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Impact of Collaborative Document Editing and Pluralsight on Digital and Writing Teaching Literacy among In-Service English Language Teachers

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Abstract

As digital technologies reshape education, integrating collaborative editing with professional development holds transformative potential for English as a Foreign Language (EFL) instruction in Saudi Arabia. To address this shift, this study focuses on enhancing digital literacy, defined as teachers' ability to integrate technology into teaching effectively, and writing pedagogy in Saudi EFL classrooms, where well-planned training and effective tool use are crucial for aligning with Vision 2030. However, the combined impact of collaborative tools, such as Google Docs, and professional development on in-service EFL teachers remains underexplored in Saudi Arabia's unique context. To fill this gap, this study examines the effects of Google Docs and Pluralsight on the digital literacy, scaffolding practices, and writing outcomes (accuracy, complexity, and cohesion) of 60 teachers, guided by the Technological Pedagogical Content Knowledge framework (TPACK), which emphasizes the synergy between technology, pedagogy, and content. Using stratified purposive sampling to achieve balanced representation, teachers were divided into three groups: collaborative editing, professional development, or both, to compare the effects. Researcher-developed tools, including the Digital Teaching Literacy Assessment, Collaborative Writing Interaction Protocol, and student writing rubric, assessed outcomes. The combined intervention group achieved 85% digital literacy proficiency and a 35.5% scaffolding rate, which significantly improved student writing; however, initial digital literacy levels of teachers may have influenced the results. Findings extend TPACK and support Vision 2030. Recommendations include prioritizing TPACK in training and integrating tools like Pluralsight. Despite contextual limits, the study is replicable; future research should explore broader samples and alternative platforms.

Keywords: Collaborative Editing, Digital Literacy, In-Service Teacher Training, Pluralsight, Writing Pedagogy.

Introduction

In an era where global connectivity drives educational transformation, Saudi Arabia's allocation of USD 50.4 billion (SAR 189 billion) to education in 2023, representing 17% of its national budget, signals a robust commitment to modernizing education through technology as part of Vision 2030 (1). However, the UNESCO Global Education Monitoring Report 2023 cautions that providing technology alone does not ensure improved educational outcomes without adequate teacher training (2). This problem is particularly evident in English as a Foreign Language (EFL) writing instruction, a complex process requiring scaffolded teaching of linguistic accuracy (correct use of grammar and vocabulary), syntactic complexity (varied sentence structures), and discourse cohesion (logical flow and organization of ideas) (3, 4). The gap between substantial technological investment and effective pedagogical implementation in Saudi Arabia highlights the urgent need for innovative approaches to enhance EFL writing instruction. Digital technologies are reshaping education by offering tools that enhance teaching and learning. Google Docs, a collaborative online platform, enables real-time editing, peer feedback, and revision tracking, fostering student engagement and improving writing quality in EFL settings (5, 6). Studies have shown that Google Docs supports the development of meaningful content and frequent revisions through collaborative interactions, enhancing linguistic accuracy and syntactic complexity (7). By facilitating student-centered learning, such platforms revolutionize how educators deliver

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writing instruction, promoting deep engagement and understanding. However, their effectiveness depends on teachers' digital literacy, defined as the ability to integrate technology effectively into pedagogical practice, highlighting the need for targeted training to maximize their potential (8). The integration of collaborative editing tools with professional development offers a transformative opportunity for EFL instruction. Google Docs facilitates collaborative learning, but its success relies on teachers' ability to implement scaffolding practices — structured instructional strategies that guide students toward independent mastery of writing skills (8). Platforms like Pluralsight, an online learning system offering structured courses on educational technology, can enhance teachers' digital literacy and pedagogical skills (9–11). Research indicates that combining collaborative tools with professional development can improve instructional methods and student outcomes; however, this synergy remains underexplored in EFL contexts (12–14). By equipping teachers with the skills to use Google Docs pedagogically, this approach fosters meaningful revisions, moving beyond superficial corrections to address coherence and complexity in student writing (15).

Western researchers have extensively documented the benefits of collaborative tools in education. Studies demonstrate that Google Docs enhances peer feedback and writing quality, with significant improvements in linguistic accuracy and syntactic complexity (10). However, these studies often focus on student outcomes in Western contexts, overlooking the unique cultural and infrastructural challenges of non-Western settings, such as Saudi Arabia, where teacher-centered pedagogies dominate (16, 17). This gap limits the applicability of Western findings to diverse educational contexts, necessitating research that addresses culturally specific barriers to technology integration in EFL instruction (18–20).

Arab researchers, particularly in Saudi Arabia, have explored educational technologies, but comprehensive studies on collaborative tools for EFL writing are scarce. Research highlights Google Docs as a motivating tool that enhances peer interaction and writing engagement among Saudi university students (21). Quasi-experimental study further confirmed that collaborative writing on Google Docs outperforms individual writing in producing high-quality descriptive paragraphs (7). However, these studies often lack focus on teacher mediation or the broader impact on writing outcomes, underscoring a critical gap in understanding how collaborative tools can be effectively integrated in Arab EFL contexts (11). This study addresses this gap by examining teacher-mediated use of Google Docs in Saudi classrooms.

In Saudi Arabia, integrating digital technologies into education presents significant challenges, despite the country's substantial resources. EFL teachers often lack subject-specific digital training, with professional development programs failing to address the pedagogical needs of writing instruction (22, 23). The institutional emphasis on exam preparation, combined with a traditionally teacher-centered, textbook-based instruction culture, further hinders the adoption of student-centered, technology-enhanced approaches (24). Surveys reveal that while teachers recognize the value of digital tools, their limited digital literacy leads to underutilization or superficial application, resulting in student revisions that focus on surface-level corrections rather than deeper improvements in coherence and complexity (25,26). These barriers highlight the need for targeted interventions to enhance teacher preparedness and classroom practices.

The combined impact of collaborative tools, such as Google Docs, and professional development platforms, like Pluralsight, on in-service EFL teachers remains underexplored in Saudi Arabia's unique cultural and infrastructural context. While studies have separately examined the benefits of collaborative platforms and professional development, few have investigated their integrated effect on teachers' digital teaching literacy and scaffolding practices (19). This gap is particularly critical in Saudi Arabia, where digital transformation is a national priority; yet, teachers require targeted training to overcome contextual barriers (7,8). This study examines how these interventions collaborate to enhance EFL writing instruction, providing new insights into fostering effective teaching practices in a culturally specific context.

Well-planned training and effective use of digital tools are essential for aligning educational practices with Saudi Arabia's Vision 2030, which prioritizes digital transformation and English

proficiency to prepare students for a knowledge-based economy (17, 22). The National Transformation Program (NTP) emphasizes modernizing curricula and up skilling educators to leverage technology effectively (22). By investing in teacher development through platforms like Pluralsight, Saudi Arabia can equip educators to meet the demands of a digital landscape, ensuring that EFL instruction supports Vision 2030's goal of preparing a globally competitive workforce. This alignment underscores the importance of integrating collaborative tools and professional development to achieve educational reform.

This study is grounded in the Technological Pedagogical Content Knowledge (TPACK) framework, which posits that effective technology integration requires a dynamic interplay of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) (23,27). TPACK guides the investigation by framing how Google Docs (TK) and Pluralsight training (PK) enhance teachers' ability to scaffold writing tasks (CK), targeting linguistic accuracy, syntactic complexity, and discourse cohesion. By emphasizing the connection between these knowledge domains, TPACK ensures that technological interventions are both pedagogically sound and contextually relevant, particularly in Saudi Arabia's EFL context, where teachers must balance language instruction with the integration of digital tools (14). This framework provides a robust theoretical foundation for assessing the impact of these interventions on teachers' digital literacy and classroom practices, as well as on student writing outcomes.

This study focuses on enhancing digital literacy and writing pedagogy in Saudi EFL classrooms by examining the effects of Google Docs and Pluralsight on teachers' instructional practices and students' writing outcomes. It poses the following objectives and research questions:

This study's objective is to investigate how integrating collaborative editing tools (Google Docs) with targeted professional development (Pluralsight) influences Saudi EFL teachers' digital literacy, scaffolding practices, and student writing outcomes. Specifically, it examines (a) the impact of collaborative editing on students' linguistic accuracy, syntactic complexity, and cohesion; (b) the effect of Pluralsight training on teachers' pedagogical strategies; and (c) the comparative advantage of combining both interventions. Together, these objectives align the study with Saudi Arabia's Vision 2030 digital transformation goals.

It is hypothesized that combining Google Docs and Pluralsight training will yield the most significant improvements in teachers' digital literacy and scaffolding practices, as well as students' writing outcomes, surpassing the effects of either intervention alone. The study's significance lies in its integrative approach, bridging technology adoption and pedagogical innovation to align with Vision 2030's educational goals (22). Its novelty stems from using Pluralsight, traditionally an IT training platform, for language teacher education, offering a scalable model for professional development (9). By examining these interventions in a culturally specific EFL context, the study addresses a critical research gap, providing insights applicable to Saudi Arabia and similar settings.

The findings are expected to inform educational policy and institutional practice by identifying actionable strategies such as prioritizing TPACK-aligned professional development in teacher training programs, embedding collaborative digital writing tools into the curriculum, and revising ICT integration benchmarks in teacher appraisal systems. For example, teacher training institutes may implement certification modules based on the Digital Teaching Literacy Assessment (DTLA) developed in this study. At the same time, school leadership can utilize the Collaborative Writing Interaction Protocol (CWIP) as a classroom observation tool to monitor the quality of scaffolding.

Theoretically, the study refines and contextualizes the TPACK framework by demonstrating how specific combinations of technological tools and professional development influence classroom-level outcomes in a non-Western EFL setting (28). These context-specific insights advance global scholarship on teacher digital readiness by foregrounding local educational priorities, such as alignment with Saudi Vision 2030.

Methodology

This study employed convergent mixed-methods, quasi-experimental design with stratified random allocation to evaluate the combined impact of collaborative document editing and Pluralsight-

based training on the digital literacy and writing instruction of in-service Saudi English language teachers. Sixty participants were stratified by teaching experience (0–5, 6–10, ≥11 years) and randomly allocated to three parallel intervention groups (A, B, C; n = 20 each), ensuring baseline comparability across conditions (29). Data collection integrated quantitative strands, the Digital Teaching Literacy Assessment (DTLA; Cronbach's α = 0.89), a validated writing rubric, and classroom observation via the Collaborative Writing Interaction Protocol (CWIP) with qualitative strands (semi-structured interviews and classroom field notes). This convergent design enabled a robust examination of how collaborative editing and professional development influenced teachers' digital literacy, scaffolding practices, and student writing outcomes within Saudi Arabia's Vision 2030 context.

Participants and Sampling

We enrolled 60 in-service Saudi English teachers from secondary schools and universities in the southern region of Saudi Arabia. Teachers were stratified by teaching experience (0–5, 6–10, ≥11 years) and then randomly allocated to three parallel groups (A, B, C; n = 20 each) to enhance baseline balance and comparability across intervention conditions (29,30). Each teacher taught writing classes of approximately 25 students and contributed five randomly sampled, anonymized student essays at pre- and post-intervention, yielding approximately 300–400 unique students indirectly represented; these artifacts served as proxies for instructional impact within an ethical, de-identified workflow (31,32). Random sampling of essays and anonymized scoring (with standardized criteria) were used to reduce selection and rater bias and to improve representativeness of writing ability distributions (33–35). The target sample size of 60 was set a priori to achieve ~0.80 power to detect medium effects under practical field constraints and with allowance for potential attrition, supporting robust between-group comparisons while maintaining logistical feasibility and internal validity (36–38). Exclusion criteria included part-time or visiting appointments; not teaching Foundation-Year academic writing during the study term; prior enrollment in a similar technology-PD trial within the past six months; lack of institutional access to the LMS/Pluralsight platform; inability to complete study activities/assessments; or declined consent (39–41).

Group Design and Interventions

Participants were divided into three experimental groups, structured to isolate the effects of tool usage and professional development. Group A used Google Docs without additional professional development (PD). Teachers attended a two-hour hands-on orientation covering document creation, permission settings, version history, and inline commenting. Students engaged in co-authoring essays, iterative peer review, and used suggestion mode to develop collaborative writing skills. Group B completed a tailored Pluralsight training track over eight weeks (~2 hours/week). The training included modules specifically selected for English writing instruction, such as digital pedagogy strategies, virtual classroom engagement, and writing assessment. Teachers continued to use their traditional classroom methods without integrating additional tools. Group C received both interventions. They completed the Pluralsight training path and simultaneously implemented collaborative writing through Google Docs. This factorial-style 3-group design enabled a comparative analysis of the standalone and combined intervention effects on pedagogical practice and student writing outcomes.

Implementation and logistics

Interventions lasted eight weeks. Pre-tests and baseline writing samples were collected in Week 0. Post-tests, new writing samples, observations, and interviews were conducted in Week 9. Fidelity was maintained through weekly check-ins, observer calibration, and standardized protocols. Schools provided access to devices and laboratories.

Challenges and Handling: (i) Intermittent bandwidth**,** materials pre-downloaded; offline packets/USB copies prepared; mobile hotspots deployed; (ii) Timetable clashes during exam periods, make-up sessions scheduled within a 7-day window; asynchronous modules enabled; (iii) Limited laboratory availability, rotating lab schedule implemented; BYOD with proctored seating used; small-group stations organized; (iv) Short-term staff absences, co-facilitator coverage assigned; session recordings and written summaries distributed; (v) LMS access delays, parallel manual tracking via secure forms/spreadsheets used; batch account creation

executed; materials distributed by email until activation. All deviations were time-stamped in an audit log, and schedules were staggered across arms to reduce cross-group spillover. The following sections delineate the distinct procedures used for quantitative and qualitative Analysis.

Outcome Measures and Instrumentation

Digital Teaching Literacy Assessment (DTLA)

Teacher digital literacy was evaluated using the DTLA, a structured instrument adapted from a validated TPACK framework. It's combined Likert-scale items and scenario-based performance tasks to measure teachers' abilities to integrate digital tools in instruction. The assessment was administered before and after the 8-week intervention, and scores (ranging from 0 to 100) quantified changes in digital literacy. The DTLA demonstrated strong internal consistency (Cronbach's $\alpha = 0.89$) and was administered either online or in print, depending on participant access. The DTLA was adapted for the study context via author review for linguistic/cultural appropriateness, expert panel appraisal (n=2 experts; 4-point relevance/clarity ratings), content validity indexing (I-CVI, S-CVI/Ave, modified kappa k*), and cognitive interviews (n= six instructors) to confirm interpretation. Items with I-CVI < 0.78 (for 6–10 experts) were revised/removed using k* as an additional decision aid. A pilot test (n = 6) was conducted to assess timing, distributional properties, and reliability.

Student Writing Performance Rubric

To measure instructional impact, a stratified subsample of five anonymized pre- and post-intervention essays per teacher was drawn for scoring, totaling 288 essays. This approach balanced feasibility with representativeness while maintaining consistency across teachers. These were evaluated for linguistic accuracy, textual cohesion, and syntactic complexity using a validated 5-point analytic rubric. Two experienced EFL raters, blinded to group assignments, scored the samples independently. Inter-rater reliability was robust (Pearson's $r > 0.90$; Cohen's $\kappa > 0.85$). The averages of both raters' scores per criterion were used in the quantitative Analysis.

Collaborative Writing Interaction Protocol (CWIP)

Classroom observation data were collected by the authors (well-trained and experienced observers) using the CWIP, a structured tool explicitly developed for this study to document instructional behaviors related to collaborative writing. Each teacher was observed once during the intervention. Observers recorded scaffolding methods, student-peer interactions, technology integration, and teacher feedback strategies. The CWIP was pilot-tested and reviewed by three domain experts, with inter-rater agreement exceeding 85%.

Semi-structured interviews were conducted with all 60 participating teachers following the intervention. Each session lasted 30–45 minutes and probed teachers' experiences with the intervention, changes in instructional strategies, confidence with digital tools, and projected sustainability of new practices. Interviews were transcribed and thematically analyzed, contributing to methodological triangulation.

This multi-instrument approach, combining the DTLA, writing rubric, CWIP, and interviews, ensured comprehensive outcome capture across cognitive, behavioral, and attitudinal domains. Triangulation of these sources strengthened construct validity and reduced the likelihood of bias due to reliance on any single method.

Data Analysis Overview

This research employed both quantitative and qualitative analysis within a convergent mixed-methods framework. The quantitative component emphasized the consideration of the set objectives; regarding the consequential shifts in teachers' digital literacy and students' writing proficiency; the qualitative component aimed to analyze instructional behaviors and their corresponding perceptions. The qualitative surveys, performance evaluations, writing rubrics, interviews, and observations enable the study to achieve methodological triangulation, thereby enhancing its validity.

Quantitative Analysis

Employed a structured inferential approach. One-way Analysis of Variance (ANOVA) was conducted on pre-test scores to verify group equivalence before the intervention. Within group improve-

-ments in digital literacy and writing performance were assessed through paired-sample t-tests. To compare post-test outcomes while controlling for pre-intervention variation, Analysis of Covariance (ANCOVA) was performed using pre-test scores as covariates.

Effect sizes were calculated using Cohen's d for within-group changes and partial eta squared (η^2) for between-group comparisons via ANCOVA. All tests were conducted using the Statistical Package for the Social Sciences (SPSS, version 28) (34) with an α level of 0.05.

To ensure instrument reliability and validity, the DTLA and the analytic writing rubric underwent pilot testing. The DTLA reported strong internal consistency (Cronbach's α = 0.89), and the rubric showed high inter-rater reliability (Cohen's κ > 0.85). Data integration was achieved through convergent Analysis of quantitative test scores, qualitative interview transcripts, and observational data from CWIP. This triangulation strategy enhanced the robustness and credibility of the study's findings.

To support the validity of parametric analyses, we tested key assumptions before inference. Normality of residuals was examined using the Shapiro–Wilk test applied to pre- and post-intervention model residuals across groups; all tests were non-significant ($p > .05$), justifying the use of parametric procedures and the choice of the Shapiro–Wilk test for small to moderate samples. Homogeneity of variances was assessed with Levene's test across the three groups; results were non-significant (**p** > .05) for both DTLA and student-writing outcomes, indicating equal variances and consistent with recommended practice for educational interventions. ANCOVA assumptions were evaluated by inspecting the linear relationship between the covariate (pre-test) and the dependent variable (post-test), as well as by testing covariate × group interactions. No significant interactions were observed, supporting the homogeneity of regression slopes and compliance with ANCOVA diagnostics (42). All analyses were conducted in **SPSS v28** with **α = .05**. Quantitative analysis was complemented by qualitative data, which were thematically analyzed using Qualitative Data Analysis Software (NVivo 14). Two researchers independently coded 20% of the interview transcripts, achieving inter-coder reliability (Cohen's κ > 0.85). Emergent themes were identified through both a priori and inductive coding. Key themes and representative examples are presented below:

Table 1: Teacher Interview Themes, Descriptions, and Representative Excerpts

Theme	Description	Representative Excerpt
Scaffolding	Instructional support strategies used to guide student writing	"I started giving them prompts and hints in Docs."
Collaboration	Peer interaction and group composition for co-authoring tasks	"They loved editing each other's drafts."
Tool Integration	Application of Google Docs features in instructional practice	"I used suggestion mode to give real-time feedback."
Teacher Confidence	Reported increases in digital comfort and pedagogical efficacy	"Now I feel confident trying new digital tools."

Table 1 summarizes the key themes from teacher interviews, including scaffolding, collaboration, tool integration, and teacher confidence. These themes were triangulated with CWIP observational data, DTLA scores, and Pluralsight engagement logs to strengthen interpretive validity and ensure data integration across sources.

Ethics and Validity

IRB approval was secured (Umm Al-Qura University; IRB/25/034, March 16, 2025). All teachers provided written informed consent. Student data were anonymized. After completing their study, Group A received access to Pluralsight for equity. Bias mitigation included blinded scoring, pilot testing, and uniform interaction among researchers.

Limitations, Generalizability, and Instrument Validity

This study was conducted in the context of Saudi Arabia's EFL higher education, which may limit its generalizability to other national settings. While the 8-week duration enabled focused implementation, its constrained assessment of long-term instructional impact. Students were not directly tracked; instead, their essays served as

proxies, which may limit precision in individual-level inference. The CWIP observation tool, although validated internally, needs external validation for broader use. Some self-reported teacher responses may be subject to bias, although triangulated with observed behavior and performance outcomes. Institutional factors such as digital access varied, potentially influencing intervention consistency. Nonetheless, the integration of qualitative and quantitative strands, use of validated and reliable instruments (e.g., DTLA, CWIP, interview guide), and rigorous randomization and stratification strategies all bolster the study's credibility. Data triangulation across interviews, classroom observations, and student outcomes strengthened the reliability and internal validity of the findings. While generalization to vastly different contexts should be cautious, the use of scalable, accessible tools such as Google Docs and Pluralsight suggests relevance to broader educational systems seeking to integrate digital writing instruction.

Results

With the study design and instruments established, the following section presents key findings that offer critical insight into how different combinations of digital tools and professional development shaped teacher competencies and instructional outcomes. These results not only highlight measurable shifts in digital literacy and classroom practice but also provide empirical grounding for scalable interventions in EFL writing instruction.

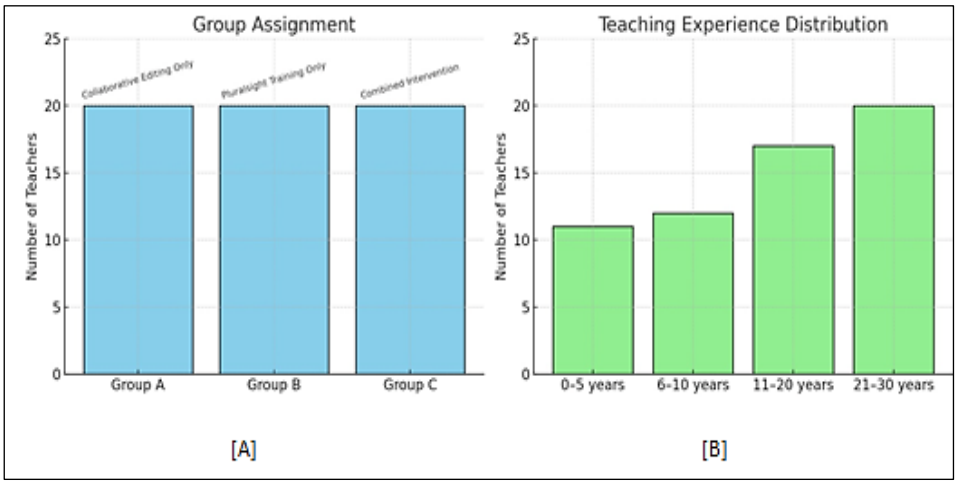

Figure 1: Participant Demographics across Groups and Experience Levels. Panel A shows Group Assignment (left), and Panel B shows Teaching Experience Distribution (right). (Note: Y-axis = Number of Teachers; X-axis = Teaching Experience Categories; Groups A–C represent Intervention Conditions)

Teacher Digital Literacy Outcomes

Figure 1 displays the participant demographics by intervention group and teaching experience level. Group C (Combined Intervention) included 17 teachers rated "Proficient" and three rated "Developing." Group B (Pluralsight Only) had 17 teachers in the "Developing" range and 3 in the "Proficient" category. Group A (Editing Only) consisted of 17 teachers rated "Developing" and three rated "Novice." No "Advanced" scores were recorded. This indicates that while all groups had foundational digital competence, only the Combined Intervention group achieved a high proportion of upper-range proficiency.

Further Analysis of individual DTLA items revealed meaningful trends. Figure 2 shows item-level average scores for the 20 Likert-based questions from Instrument 1. Group C scored consistently higher across all items, particularly those targeting integration of scaffolding and digital tools in writing instruction (e.g., Q5: "Use revision history to assess student writing development," Q13: "Guide students in using cohesive devices," Q15: "Apply professional development to classroom technology use"). Groups A and B demonstrated relatively stronger performance on foundational items, such as tool access (Q1), commenting (Q2), and hyperlinking resources (Q6), but showed weaker performance on advanced pedagogical applications. This suggests that while basic familiarity with digital tools was every day, deeper pedagogical integration was less frequent outside the Combined Intervention group.

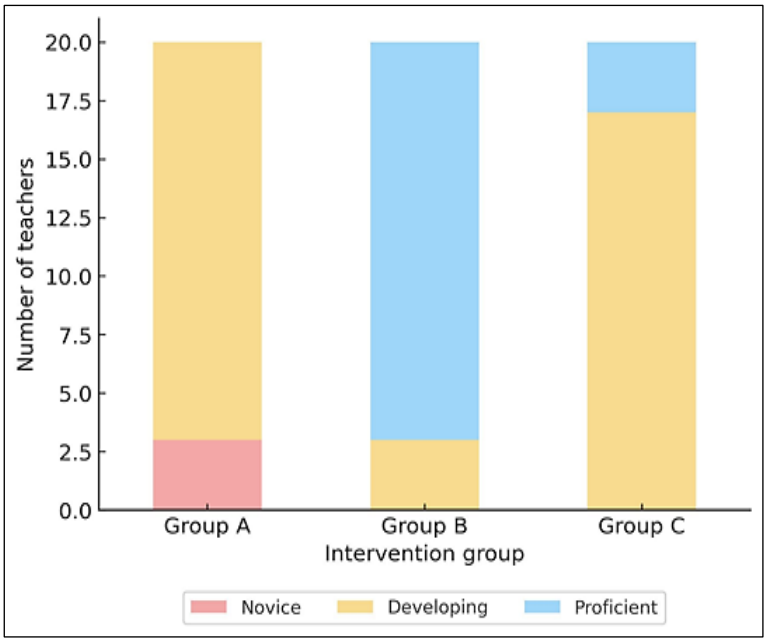

Figure 2: DTLA Proficiency Levels by Intervention Group

Figure 2 shows the average proficiency across 20 Likert-based digital teaching items for each intervention group. (Note: Y-axis = Mean Score on DTLA items; X-axis = Item Numbers 1–20; Groups A–C represent intervention conditions)

Figure 2 illustrates group-wise DTLA proficiency levels across the 20 Likert items, showing how each intervention group scored on key aspects of digital teaching literacy. Scores reflect averages per item; Group C shows the highest across advanced items. It highlights the consistently higher scores of the combined-intervention group on advanced pedagogical and scaffolding items compared with the other two groups, demonstrating the added value of integrated training.

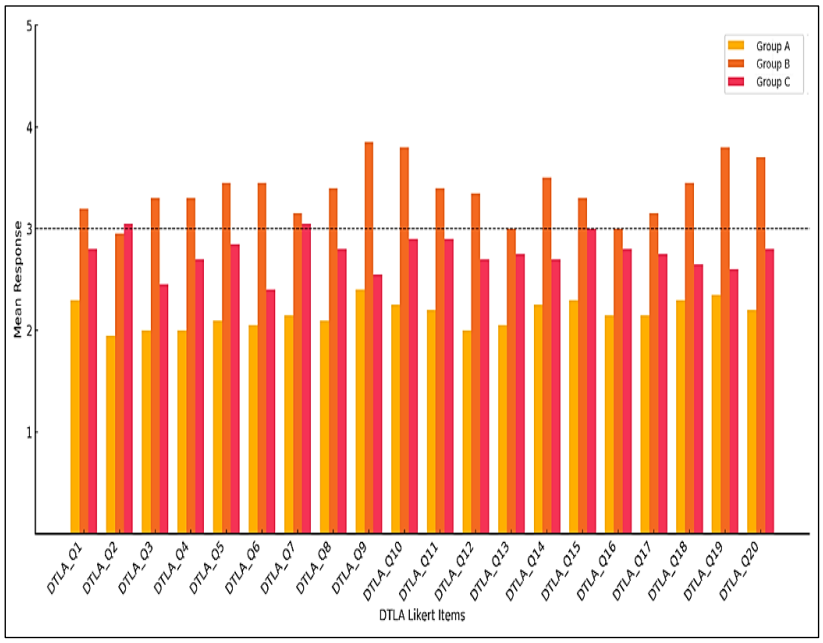

Figure 3: Mean DTLA item Scores by Group

Figure 3 presents the average score on each DTLA item for Groups A, B, and C, highlighting comparative strengths of the combined intervention. (Note: Y-axis = Average DTLA Item Score (0–5); X-axis = Item Numbers 1–20; Groups A–C represent intervention conditions. Figure 3 presents the mean DTLA item scores by group, illustrating how teachers in each intervention

condition performed across all 20 digital teaching items. Group C consistently outperformed Groups A and B on advanced items. It underscores that the combined-intervention group consistently achieved higher averages on advanced integration and scaffolding indicators than the standalone groups, evidencing stronger pedagogical application of digital tools.

Classroom Observation Trends

Using the Collaborative Writing Interaction Protocol (CWIP), five observed lessons were analyzed in each group. Table 2 summarizes the average percentage of observed scaffolding moments and the primary strategies employed by teachers in each group. Group A's scaffolding remained surface-level, focused on grammar correction and mechanical feedback. Group B demonstrated more modeling behaviors, particularly in sentence formation and logical transitions, whereas Group C employed advanced scaffolding strategies aligned with linguistic complexity and discourse cohesion. Scaffolding in Group C often involved using Google Docs' comment features and structured peer collaboration.

Table 2: Scaffolding Frequency and Example Practices by Group

Group	Average Scaffolding %	Common Scaffolding Strategies
A	17.2%	Grammar correction, mechanical revisions, and basic linking words
B	30.0%	Sentence modeling, transition phrases, and peer editing protocols
C	35.5%	Cohesion scaffolding, paragraph-level modeling, embedded feedback comments

Table 2 displays the average percentage of observed scaffolding moments and common instructional strategies across the three groups. In Group C, teachers were observed prompting students to refine sentence transitions (e.g., using "Although X, Y" constructions), suggesting vocabulary enhancements, and encouraging iterative peer feedback. These behaviors reflected a more active use of the collaborative editing platform.

Teacher Interview Themes

Semi-structured interviews were conducted with all groups (n = 60) involving teachers (20 from each group). Four major themes emerged from the thematic Analysis, with varying emphases across the intervention groups. These themes and illustrative sub-themes are presented in Table 3.

One Group C teacher remarked, "Pluralsight taught me the tools, and Google Docs let me put them into action. I use suggestion mode to propose better transitions or combine sentences, which students could accept." Another noted using comments to scaffold cohesion: "I highlight and ask: could you add a connector like 'however' here?" In contrast, a Group A participant described their experience as "mainly trying to make the platform work" and "letting students fix small errors in pairs."

Table 3: Themes Identified in Teacher Interviews and their Prevalence by Group (+: Theme Noted; ++: Theme Strongly Noted; –: Theme Not Noted)

Theme	Examples (sub-themes)	Group A	Group B	Group C
Confidence in Digital Tools	Platform navigation, real-time editing, and troubleshooting	+	++	++
Evolution of Scaffolding Strategies	Grammar corrections, cohesion modeling, and feedback via comments	+	+	++
Instructional Transformation	Lesson redesign, peer review protocols, digital rubrics	–	+	++
Perceived Impact and Theme	Student engagement, writing responsiveness, and lesson flow	+	+	++

Table 3 highlights the presence and intensity of interview themes across Groups A, B, and C. Across the quantitative and qualitative data, Group C consistently demonstrated higher performance, more frequent scaffolding, and deeper instructional reflection. Key results include:

- Group C had the highest concentration of Proficient teachers based on DTLA scores.

- Mean Likert item scores were highest in Group C for nearly all 20 digital teaching items.
- Scaffolding behavior was more frequent and more linguistically focused in Group C classrooms.
- Group C teachers reported greater confidence in using the tools, stronger scaffolding strategies, and a larger perceived impact on students.
- Group B showed moderate improvements in tool familiarity and lesson planning.
- Group A demonstrated basic tool use with minimal pedagogical adaptation.

These results provide a comparative overview of outcomes for each intervention model, setting the stage for deeper interpretation in the Discussion section.

Discussion

This study explored the impact of collaborative document editing (e.g., Google Docs) and Pluralsight-based professional development on the digital teaching literacy, linguistic scaffolding practices, and student writing outcomes of 60 in-service Saudi English language teachers. Employing a mixed-methods approach, the study addressed three research questions (RQs) through quantitative measures (the Digital Teaching Literacy Assessment (DTLA) and the Collaborative Writing Interaction Protocol (CWIP)) and qualitative data (semi-structured teacher interviews). The findings provide significant insights into the efficacy of integrating technology and professional development, with implications for the Technological Pedagogical Content Knowledge (TPACK) framework, educational practice, and policy, particularly in the context of Saudi Arabia's Vision 2030 (17).

Theoretical Implications for the TPACK framework

The study advances the TPACK framework posited by illustrating the operationalization of technological (TK), pedagogical (PK), and content knowledge (CK) couplings within language education (27). Participants in the synergistic intervention cohort (Group C), which concurrently employed Google Docs and Pluralsight training, achieved a mean digital teaching literacy attainment of 85% and a scaffolding incidence of 35.5%, attesting to substantive TPACK maturation. Such findings corroborate contention regarding the requisite confluence of knowledge domains for efficacious technology deployment (43). Moving beyond the dominant emphasis on pre-service preparation and generic technology adoption, the current inquiry expands the TPACK corpus by providing empirical corroboration from in-service educators who are acculturated within a discrete linguistic and disciplinary framework, specifically English language pedagogy in the Saudi Arabian context. The study highlights the mediating role of sustained, contextually embedded professional development in bridging the gap between abstract comprehension and operational execution, thereby enriching the existing literature on TPACK.

Why the Combined Intervention Outperformed Standalone Approaches? The combined intervention (Group C) yielded superior results compared to standalone interventions (Groups A and B), as evidenced by higher DTLA scores and CWIP scaffolding rates. Group C's success can be attributed to the connection between practical tool use and pedagogical training. While Group A (Collaborative Editing Only) focused on surface-level corrections (e.g., spelling, grammar, 17.2% scaffolding rate), and Group B (Pluralsight Training Only) improved clarity but not cohesion or complexity (30.0% scaffolding rate), Group C teachers integrated collaborative tools with pedagogical strategies, prompting students to use cohesive devices and complex sentence structures. This synergy enabled teachers to transform their pedagogy, aligning with the TPACK framework's emphasis on the intersection of technology, pedagogy, and content. The qualitative data further supported this, with Group C teachers reporting greater confidence in using technology to enhance student engagement and linguistic outcomes.

Experience-Based Differences: Because teachers were stratified by experience level (0–5, 6–10, ≥11 years), the findings reveal meaningful contrasts between novice and experienced instructors. Quantitative DTLA results showed that the most experienced teachers initially scored lower on advanced digital-pedagogy items but demonstrated the largest gains after training, whereas novice teachers displayed steadier but smaller gains across items. Qualitative interview data reinforced this pattern: experienced teachers reported a "mindset shift" toward collaborative editing and complex scaffolding, while newer

teachers highlighted confidence-building and step-by-step scaffolding. Together, these results underscore that professional development and tool integration benefit all experience groups but may operate through different mechanisms, suggesting that future interventions should tailor support to the teacher career stage.

Comparison with Existing Literature

The findings on student engagement and linguistic improvement align with and extend existing literature on technology-enhanced language learning. Research consistently shows that collaborative tools, such as Google Docs, enhance student engagement by fostering interaction and peer feedback (44, 45). For example, it was found that online collaborative writing instruction using Tencent Docs improved writing performance, motivation, and self-efficacy among Chinese EFL learners, mirroring our results on linguistic accuracy, complexity, and cohesion (45). Similarly, it was highlighted how digital tools increase motivation and engagement in language learning (46). However, this study's unique contribution lies in its integration of collaborative editing with professional development, demonstrating that training amplifies the benefits of technology. Unlike studies that focus solely on tool use or student outcomes, our findings highlight the crucial role of teacher training in achieving maximum linguistic improvements, particularly in a culturally specific context such as Saudi Arabia. These findings echo on collaborative professional development and on digital learning communities (18,19), both of which emphasize the role of teacher-to-teacher interaction in sustaining technology adoption. They also complement who demonstrated that targeted training plus digital tools produced measurable improvements in teachers' instructional quality, aligning closely with the present study's combined-intervention results (13).

Educator-Focused Contribution: Unlike many technology-enhanced writing studies that foreground student outcomes, this research centers on the professional development of in-service educators as the primary drivers of pedagogical change. By emphasizing teacher digital literacy and scaffolding practices rather than merely student achievement, the study provides a fresh perspective on how collaborative tools and structured training reshape professional communication, evaluation procedures, and instructional design. This educator-focused lens extends the literature on technology integration by showing how sustained teacher capacity-building amplifies the effectiveness of digital writing platforms, offering an alternative framework for assessing impact that prioritizes teacher agency and long-term instructional transformation.

Comparison with Western and Asian Contexts: In Western contexts, TPACK research frequently focuses on pre-service teacher education, examining how coursework develops technological, pedagogical, and content (43). This study adds a new dimension by focusing on in-service teachers, showing that professional development can enhance TPACK post-training. In Asian contexts, particularly in language education, studies like in China have demonstrated that collaborative tools improve writing outcomes, aligning with our findings (45). However, the specific combination of Google Docs and Pluralsight training, coupled with the cultural context of Saudi Arabia, provides a unique perspective. Saudi Arabia's educational system, influenced by Vision 2030's emphasis on digital transformation, differs from Western and Asian contexts, where technology integration may be more established or focused on different platforms (e.g., WeChat in China). This study's findings suggest that culturally tailored interventions can yield significant results, even in less-explored contexts.

Practical Applications

The results are essential for other Middle Eastern countries with an educational system similar to Saudi Arabia's, such as focusing on teaching the English language and digital skills. The focus on the use of collaborative technologies in conjunction with professional development in the study can be integrated into the teacher training and retraining programs in the primary, secondary, and higher educational institutions, especially in the teaching of languages. Schools and academic institutions can utilize these findings to develop tech-focused pedagogical professional development programs for teachers, training them to use Google Docs and similar technologies. The results can also be used in other parts of the world undergoing digital changes, considering local culture and context.

While editing technologies such as Grammarly, Turnitin, and AI-based correctors can improve

surface-level accuracy, overreliance may diminish reflective writing and originality. Instructors should balance these tools with teacher-led scaffolding, peer review, and activities fostering authentic language production. Our findings suggest these technologies are most effective as scaffolds; without guided use, their benefits are likely temporary rather than sustained. Institutions can balance the advantages of editing tools with creativity and critical thinking by positioning them as supportive aids within teacher-led and peer-review practices rather than as substitutes for evaluation.

Generalizability to other Contexts and Technologies

The results may be generalizable to other contexts where teachers are integrating technology into their teaching, particularly if similar professional development is provided. Collaborative editing tools like Google Docs, which support real-time collaboration and feedback, could be replaced with similar platforms (e.g., Microsoft Teams, Notion) with comparable outcomes, as long as teachers receive training on their pedagogical application. However, generalizability is limited by the study's specific context, Saudi Arabia's educational system, and its focus on English language teaching. Cultural attitudes toward technology, teacher training infrastructure, and student demographics must be taken into consideration before applying these findings elsewhere. For instance, the principles of TPACK and collaborative learning can be used for other subjects, but the specific linguistic improvements observed may be unique to language education. Longitudinal studies with diverse samples are needed to confirm broader applicability.

Broader Implications for Policy and Curriculum Design in Saudi Arabia

The findings have significant implications for policy and curriculum design in Saudi Arabia, aligning with Vision 2030's goal of digital transformation. First, educational policies should prioritize integrating digital literacy into teacher training programs and national curricula, ensuring teachers are proficient in using technology pedagogically. Second, professional development initiatives should focus on combining practical tool use with theoretical training, as demonstrated by the success of Group C. Third, given the importance of English in Saudi Arabia's economic and educational landscape, policies should support technology-enhanced language teaching initiatives. Finally, policymakers should encourage further research to evaluate the effectiveness of various technologies and training methods, informing evidence-based curriculum design. For example, incorporating collaborative tools into the national curriculum could be supported by mandatory professional development programs, ensuring sustainable implementation.

Limitations and Future Directions

While this study provides robust mixed-methods evidence, several limitations should be noted. First, the eight-week intervention limits our ability to assess long-term retention of digital teaching practices or sustained student writing gains. Second, although we triangulated data across instruments, student outcomes were captured indirectly through teacher-selected essays, which may not fully represent all learners. Third, the study's focus on Saudi Arabia constrains generalizability to other contexts with different technological infrastructures or pedagogical cultures. Future research should therefore employ longitudinal designs, larger and more diverse samples, and direct measures of student performance to confirm the durability and transferability of these findings. Comparative trials of alternative platforms (e.g., Microsoft Teams, LinkedIn Learning) and at different educational levels (primary, secondary, university) could further refine best practices for scaling collaborative digital writing interventions.

Conclusion

This research demonstrates that the use of collaborative editing technologies, including Google Docs, along with systematic professional development frameworks such as Pluralsight, augments the digital teaching literacy and pedagogical skills of Saudi EFL teachers, resulting in an enhancement of learner participation and quantifiable linguistic outcomes. The study outcomes, situated within the TPACK framework, align with the objectives of Saudi Arabia's Vision 2030, which aims at digitally integrating English language skills as one of the cornerstones of educational development. Teachers from the combined intervention group outperformed other participants in both digital teaching literacy (with 85% on the DTLA) and scaffolding (35.5% on the

CWIP), which corresponded with marked enhancement in learners' writing accuracy, syntactic complexity, and cohesion. This suggests that improved student learning outcomes cannot be achieved solely with access to digital resources; a well-structured pedagogical framework that equips students with digital language teaching skills is also essential. Pluralsight facilitated this shift as a pedagogical application of technology, proving to be a significant enabler that filled the gap between technological competence and pedagogical application. Its well-structured modules enabled teachers to move from basic feedback to advanced, structured writing instruction and sophisticated collaborative teaching.

To achieve these outcomes, educational policymakers and training bodies must embed both technological skill training and instructional skill frameworks within their development frameworks. Sustaining these changes will require ongoing online course support, in-person training sessions, and sustained coaching to facilitate the appropriate integration of digital tools within classroom activities. Further research should aim for a larger and more representative sample of regions and educational levels, with extended intervention periods, and a more direct evaluation of student writing samples to rigorously confirm the linguistic advancements.

Comparative studies of alternative platforms, such as Microsoft Teams or LinkedIn Learning, and the application of this model in resource-constrained or primary-level settings will expand its relevance. While the findings are promising, the study was limited by its small sample size, short intervention period, and reliance on self-reported teacher data. These limitations underscore the need for broader, longitudinal studies and mixed-method designs that include experimental controls and qualitative feedback. The Ministry of Education can play a pivotal role by incorporating digital pedagogical competencies into national teacher training standards, supporting pilot initiatives, and ensuring alignment with curriculum goals.

Potential barriers such as educator resistance, funding limitations, and institutional inertia must be addressed through stakeholder engagement and clear communication of the benefits of technology-enhanced instruction. To achieve scalability, teacher education institutions should embed digital pedagogy, including TPACK-aligned competencies, into pre-service and in-service training curricula. Certification processes may also be revised to assess both digital literacy and scaffolding practices as core teaching competencies. The national rollout will require coordinated leadership across the Ministry of Education, universities, and schools, ensuring that policy, curriculum design, and classroom practices align around a shared vision of digital innovation. The tripartite collaboration of these stakeholders is essential for implementing this dual-intervention strategy effectively and sustainably. This study should also prompt international researchers and practitioners to consider how private-sector platforms, such as Pluralsight, can be adapted for public education, particularly in regions undergoing rapid educational reform. By connecting teacher capacity-building to student-centered learning outcomes, this research offers both a model and a mandate for action. Replication in diverse contexts, evaluation of different training-content combinations, and investigation of long-term impact will be crucial to refining and scaling this model. Ultimately, the findings confirm that a blended approach to teacher development, one that unites collaborative technology with targeted pedagogical training, can serve as a transformative strategy for improving English language teaching in Saudi Arabia. By responding to national goals, addressing pedagogical gaps, and advancing theoretical frameworks such as TPACK, this study lays a foundation for sustainable and impactful reforms in digital language education.

Abbreviations

ANCOVA: Analysis of Covariance, ANOVA: Analysis of Variance, CK: Content Knowledge, CWIP: Collaborative Writing Interaction Protocol, DTLA: Digital Teaching Literacy Assessment, EFL: English as a Foreign Language, IRB: Institutional Review Board, MANOVA: Multivariate Analysis of Variance, NTP: National Transformation Program, Nvivo: Qualitative Data Analysis Software, TPACK: Technological Pedagogical Content Knowledge, PD: Professional Development, PK: Pedagogical Knowledge, SAR: Saudi Riyal, SPSS: Statistical Package for the Social Sciences, TK: Technological Knowledge.

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Author Contributions

Hashem A Alsamadani: conceptualization, study design, data collection, drafted the manuscript, critical revision, Sadia Gondal: conceptualization, study design, data collection, drafted the manuscript, Ubaid Ullah Ubaid: study design, data collection, data analysis, Zarrina Salieva: study design, data collection, drafted the manuscript. All authors approved the final version of the manuscript, are accountable for all aspects of the work, and share responsibility for its integrity. All authors also contributed to and personally assumed responsibility for study funding and article processing charges (APC).

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Declaration of Artificial Intelligence (AI) Assistance

This manuscript employed AI-assisted tools solely for grammar and language refinement under author supervision. All content, data, and analysis were developed and verified by the authors.

Ethics Approval

The study was approved by the Institutional Review Board (IRB) of the university where it was conducted (IRB Approval No. IRB/25/034). All participants provided informed consent before their involvement in the study.

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