note. GPA = Grade Point Average (4.0 scale). Technology proficiency and educational AI proficiency levels were self-reported by participants.

Table 1 presents the demographic characteristics and group equivalence analysis between the control and experimental groups. Statistical analyses revealed no significant differences between the groups across all demographic variables, indicating successful random assignment and group equivalence. The gender distribution was comparable between the control (76.7% female, 23.3% male) and experimental groups (73.3% female, 26.7% male; p = 0.86). Similarly, the academic level distribution showed no significant differences (p = 0.21), with a balanced representation of junior (control: 53.3%, experimental: 56.7%) and senior students (control: 46.7%, experimental: 43.3%). Regarding perceived educational technology skills, although the control group showed a slightly higher proportion of participants rating themselves as "high" skilled (56.7% vs. 36.7% in the experimental group), and the experimental group had more participants in the "moderate" category (60.0% vs. 36.7% in the control group), these differences were not statistically significant (p = 0.08). Academic performance, as measured by GPA, was also

comparable between the control (M = 3.28, SD = 0.31) and experimental groups (M = 3.20, SD = 0.33; p = 0.55). These findings demonstrate the homogeneity of the groups across all key demographic variables, including gender, academic level, perceived technology skills, and academic performance. This equivalence strengthens the internal validity of the study and ensures that any subsequent differences observed between the groups can be more confidently attributed to the experimental intervention rather than pre-existing group differences.

3.2 Experimental Design and Procedure

This section outlines the comprehensive experimental design and procedure employed in the study to investigate the effectiveness of AI-assisted tools versus traditional methods in enhancing feedback literacy and reflective practice among pre-service English teachers. The quasi-experimental setup, detailed below, was meticulously crafted to ensure rigorous evaluation and comparison of the two distinct feedback methods over a period of six weeks.

Figure 1

Experimental Design Flow Diagram of the Study

[Figure 1 is attached as a separate file]

Note

A distinct feature of this design was the combined theory sessions, which ensured that both groups received identical foundational training in feedback principles, while only varying the tools and methods used for practical application.

As illustrated in Fig. 1, the study engaged 59 participants who were systematically divided into an experimental group (n = 29) and a control group (n = 30). The sequence of activities, from pre-testing through to post-testing, was designed to provide robust data on the impacts of AI integration into educational feedback processes.

Pre-test Measures

Both groups initiated the experiment with comprehensive pre-tests using validated scales designed to measure their competencies in feedback literacy and reflective practices for teaching English as a Foreign Language.

Weekly Combined Theory Sessions

Every week, participants from both experimental and control groups attended theory sessions together in the same sessions to maintain consistent theoretical grounding across the study. These sessions covered feedback provision principles, feedback models, fundamental concepts and strategies for giving effective feedback to written texts.

Differentiated Practice Sessions

Throughout the intervention, both groups provided feedback on the same set of student writing samples to ensure comparability of experience. The writing samples, carefully selected from assignments submitted in the previous year's writing course (see Appendix 1), were chosen to represent various proficiency levels and common error types in EFL writing.

Experimental Group

This group received additional specialized training (1 hour per week throughout the 6-week period) on the use of AI tools for feedback supply, mirroring the subjects presented in the Theory Sessions. For instance, while the second week's Theory Session covered "Hattie & Timperley's feedback model" in a theoretical context, the experimental group engaged in activities using this model to provide feedback with the assistance of AI during their AI-assisted feedback training (for samples see Appendix 2). Following the training, participants applied these AI tools during their practice sessions.

Control Group

In contrast, the control group continued to employ traditional paper-pencil techniques during their practice sessions (see Appendix 3). This approach allowed for a direct comparison to evaluate the added value, if any, of integrating AI into feedback practices. Additionally, to prevent any information exchange between the control group and the experimental group about the AI-assisted training, it was communicated with the control group that the same comprehensive AI-assisted training will be provided to them after the end of the study without any modifications. This promised training was indeed delivered to them following the conclusion of the research as assured.

Post-Test Measures

The intervention period completed with a post-test using the same scales administered at the beginning as pretests. This final measurement was critical in assessing the change in participant competencies and the differential impacts of AI-assisted versus traditional feedback methods.

3.3 Data collection tools

To examine the impact of AI-assisted tools on pre-service English teachers' feedback literacy and reflective practice skills, two validated instruments were administered as pre-test and post-test measures. The data collection tools included the L2 Writing Teacher Feedback Literacy Scale (Lee et al., 2023) and the Teacher Reflective Practice Scale for EFL Teachers (Estaji & Fatalaki, 2023).

L2 Writing Teacher Feedback Literacy Scale. The L2 Writing Teacher Feedback Literacy Scale (FLS), developed by Lee et al. (2023), consists of 34 items across three factors: perceived knowledge (10 items), values (12 items), and perceived skills (12 items). The construct validity of the scale was examined through exploratory factor analysis (n = 223) and confirmatory factor analysis (n = 208). The

CFA results demonstrated good model fit for the three-factor structure ($X^2/df = 1.6$, RMSEA = 0.052, SRMR = 0.063, NNFI = 0.97, CFI = 0.97). The Cronbach's alpha internal consistency coefficients calculated for reliability showed high values for the EFA sample in perceived knowledge (α = 0.91), values (α = 0.86), and perceived skills (α = 0.90) factors. Similarly, high reliability values were obtained for the CFA sample (α = 0.90, α = 0.80, α = 0.90, respectively). The overall Cronbach's alpha value for the entire scale was found to be 0.93 in both analyses (Lee et al., 2023).

Teacher Reflective Practice Scale for EFL Teachers. The Teacher Reflective Practice Scale for EFL Teachers, developed by Estaji and Fatalaki (2023), comprises 33 items distributed across five factors: interpersonal (9 items), intrapersonal (5 items), critical (5 items), behavioral (7 items), and strategic (7 items). The construct validity was examined through exploratory and confirmatory factor analyses. The EFA results revealed that the five-factor structure explained 85% of the total variance. The CFA results demonstrated acceptable fit indices for the five-factor structure (CMIN/DF < 3, GFI > 0.90, CFI > 0.90, TLI > 0.90, RMSEA < 0.08, SRMR < 0.08). The scale's reliability was established with a Cronbach's alpha coefficient of 0.93, and the corrected item-total correlations ranged from 0.30 to 0.70 (Estaji & Fatalaki, 2023).

3.4 Data Analysis

Although Analysis of Covariance (ANCOVA) was initially planned in the research proposal with the aim of determining the direct effect of the experimental treatment on post-test scores by controlling for pre-test differences between the experimental and control groups, this analysis could not be conducted due to violations of ANCOVA assumptions. Specifically, the small sample size in the groups and non-normal distribution of the data necessitated the use of non-parametric methods instead. The normality assumption was tested using the Shapiro-Wilk's test, which confirmed the non-normal distribution of the data. Given these limitations, several non-parametric statistical methods were employed. The Mann-Whitney U test was used to examine differences in subscale scores between study groups. The Wilcoxon signed-rank test was conducted to analyze pre-test and post-test differences within groups. Chi-square analysis was performed to examine differences in group characteristics. The critical decision value was set at 0.05. All analyses were conducted using SPSS version 25.

4. Results

The study explored the impact of AI-supported tools on pre-service English teachers' feedback literacy and reflective practice skills through a quasi-experimental study. The results are organized into five comprehensive analyses: (1) baseline comparisons between control and experimental groups, (2) post-intervention comparisons between groups, (3) within-group analysis of the control group's development, (4) within-group analysis of the experimental group's progress, and (5) comparative analysis of improvement rates between groups. For each analysis, it was examined two major dimensions - teacher feedback literacy (comprising perceived knowledge, values, and perceived skills) and teacher reflective practice (comprising interpersonal, intrapersonal, critical, behavioral, and strategic reflection). Statistical analyses were conducted using Mann-Whitney U tests for between-group comparisons and Wilcoxon

signed-rank tests for within-group analyses, with significance level set at $p < .05$. The findings reveal patterns in the development of both feedback literacy and reflective practice skills across the experimental and control conditions.

Table 2

Pretest Score Comparisons Between Control and Experimental Groups Across Feedback Literacy and Reflective Practice Dimensions

		Groups		p
		Control	Experimental	
		X ± s.s.	X ± s.s.	
Teacher feedback literacy	perceived knowledge	3,10 ± 0,52	3,08 ± 0,49	0,23
	values	3,39 ± 0,39	3,39 ± 0,48	0,58
	perceived skills	3,51 ± 0,44	3,56 ± 0,47	0,67
Teacher reflective practice	interpersonal reflection	3,99 ± 0,55	3,97 ± 0,55	0,58
	intrapersonal reflection	4,11 ± 0,63	4,12 ± 0,6	0,19
	critical reflection	4,29 ± 0,64	4,34 ± 0,6	0,31
	behavioral reflection	3,86 ± 0,55	3,75 ± 0,73	0,36
	strategic reflection	4,06 ± 0,56	4,12 ± 0,77	0,39
**Mann-Whitney U test				

Table 2 presents the pretest scores comparison between the control and experimental groups across two major dimensions: teachers' feedback literacy and teacher reflective practice. Mann-Whitney U tests revealed no statistically significant differences between the groups on any of the measured variables, indicating equivalent baseline levels prior to the intervention. The teacher reflective practice dimension demonstrated similar baseline equivalence across all five subcomponents. The groups showed comparable scores in interpersonal reflection ($M_{control} = 3.99$, $SD_{control} = 0.55$; $M_{exp} = 3.97$, $SD_{exp} = 0.55$; $p = .58$), intrapersonal reflection ($M_{control} = 4.11$, $SD_{control} = 0.63$; $M_{exp} = 4.12$, $SD_{exp} = 0.60$; $p = .19$), critical reflection ($M_{control} = 4.29$, $SD_{control} = 0.64$; $M_{exp} = 4.34$, $SD_{exp} = 0.60$; $p = .31$), behavioral reflection ($M_{control} = 3.86$, $SD_{control} = 0.55$; $M_{exp} = 3.75$, $SD_{exp} = 0.73$; $p = .36$), and strategic reflection ($M_{control} = 4.06$, $SD_{control} = 0.56$; $M_{exp} = 4.12$, $SD_{exp} = 0.77$; $p = .39$). These comprehensive findings demonstrate that both groups started from comparable baseline levels across all measured dimensions and their respective subcomponents. This equivalence in pretest scores strengthens the internal validity of the study and ensures that any post-intervention differences can be more confidently attributed to the experimental treatment rather than pre-existing group differences.

Table 3

Posttest Score Comparisons Between Control and Experimental Groups Across Feedback Literacy and Reflective Practice Dimensions

		Groups		p
		Control	Experimental	
		X ± s.s.	X ± s.s.	
Teacher feedback literacy	perceived knowledge	3,22 ± 0,49	3,65 ± 0,51	0,01*
	values	3,39 ± 0,45	3,81 ± 0,55	0,01*
	perceived skills	3,62 ± 0,43	4,06 ± 0,51	0,01*
Teacher reflective practice	interpersonal reflection	4,17 ± 0,54	4,41 ± 0,46	0,04*
	intrapersonal reflection	4,27 ± 0,6	4,69 ± 0,41	0,01*
	critical reflection	4,32 ± 0,69	4,72 ± 0,49	0,01*
	behavioral reflection	4,03 ± 0,59	4,33 ± 0,54	0,04*
	strategic reflection	4,23 ± 0,53	4,46 ± 0,64	0,03*
**Mann-Whitney U test, *significant at p < 0.05 level				

Table 3 presents the posttest comparison between control and experimental groups across two major dimensions: teachers' feedback literacy, and teacher reflective practice. Mann-Whitney U tests revealed significant differences between the groups across all measured variables ($p < .05$), consistently favoring the experimental group. In the teachers' feedback literacy dimension, the experimental group demonstrated significantly higher scores across all three subcomponents. The most notable improvements were observed in perceived skills ($M_{exp} = 4.06$, $SD_{exp} = 0.51$; $M_{control} = 3.62$, $SD_{control} = 0.43$; $p = .01$), followed by perceived knowledge ($M_{exp} = 3.65$, $SD_{exp} = 0.51$; $M_{control} = 3.22$, $SD_{control} = 0.49$; $p = .01$) and values ($M_{exp} = 3.81$, $SD_{exp} = 0.55$; $M_{control} = 3.39$, $SD_{control} = 0.45$; $p = .01$). These results indicate substantial enhancement in all aspects of feedback literacy following the intervention.

The teacher reflective practice dimension showed similar patterns of improvement across all five subcomponents. The experimental group achieved significantly higher scores in intrapersonal reflection ($M_{exp} = 4.69$, $SD_{exp} = 0.41$; $M_{control} = 4.27$, $SD_{control} = 0.60$; $p = .01$) and critical reflection ($M_{exp} = 4.72$, $SD_{exp} = 0.49$; $M_{control} = 4.32$, $SD_{control} = 0.69$; $p = .01$), demonstrating enhanced deep reflection capabilities. Additionally, significant improvements were observed in interpersonal reflection ($p = .04$), behavioral reflection ($p = .04$), and strategic reflection ($p = .03$), with the experimental group consistently outperforming the control group. These findings are particularly meaningful when considered alongside the pretest results, which showed no significant differences between groups. The consistent pattern of higher scores in the experimental group across all dimensions suggests that the intervention was highly effective in developing teachers' feedback literacy and reflective practices. The comprehensive nature of

these improvements, spanning knowledge, skills, and various forms of reflection, indicates that the intervention successfully addressed multiple facets of teacher professional development.

Table 4
Within-Group Analysis of Control Group's Pre-test and Post-test Scores Across Feedback Literacy and Reflective Practice Dimensions

		Control		p
		Pre-test	Post-test	
		X ± s.s.	X ± s.s.	
Teacher feedback literacy	perceived knowledge	3,10 ± 0,52	3,22 ± 0,49	0,13
	values	3,39 ± 0,39	3,39 ± 0,45	0,90
	perceived skills	3,51 ± 0,44	3,62 ± 0,43	0,35
Teacher reflective practice	interpersonal reflection	3,99 ± 0,55	4,17 ± 0,54	0,22
	intrapersonal reflection	4,11 ± 0,63	4,27 ± 0,6	0,20
	critical reflection	4,29 ± 0,64	4,32 ± 0,69	0,92
	behavioral reflection	3,86 ± 0,55	4,03 ± 0,59	0,19
	strategic reflection	4,06 ± 0,56	4,23 ± 0,53	0,17
**Wilcoxon signed-rank test *p < 0.05 significant difference				

As shown in Table 4, in the teachers' feedback literacy dimension, the control group showed no significant changes between pre-test and post-test measurements across all three components: perceived knowledge (Mpre = 3.10, SDpre = 0.52; Mpost = 3.22, SDpost = 0.49; p = .13), values (remaining stable at M = 3.39; p = .90), and perceived skills (Mpre = 3.51, SDpre = 0.44; Mpost = 3.62, SDpost = 0.43; p = .35). These findings suggest that traditional teaching practices alone did not significantly enhance teachers' feedback literacy. The teacher reflective practice dimension similarly showed no significant changes across its five components. Although slight increases were observed in all areas - interpersonal (p = .22), intrapersonal (p = .20), critical (p = .92), behavioral (p = .19), and strategic reflection (p = .17) - none reached statistical significance. This pattern indicates that standard educational practices did not substantially impact teachers' reflective capabilities in these areas.

Table 5

Within-Group Analysis of Experimental Group's Pre-test and Post-test Scores Across Feedback Literacy and Reflective Practice Dimensions

		Experimental		p
		Pre-test	Post-test	
		X ± s.s.	X ± s.s.	
Teacher feedback literacy	perceived knowledge	3,08 ± 0,49	3,65 ± 0,51	0,01*
	values	3,39 ± 0,48	3,81 ± 0,55	0,01*
	perceived skills	3,56 ± 0,47	4,06 ± 0,51	0,01*
Teacher reflective practice	interpersonal reflection	3,97 ± 0,55	4,41 ± 0,46	0,01*
	intrapersonal reflection	4,12 ± 0,6	4,69 ± 0,41	0,01*
	critical reflection	4,34 ± 0,6	4,72 ± 0,49	0,02*
	behavioral reflection	3,75 ± 0,73	4,33 ± 0,54	0,01*
	strategic reflection	4,12 ± 0,77	4,46 ± 0,64	0,03*
**Wilcoxon signed-rank test *p < 0.05 significant difference				

As shown in Table 5, the teachers' feedback literacy dimension showed substantial improvements across all components. Perceived knowledge increased significantly (Mpre = 3.08, SDpre = 0.49; Mpost = 3.65, SDpost = 0.51; p = .01), as did values (Mpre = 3.39, SDpre = 0.48; Mpost = 3.81, SDpost = 0.55; p = .01) and perceived skills (Mpre = 3.56, SDpre = 0.47; Mpost = 4.06, SDpost = 0.51; p = .01). These comprehensive improvements suggest that the intervention effectively enhanced all aspects of teachers' feedback literacy. In the teacher reflective practice dimension, significant positive changes were observed across all five components: interpersonal (p = .01), intrapersonal (p = .01), critical (p = .02), behavioral (p = .01), and strategic reflection (p = .03). The most notable improvements were seen in intrapersonal reflection (Mpre = 4.12, SDpre = 0.60; Mpost = 4.69, SDpost = 0.41) and behavioral reflection (Mpre = 3.75, SDpre = 0.73; Mpost = 4.33, SDpost = 0.54). These enhancements point to the effectiveness of the interventions, demonstrating their impact in elevating both the theoretical understanding and practical applications of feedback literacy and reflective practice among participants. The results from the experimental group are particularly telling, as they highlight the potential for targeted educational curricula to foster substantial growth in these critical educational skills.

Table 6

Comparative Analysis of Percentage Changes Between Pre-test and Post-test Scores Across Control and Experimental Groups

		Groups		p
		Control	Experimental	
		X ± s.s.	X ± s.s.	
Teacher feedback literacy	perceived knowledge	5,06 ± 13,82	27,87 ± 27,56	0,01*
	values	0,52 ± 9,92	18,88 ± 27,92	0,01*
	perceived skills	3,73 ± 12,13	16,03 ± 20,99	0,01*
Teacher reflective practice	interpersonal reflection	5,93 ± 18,9	10,22 ± 19,49	0,01*
	intrapersonal reflection	5,63 ± 20,49	11,44 ± 18,99	0,04*
	critical reflection	1,21 ± 13,02	8,06 ± 19,2	0,02*
	behavioral reflection	5,49 ± 17,3	18,45 ± 21,33	0,03*
	strategic reflection	5,71 ± 18,09	11,95 ± 26,63	0,04*
**Mann-Whitney U test ***Change rates were calculated as ((post-test - pre-test) / pre-test) × 100				

Table 6 presents a comparative analysis of the percentage changes between pre-test and post-test scores across control and experimental groups, calculated as ((post-test - pre-test)/pre-test × 100). Mann-Whitney U tests revealed significant differences between the groups across all measured dimensions, with $p < .05$, consistently showing superior gains in the experimental group.

In the teachers' feedback literacy dimension, the experimental group demonstrated markedly higher improvement rates across all three components. The most substantial difference was observed in perceived knowledge, where the experimental group showed a 27.87% increase (SDexp = 27.56) compared to the control group's modest 5.06% improvement (SDcontrol = 13.82, $p = .01$). Similarly, the values component showed an 18.88% increase (SDexp = 27.92) in the experimental group versus a minimal 0.52% change (SDcontrol = 9.92, $p = .01$). The perceived skills component demonstrated a 16.03% improvement (SDexp = 20.99) in the experimental group compared to 3.73% (SDcontrol = 12.13, $p = .01$). These substantial differences in improvement rates suggest that the intervention was particularly effective in enhancing teachers' feedback literacy capabilities.

The teacher reflective practice dimension revealed a consistent pattern of higher improvement rates in the experimental group across all five components. The most notable differences were observed in behavioral reflection (experimental: 18.45%, SDexp = 21.33; control: 5.49%, SDcontrol = 17.30, $p = .03$) and strategic reflection (experimental: 11.95%, SDexp = 26.63; control: 5.71%, SDcontrol = 18.09, $p = .04$). The experimental group also showed significantly higher improvement rates in interpersonal reflection

(experimental: 10.22%; control: 5.93%, p = .01), intrapersonal reflection (experimental: 11.44%; control: 5.63%, p = .04), and critical reflection (experimental: 8.06%; control: 1.21%, p = .02).

These comprehensive findings provide strong evidence for the intervention's effectiveness, demonstrating consistently higher improvement rates across all measured dimensions in the experimental group. Furthermore, the consistent pattern of improvements in the experimental group, even in areas where the control group showed minimal or negative change, underscores the comprehensive impact of the intervention on teachers' professional development. These results have important implications for teacher professional development curricula, suggesting that structured interventions can significantly enhance the development of these crucial professional competencies.

5. Discussion

This study aimed to explore the development of AI-assisted feedback literacy and reflective practice skills among pre-service English teachers. By integrating AI tools into feedback processes within a quasi-experimental educational setting, it was investigated whether these tools significantly enhance feedback literacy and reflective practice compared to traditional methods. The findings indicate that both groups had similar baseline scores, showing no significant differences before the intervention. However, post-intervention results revealed that the experimental group (using AI-supported tools) achieved significantly higher gains in all aspects of feedback literacy (perceived knowledge, values, and perceived skills) and reflective practice (interpersonal, intrapersonal, critical, behavioral, and strategic reflection) than the control group (using paper-pencil techniques). While the control group exhibited little to no statistically significant progress, the experimental group demonstrated significant improvements across all measured dimensions, highlighting the effectiveness of AI-assisted feedback in enhancing teacher skills.

The integration of AI-supported tools in teacher education has demonstrated significant potential for enhancing both feedback literacy and reflective practice among pre-service English teachers. The findings reveal a clear advantage of AI-assisted methods over traditional techniques, aligning with recent research in the field. Our results align closely with previous studies emphasizing AI's capacity to deliver personalized, high-quality feedback, thereby enhancing learning outcomes in language education. For instance, the significant improvement observed in our experimental group reflect the findings of Guo et al. (2024), who demonstrated AI-supported peer feedback’s effectiveness in improving both feedback quality and writing proficiency among EFL learners. This consistency strengthens the argument for integrating AI tools into teacher training curricula to encourage feedback literacy. Extending this, our study demonstrates that AI not only enhances feedback literacy, as suggested by Buckingham Shum et al. (2023), but also collaboratively increases reflective practice skills. Furthermore, the improvements in our experimental group are consistent with Shafiee Rad and Roohani (2023), who noted significant gains in writing outcomes and feedback literacy through AI tool usage in second language learning, supporting AI's potential to transform language education. These findings collectively underscore the efficacy of AI in improving feedback practices within teacher education, potentially fostering more adaptive and

effective pedagogical approaches, a concept that aligns with Carless and Winstone's (2023) framework emphasizing integrated design, relational, and pragmatic dimensions of feedback literacy. The observed decrease in instructor workload through automated feedback, as reported by Lee and Moore (2024) regarding Generative AI in higher education, may also contribute to the sustainability of AI-enhanced feedback interventions in teacher education, further supporting the claims of Ning (2024) about AI's role in reshaping education to enhance teaching.

An important aspect to consider when interpreting these findings is the demographic profile of our participants. The relatively small proportion of participants reporting advanced AI experience (13–14%) introduces an important consideration for future research and implementation. This limited representation of advanced AI users suggests that the observed positive outcomes might represent a cautious estimate of the potential impact of AI-assisted feedback systems. As pre-service teachers develop more advanced AI literacy through systematic experience and training, the effectiveness of AI-enhanced feedback mechanisms could potentially increase further. The demographic and competency profile thus not only enriches our interpretation of the current findings but also suggests promising directions for future research examining the relationship between AI literacy development and feedback effectiveness in teacher education contexts.

While the observed improvements are considerable, a detailed analysis necessitates the consideration of alternative interpretations. The "novelty effect," as conceptualized by Iannone and Vondrová (2024), suggests that initial enthusiasm for technological innovations may temporarily enhance performance metrics. However, the sustained and statistically significant improvements documented in the post-intervention phase, when controlled for baseline competencies, indicate that the benefits of AI integration go beyond novelty effects. One compelling interpretation suggests that AI tools effectively provided a form of structured "digital mentorship," paralleling the documented benefits of human tutor support in enhancing reflective practice development, as established in the study by Mauri et al. (2016). This interpretation aligns with Dewey's understanding of experience-based learning (Authors, 2024), where technological tools serve as mediators of meaningful educational experiences. Nevertheless, even when considering for these alternative perspectives, the consistent improvements observed across all measured dimensions in the experimental group provide strong evidence for the efficacy of AI-supported feedback in enhancing both feedback literacy and reflective practice capabilities.

The synthesis of these findings both aligns with and extends current theoretical frameworks, demonstrating that AI tools can serve as effective digital models for reflective practice development, as proposed by Baker (2022), while contributing to the dimension-based approach to reflective practice advancement outlined by Estaji and Fatalaki (2023). The research reveals novel insights regarding AI's potential to enhance reflective practice by offering equitable development opportunities regardless of prior experience levels, a finding particularly significant for encouraging teacher self-efficacy, as supported by some research (Khoshsima et al., 2016; Moradkhani et al., 2017). Looking ahead, teacher education curricula should strategically incorporate AI tools while ensuring comprehensive training protocols, as emphasized by Karimi et al. (2024), and addressing potential implementation challenges to

fully leverage AI's transformative potential in preparing future educators for contemporary classroom complexities. This strategic integration should maintain a balance between technological innovation and fundamental pedagogical principles, ensuring that AI tools enhance rather than replace the essential human elements of teacher development.

The findings of this study reveal significant implications for teacher education and the improving environment of AI integration in educational settings. The experimental group demonstrated significant improvements in feedback literacy and reflective practice capabilities, suggesting that AI-assisted tools hold considerable potential for transforming teacher education. The implementation of AI tools capable of delivering individualized, criterion-referenced feedback appears to systematize reflective practices while promoting deeper professional growth, which aligns with recent empirical evidence presented by Lee and Moore (2024) regarding the benefits of reduced instructor workload and enhanced learning outcomes through generative AI applications.

The study's outcomes particularly highlight the capacity of AI- tools to address varying levels of initial proficiency among pre-service teachers. The comprehensive gains observed across multiple dimensions of feedback literacy and reflective practice indicate that AI-supported methodologies can effectively standardize skill development by providing structured, systematic guidance regardless of teacher candidates' baseline competencies. These findings support the work of Afzaal et al. (2024), who confirmed that explainable AI-driven feedback mechanisms promote self-regulated learning processes and subsequent improvements in academic performance. Such evidence suggests that the strategic integration of AI technologies within teacher education curricula could democratize access to high-quality professional development opportunities, thereby contributing to the advancement of educational equity.

The findings particularly underscore the supplementary nature of AI in augmenting teacher feedback practices, rather than replacing pedagogical approaches. Recent empirical investigations by Guo and Wang (2024) demonstrate that contemporary AI tools can generate comprehensive and targeted feedback that enhances instructional effectiveness. When technology is integrated with teacher modeling, as outlined in Pretorius's (2023) systematic analysis, it enables deeper understanding and application of advanced feedback strategies. This deliberate integration of human expertise with AI-supported systems creates opportunities for teachers to give more attention to advanced instructional methodologies, ensuring that routine feedback processes do not compromise the quality of essential pedagogical interactions.

The implications of these findings extend well beyond the boundaries of language education, suggesting broader applications across diverse educational contexts. The successful implementation of AI-tools in this study indicates significant potential for cross-disciplinary adaptation, a finding that aligns with Coenen and Pfenninger's (2024) research demonstrating significant improvements in personalized feedback delivery within science education contexts. This evidence of cross-disciplinary applicability necessitates a comprehensive reassessment of curriculum design principles and educational policy

frameworks, potentially leading to the development of more responsive and adaptive learning. The integration of AI tools within teacher education curricula represents a promising direction for advancing feedback literacy and reflective practice capabilities. These technological solutions not only support individual teacher development but also contribute to systematic improvements in professional training methodologies. As educational institutions increasingly acknowledge the value of AI-enhanced feedback systems, future research initiatives should examine longitudinal outcomes and investigate the contextual variables that may influence their effectiveness. This investigation thus provides valuable insights into the transformative potential of AI in teacher education, establishing a foundation for more innovative and equitable approaches to professional development.

6. Limitations and Future Directions

While this study provides strong evidence regarding the benefits of AI- tools, it is essential to acknowledge several limitations that contextualize these findings. In particular, the quasi-experimental design—although strong for supporting comparative effectiveness—was implemented within a controlled educational setting. Although such a context facilitates focused intervention and precise measurement, it may not fully capture the multifaceted dynamics inherent in authentic, real-world classroom environments. Consequently, the direct generalizability of these effect sizes to broader, less controlled educational settings should be interpreted with caution. As Park (2023) and Tang et al. (2024) noted, AI-tools, despite their promise, may face challenges in consistently delivering evidence-based responses or in accurately assessing nuanced aspects of complex skills such as critical thinking; these issues warrant further exploration, particularly within the context of reflective practice in ecologically valid classroom environments.

Despite these limitations, our findings strongly demonstrate the potential of AI-supported interventions to significantly enhance feedback literacy and reflective practice skills among pre-service teachers in a structured training environment. The consistency of the results with existing literature reinforces the validity of these observed benefits, suggesting that the effects are genuine rather than merely artifacts of the experimental setting. Nevertheless, addressing the identified limitations opens several opportunities for future research. Firstly, longitudinal studies are imperative to evaluate the continuous impact of AI-assisted feedback literacy development in authentic classroom settings. Future research should investigate the long-term effects on both teacher practices and student learning outcomes. Moreover, qualitative studies exploring teacher and student experiences with AI-augmented feedback processes could offer valuable insights into the mechanisms of AI's influence, thereby informing best pedagogical practices. In addition, research must address potential barriers to widespread AI adoption—as highlighted by Chou et al. (2022)—including teacher efficacy perceptions, limited resources, and varying levels of AI literacy among educators and students. As Celik (2023) and Knoth et al. (2024) emphasize, computational thinking skills and AI literacy are essential for effective AI integration; thus, further investigation is needed to determine optimal strategies for promoting these competencies within teacher education curricula while ensuring equitable access to the necessary technologies across diverse educational contexts. Additionally, it is essential to investigate strategies that reduce

psychological barriers and anxieties associated with AI adoption in educational settings, as suggested by Schiavo et al. (2024). Practically, these findings promote for the strategic integration of AI literacy training and AI-supported tools into teacher education curricula, supported by institutional support and resources (Gupta & Bhaskar, 2020). By addressing these limitations and engaging in the outlined research directions, it can be progresses toward a more comprehensive and equitable integration of AI in teacher education, thereby enhancing the overall quality of teaching and learning in 21st-century classrooms.

7. Conclusion

This study investigated the impact of AI-supported tools on pre-service English teachers' feedback literacy and reflective practice skills, revealing a statistically significant difference in post-intervention outcomes between experimental and control groups. While both groups demonstrated comparable baseline competencies, the experimental group, utilizing AI tools, exhibited superior gains in all dimensions of feedback literacy and reflective practice compared to the control group, which used traditional paper-pencil methods. This finding directly answers the research question, confirming that AI integration significantly enhances these crucial teacher competencies within a structured educational setting. Future research should prioritize longitudinal studies in authentic classroom environments to assess the sustained impact of AI-enhanced feedback. Furthermore, addressing barriers to AI adoption, such as teacher AI literacy and resource constraints, is critical for widespread and equitable implementation. Strategically integrating AI literacy training into teacher education curricula is recommended to fully leverage AI's transformative potential in preparing future educators for the complexities of modern classrooms.

Declarations

Ethical Approval.

This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was granted by the Scientific Research and Publication Ethics Committee at Nevsehir Hacı Bektaş Veli University in Türkiye (Approval No: 2300079774, Date: 19/04/2024). All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Informed consent.

Written informed consent was obtained from all 59 participating pre-service teachers on 21/09/2024 by the researcher via the Google Forms platform prior to their involvement in the study. In the week the experimental intervention commenced (September 21, 2024), participants were verbally informed about the study's purpose, procedures, the voluntary nature of participation, and their right to withdraw at any time without academic consequences. The written consent form, embedded at the beginning of the Google Forms survey instrument, covered participation in the study, data collection procedures, and the

use of anonymized data for research and publication purposes. All participants were assured that their anonymity would be maintained and that individual responses would not be linked to their identities. As this study involved non-interventional survey research alongside the quasi-experimental classroom intervention, participants were fully informed that the research was being conducted to investigate the effects of AI-assisted tools on feedback literacy and reflective practice development, and that there were no foreseeable risks to their participation.

Declaration of generative AI and AI-assisted technologies in the writing process. During the preparation of this research, the authors employed AI tools such as ChatGPT and DeepL for enhancing the fluency of the text, simplifying complex sentences for better clarity, explaining and justifying complicated constructs, and splitting lengthy sentences into shorter ones to ease comprehension. These applications assisted in ensuring the manuscript's readability while maintaining academic rigor. After using these AI tools, the author(s) reviewed and edited the content as necessary, taking full responsibility for the content of the publication. It's crucial to note that all data and findings come from properly cited sources, not AI-generated. The author(s) fully ensure the research's integrity and accuracy.

Competing interests.

The authors declare that they have no competing interests related to this research.

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Author Contribution

Bengü AKSU ATAÇ crafted the introduction and discussion sections, establishing the study's framework, structured the research questions and played a key role in data gathering. Fatih KARATAŞ led the literature review, contributed to the method and results sections, managed the creation and execution of data collection tools, and developed the methodology. Each author has reviewed and approved the final manuscript.

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Data Availability

Data Availability. The datasets generated and analyzed during the current study, including raw and processed survey data, the survey instruments (Teacher Reflective Practice Scale and Foreign Language Writing Teacher Feedback Literacy Scale), coding schemes, variable definitions, and statistical analysis scripts, are available in the repository at the following drive link. Anonymized participant data, data collection protocols, and the intervention materials are included as supplementary files.https://drive.google.com/drive/folders/1Vr6viuxox6L8QDAxBNkFGjsqqJKU_9-Y?usp=sharing

References

1. Afzaal M, Zia A, Nouri J, Fors U (2024) Informative feedback and explainable AI-based recommendations to support students' self-regulation. Technol Knowl Learn 29(1):331–354. https://doi.org/10.1007/s10758-023-09650-0
2. AlGhamdi R (2024) Exploring the impact of ChatGPT-generated feedback on technical writing skills of computing students: A blinded study. Educ Inform Technol. https://doi.org/10.1007/s10639-024-12594-2
3. Baker A (2022) Enhancing teachers' knowledge base of L2 oral communication pedagogy: Reflective practices of an online teacher educator. Engl Australia J 38(2):5–23
4. Baker FS (2014) A pathway to play in early childhood education developed through the explicit modelling of reflective practice in teacher education in Abu Dhabi, UAE. Reflective Pract 15(2):203–217. https://doi.org/10.1080/14623943.2014.883306
5. Benitt N (2019) Campus meets classroom: Video conferencing and reflective practice in language teacher education. Eur J Appl Linguistics TEFL 8(2):121–139
6. Buckingham Shum S, Lim L-A, Boud D, Bearman M, Dawson P (2023) A comparative analysis of the skilled use of automated feedback tools through the lens of teacher feedback literacy. Int J Educational Technol High Educ 20(1):43. https://doi.org/10.1186/s41239-023-00410-9
7. Büyüköztürk Ş (2016) *Deneysel desenler: öntest-sontest kontrol grubu desen ve veri analizi* [Experimental designs: pretest-posttest control group design and data analysis] (5th ed.). Pegem
8. Carless D (2022) From teacher transmission of information to student feedback literacy: Activating the learner role in feedback processes. Act Learn High Educ 23(2):143–153. https://doi.org/10.1177/1469787420945845
9. Carless D, Winstone N (2023) Teacher feedback literacy and its interplay with student feedback literacy. Teach High Educ 28(1):150–163. https://doi.org/10.1080/13562517.2020.1782372

10. Celik I (2023) Exploring the determinants of artificial intelligence (AI) literacy: Digital divide, computational thinking, cognitive absorption. Telematics Inform 83:102026. https://doi.org/10.1016/j.tele.2023.102026
11. Chan CKY, Luo J (2022) Exploring teacher perceptions of different types of 'feedback practices' in higher education: Implications for teacher feedback literacy. Assess Evaluation High Educ 47(1):61–76. https://doi.org/10.1080/02602938.2021.1888074
12. Chen C, Liu AJ (2024) Understanding partnerships in teacher and student feedback literacy: Shared responsibility. Innovations Educ Teach Int 61(1):31–44. https://doi.org/10.1080/14703297.2022.2153722
13. Chien CC, Chan HY, Hou HT (2024) Learning by playing with generative AI: design and evaluation of a role-playing educational game with generative AI as scaffolding for instant feedback interaction. J Res Technol Educ 1–20. https://doi.org/10.1080/15391523.2024.2338085
14. Chien CW (2020) A case study of the use of the Six Thinking Hats to enhance the reflective practice of student teachers in Taiwan. *Education 3–13*, *49*(5), 606–617. https://doi.org/10.1080/03004279.2020.1754875
15. Chou C, Shen T, Shen T, Shen C (2022) The level of perceived efficacy from teachers to access AI-based teaching applications. Res Pract Technol Enhanced Learn 18:021. https://doi.org/10.58459/rptel.2023.18021
16. Coenen C, Pfenninger M (2024) Transforming learning experiences and assessments through AI-empowered cocreation of quality feedback. New Dir Teach Learn. https://doi.org/10.1002/tl.20628
17. Cui Y, Jin H, Gao Y (2023) Developing EFL teachers' feedback literacy for research and publication purposes through intra- and inter-disciplinary collaborations: A multiple-case study. Assess Writ 57. https://doi.org/10.1016/j.asw.2023.100751
18. Cukurova M, Luckin R, Kent C (2020) Impact of an Artificial Intelligence Research Frame on the Perceived Credibility of Educational Research Evidence. Int J Artif Intell Educ 30(2):205–235. https://doi.org/10.1007/s40593-019-00188-w
19. de Kleijn RAM (2021) Supporting student and teacher feedback literacy: An instructional model for student feedback processes. Assess Evaluation High Educ 48(2):186–200. https://doi.org/10.1080/02602938.2021.1967283
20. Estaji M, Fatalaki JA (2023) Development and validation of teacher reflective practice scale for EFL teachers. Reflective Pract 24(4):464–480. https://doi.org/10.1080/14623943.2023.2210068
21. Esteban SG, Laborda JG (2018) Linking technology and reflective practice in primary ELT teacher education. Onomázein 41:78–94. https://doi.org/10.7764/onomazein.41.09
22. Evmenova AS, Regan K, Mergen R, Hrisseh R (2024) Improving writing feedback for struggling writers: Generative AI to the rescue? *TechTrends, 68*(4), 790–802. https://doi.org/10.1007/s11528-024-00965-y
23. Fraenkel J, Wallen N, Hyun H (2022) How to design and evaluate research in education, 11th edn. McGraw-Hill

24. Guo K (2024) EvaluMate: Using AI to support students' feedback provision in peer assessment for writing. *Assessing Writing, 61*. https://doi.org/10.1016/j.asw.2024.100864
25. Guo K, Pan M, Li Y, Lai C (2024) Effects of an AI-supported approach to peer feedback on university EFL students' feedback quality and writing ability. Internet High Educ 63:100962. https://doi.org/10.1016/j.iheduc.2024.100962
26. Gupta K, Bhaskar P (2020) Inhibiting and motivating factors influencing teachers' adoption of AI-based teaching and learning solutions: Prioritization using analytic hierarchy process. J Inform Technol Educ Res 19:693–723. https://doi.org/10.28945/4640
27. Hsia L-H, Hwang G-J, Hwang J-P (2023) AI-facilitated reflective practice in physical education: An auto-assessment and feedback approach. Interact Learn Environ. https://doi.org/10.1080/10494820.2023.2212712
28. Iannone P, Vondrová N (2024) The novelty effect on assessment interventions: A qualitative replication study of oral performance assessment in undergraduate mathematics. Int J Sci Math Educ 22:375–397. https://doi.org/10.1007/s10763-023-10368-9
29. Jara RF, Russell T (2023) Encouraging reflective practice in the teacher education practicum: A dean's early efforts. *Frontiers in Education, 8*. https://doi.org/10.3389/feduc.2023.1040104
30. Jho H, Ha M (2024) Towards effective argumentation: Design and implementation of a generative AI-based evaluation and feedback system. J Baltic Sci Educ 23(2):280–291. https://doi.org/10.33225/jbse/24.23.280
31. Jiang L, Yu S (2021) Understanding changes in EFL teachers' feedback practice during COVID-19: Implications for teacher feedback literacy at a time of crisis. Asia-Pacific Educ Researcher 30(6):509–518. https://doi.org/10.1007/s40299-021-00583-9
32. Karimi F, Fakhri Alamdari E, Ahmadian M (2024) A reflective practice for EFL teacher development in view of teacher educators: Components and process. Engl Teach Learn 48:347–367. https://doi.org/10.1007/s42321-022-00138-1
33. Kazu İY, Kuvvetli M (2024) The role of Duolingo in enhancing language skills: A mixed methods study. https://doi.org/10.6084/m9.figshare.25951315.v1
34. Khoshsima H, Shirnejad A, Farokhipour S, Rezaei J (2016) Investigating the role of experience in reflective practice of Iranian language teachers. J Lang Teach Res 7(6):1224–1230. https://doi.org/10.17507/jltr.0706.22
35. Knoth N, Tolzin A, Janson A, Leimeister JM (2024) AI literacy and its implications for prompt engineering strategies. Computers Education: Artif Intell 6:100225. https://doi.org/10.1016/j.caeai.2024.100225
36. Lee I, Karaca M, Inan S (2023) The development and validation of a scale on L2 writing teacher feedback literacy. *Assessing Writing, 57*. https://doi.org/10.1016/j.asw.2023.100743
37. Lee SS, Moore RL (2024) Harnessing generative AI (GenAI) for automated feedback in higher education: A systematic review. Online Learn J 28(3):82–104. https://doi.org/10.24059/olj.v28i3.4593

38. Li S, Wang Y, Zhao X (2021) Artificial intelligence in education: Improving feedback and reflective learning. Computers Educ 166., Article 104154. https://doi.org/10.1016/j.compedu.2021.104154
39. Li Z, Bonk CJ (2023) Self-directed language learning with Duolingo in an out-of-class context. *Computer Assisted Language Learning*. Advance online publication. https://doi.org/10.1080/09588221.2023.2206874
40. Liu S, Yuan R, Wang K (2024) Explicit teaching of reflective practice (RP) in pre-service teacher education: Probing the immediate and long-term influence. Teachers Teach. https://doi.org/10.1080/13540602.2024.2383363
41. Luckin R, Holmes W, Griffiths M, Forcier LB (2018) Artificial intelligence and future learning. UCL Institute of Education
42. Mauri T, Clarà M, Colomina R, Onrubia J (2016) Educational assistance to improve reflective practice among student teachers. Electron J Res Educational Psychol 14(2):287–309. https://doi.org/10.25115/EJREP.39.15070
43. Menon D, Azam S (2021) Investigating preservice teachers' science teaching self-efficacy: An analysis of reflective practices. Int J Sci Math Educ 19(8):1587–1607. https://doi.org/10.1007/s10763-020-10131-4
44. Mishra P, Warr M, Islam R (2023) TPACK in the age of ChatGPT and Generative AI. J Digit Learn Teacher Educ 39(4):235–251. https://doi.org/10.1080/21532974.2023.2247480
45. Moradkhani S, Raygan A, Moein MS (2017) Iranian EFL teachers' reflective practices and self-efficacy: Exploring possible relationships. System 65:1–14. https://doi.org/10.1016/j.system.2016.12.011
46. Nasrul V, Fatimah S (2023) The effect of using Duolingo application on students' English learning motivation and vocabulary enrichment: An experimental research at SMKN 1 Padang. J Engl Lang Teach 12(3):933–954
47. Ning Y (2024) Teachers' AI-TPACK: Exploring the relationship between knowledge elements. Sustainability 16(3):978. https://doi.org/10.3390/su16030978
48. Novillo P, Pujolà JT (2019) Analysing e-tutoring strategies to foster pre-service language teachers' reflective practice in the first stages of building an e-portfolio. Univers J Educational Res 7(5):1234–1246. https://doi.org/10.13189/ujer.2019.070509
49. Park J (2023) Medical students' patterns of using ChatGPT as a feedback tool and perceptions of ChatGPT in a Leadership and Communication course in Korea: A cross-sectional study. J Educational Evaluation Health Professions 20:29. https://doi.org/10.3352/jeehp.2023.20.29
50. Pishtari G, Sarmiento-Márquez E, Rodríguez-Triana MJ, Wagner M, Ley T (2024) Mirror mirror on the wall, what is missing in my pedagogical goals? The Impact of an AI-Driven Feedback System on the Quality of Teacher-Created Learning Designs. *Proceedings of the 14th Learning Analytics and Knowledge Conference*, 145–156. https://doi.org/10.1145/3636555.3636862
51. Pretorius L (2023) Fostering AI literacy: A teaching practice reflection. *Journal of Academic Language and Learning*, *17*(1), T1-T8. Retrieved from

https://journal.aall.org.au/index.php/jall/article/view/891

52. Rashid MP, Gehringer E, Khosravi H (2024) Navigating (Dis)agreement: AI Assistance to Uncover Peer Feedback Discrepancies. *Proceedings of the 14th Learning Analytics and Knowledge Conference*, 907–914. https://doi.org/10.1145/3636555.3636931
53. Schiavo G, Businaro S, Zancanaro M (2024) Comprehension, apprehension, and acceptance: Understanding the influence of literacy and anxiety on acceptance of artificial intelligence. Technol Soc 77:102537. https://doi.org/10.1016/j.techsoc.2024.102537
54. Schluer J (2022) Pre-service teachers' perceptions of their digital feedback literacy development before and during the pandemic. Int J TESOL Stud 4(3):15–32. https://doi.org/10.46451/ijts.2022.03.03
55. Shafiee Rad H, Roohani A (2024) Fostering L2 Learners' Pronunciation and Motivation via Affordances of Artificial Intelligence. Computers Schools 1–22. https://doi.org/10.1080/07380569.2024.2330427
56. Singh E, Vasishta P, Singla A (2025) AI-enhanced education: exploring the impact of AI literacy on generation Z's academic performance in Northern India. Qual Assur Educ 33(2):185–202. https://doi.org/10.1108/qae-02-2024-0037
57. Steiss J, Tate T, Graham S, Cruz J, Hebert M, Wang J, Moon Y, Tseng W, Warschauer M, Olson CB (2024) Comparing the quality of human and ChatGPT feedback of students' writing. Learn Instruction 91. https://doi.org/10.1016/j.learninstruc.2024.101894
58. Sunra L, Haryanto H, Nur S (2020) Teachers' reflective practice and challenges in an Indonesian EFL secondary school classroom. Int J Lang Educ 4(2):289–300. https://doi.org/10.26858/ijole.v4i2.13893
59. Tam ACF (2024) Interacting with ChatGPT for internal feedback and factors affecting feedback quality. Assess Evaluation High Educ 50(2):219–235. https://doi.org/10.1080/02602938.2024.2374485
60. Tang T, Sha J, Zhao Y, Wang S, Wang Z, Shen S (2024) Unveiling the efficacy of ChatGPT in evaluating critical thinking skills through peer feedback analysis: Leveraging existing classification criteria. Think Skills Creativity 53:101607. https://doi.org/10.1016/j.tsc.2024.101607
61. Tzirides AO, Zapata G, Kastania NP, Saini AK, Castro V, Ismael SA, You Y, dos, Santos TA, Searsmith D, O'Brien C, Cope B, Kalantzis M (2024) Combining human and artificial intelligence for enhanced AI literacy in higher education. *Computers and Education Open, 6*. https://doi.org/10.1016/j.caeo.2024.100184
62. Venter J, Coetzee SA, Schmulian A (2024) Exploring the use of artificial intelligence (AI) in the delivery of effective feedback. Assess Evaluation High Educ 1–21. https://doi.org/10.1080/02602938.2024.2415649
63. Villagran I, Hernandez R, Schuit G, Neyem A, Fuentes-Cimma J, Miranda C, Hilliger I, Duran V, Escalona G, Varas J (2024) Implementing artificial intelligence in physiotherapy education: A case

study on the use of large language models (LLM) to enhance feedback. IEEE Trans Learn Technol 1–12. https://doi.org/10.1109/TLT.2024.3450210

64. Wang Y, Derakhshan A, Pan Z, Ghiasvand F (2023) Chinese EFL teachers' writing assessment feedback literacy: A scale development and validation study. *Assessing Writing, 56*. https://doi.org/10.1016/j.asw.2023.100726
65. Yang H, Gao C, Shen H-Z (2024) Learner interaction with, and response to, AI-programmed automated writing evaluation feedback in EFL writing: An exploratory study. Educ Inform Technol 29(4):3837–3858. https://doi.org/10.1007/s10639-023-11991-3
66. Zhan Y (2024) Feedback literacy of teacher candidates: Roles of assessment course learning experience and motivations for becoming a teacher. Asia-Pacific Educ Researcher 33(5):1117–1127. https://doi.org/10.1007/s40299-023-00779-1
67. Zhan Y, Yan Z (2025) Students' engagement with ChatGPT feedback: implications for student feedback literacy in the context of generative artificial intelligence. Assess Evaluation High Educ 1–14. https://doi.org/10.1080/02602938.2025.2471821
68. Zhang J, Zhang Z (2024) AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. J Comput Assist Learn 40(4):1871–1885. https://doi.org/10.1111/jcal.12988

Figures

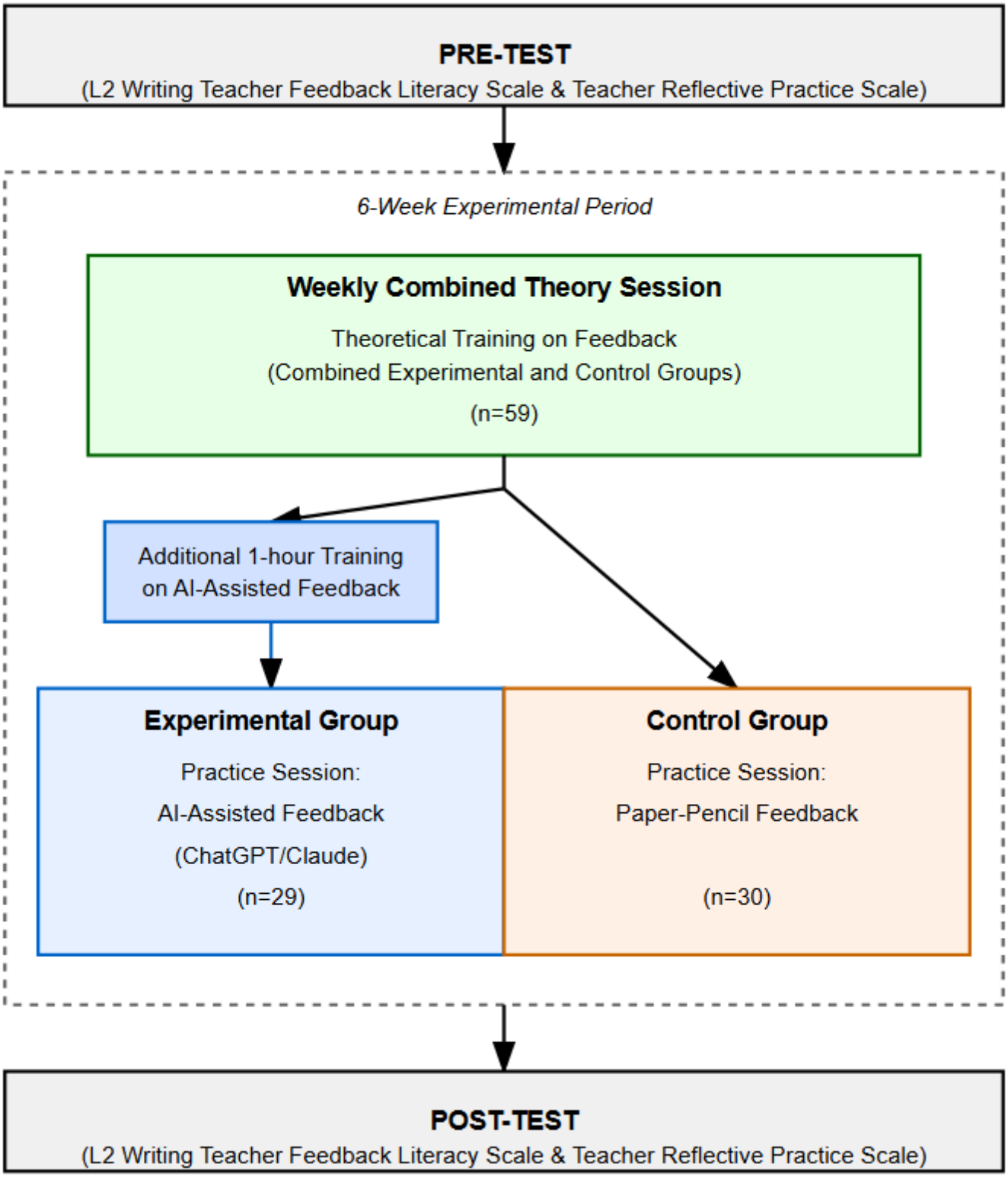


Figure 1

Experimental Design Flow Diagram of the Study

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