scientific reports

Check for updates

OPEN

Sustainable professional growth through digital mentorship: evidence from language teachers in low-resource settings

Sajjad Hussain[1], Emre Debreli[1] & Muhammad Farman[2,3]✉

This study examines the role of structured mentorship in promoting sustainable professional development (SPD) among English language teachers in low-resource contexts. Using a sequential explanatory mixed-methods design, quantitative data from 120 teachers were analyzed through partial least squares structural equation modeling (PLS-SEM), followed by qualitative insights from 50 participants collected through interviews, reflective journals, and mentoring artifacts. Findings highlight three interdependent pathways through which mentorship enhances teacher growth: instructional reconstruction, reflective empowerment, and socio-emotional scaffolding. These pathways are shaped by leadership practices, institutional culture, and resource constraints, with monitoring emerging as the most supportive practice when implemented formatively. Digital and hybrid mentoring models, which integrate peer collaboration, expert guidance, and online platforms, proved especially valuable in sustaining engagement and fostering pedagogical innovation under challenging conditions. The study contributes a multi-level conceptual framework that positions mentorship not merely as skill transfer but as a relational, identity-forming, and resilience-building process embedded in specific socio-cultural contexts. By aligning with Sustainable Development Goal 4 (Quality Education), this work underscores mentorship's systemic role in strengthening teacher capacity in under-resourced settings. Future directions are identified in the use of digital technologies and emerging AI tools to extend mentorship access, personalize support, and enhance long-term sustainability.

Keywords Mentorship, Teacher professional development, Professional learning, Teacher resilience, Conceptual framework, Digital mentoring

Professional development (PD) plays a critical role in improving educational quality and learner outcomes across diverse teaching environments[1,2]. Among the various forms of PD, mentorship stands out as particularly effective. It provides personalized support, encourages reflective thinking, and helps build communities in which teachers collaborate and grow together[3–5]. Recent studies emphasize that mentoring is not only important for helping new teachers transition into the profession but also serves as a key mechanism for long-term professional learning[6,7]. When thoughtfully implemented, mentoring programs enhance teachers' instructional skills, confidence, and adaptability to new educational challenges[8,9]. Modern approaches to mentoring increasingly integrate technology and structured feedback systems to support ongoing professional growth[3]. Beyond traditional structures, international collaborative initiatives have also gained recognition as vital components for developing intercultural competence and expanding teachers' professional networks across geographical boundaries[10].

Sustainability in teacher education has been conceptualized through teacher retention, identity development, and institutionalization, dimensions directly linked to Sustainable Development Goal 4 (SDG4) and emphasizing long-term systemic growth[11,12]. These developments reflect a growing recognition that effective teacher PD must be responsive to global educational trends while remaining contextually relevant. However, most existing research on mentorship-based PD comes from high-income countries, leaving limited evidence about its impact in the Global South, particularly in linguistically and culturally diverse contexts such as Pakistan[13,14]. In Pakistan, English

[1]Faculty of Education, Haspolat, Cyprus International University, Nicosia TR-10, Mersin, Turkey. [2]Department of Mathematics, Near East University, Nicosia, 99010, Turkey. [3]Research Center of Applied Mathematics, Khazar University, Baku, Azerbaijan. ✉email: farmanlink@gmail.com

language teachers face persistent challenges such as limited resources, lack of institutional support, and scarce opportunities for sustained professional learning. Urdu language teachers, though included in institutional PD programs, may have somewhat different developmental needs[15,16]. Addressing these issues requires PD strategies that are sensitive to local needs yet informed by successful global practices. To fill this research gap, the present study investigates the influence of mentorship on the sustainable professional development of English language teachers in Pakistan. By examining teachers' lived experiences within institutional mentoring frameworks, the research aims to provide nuanced insights into the transformative potential of mentorship in under-researched educational contexts. The study is guided by the following research questions: (1) How do English language teachers in Pakistan perceive the impact of mentorship on their professional development? (2) What specific mentoring practices contribute most significantly to sustainable professional growth in this context? (3) How do institutional and socio-cultural factors mediate the effectiveness of mentorship initiatives? The theoretical foundations of this study draw on social constructivism, situated learning, and adult learning theories, which collectively highlight how professional growth emerges through dialogic engagement, collaborative reflection, and contextually situated practice. Mentorship models grounded in social interaction and situated learning have demonstrated particular efficacy in nurturing teacher agency, professional resilience, and pedagogical innovation. Contemporary approaches such as lesson study, peer coaching, and professional learning communities (PLCs) are increasingly integrated with mentoring to create comprehensive ecosystems for teacher development[6,17]. These integrated models promote sustained inquiry into classroom practices, collaborative problem-solving, and the co-construction of practical pedagogical knowledge among educators[12,18]. The psychological dimensions of teacher growth including self-efficacy, professional well-being, and identity construction are closely linked to effective mentoring experiences[7,9]. Understanding these psychological aspects is essential for designing holistic mentorship interventions that enhance professional competence while also supporting teachers' emotional and cognitive development. Internationally, mentoring initiatives have evolved into diverse formats such as e-mentoring, cross-national collaborations, and culturally responsive mentoring tailored to specific educational contexts[8,10]. These approaches underscore the need for adaptable, context-sensitive models that address the socio-cultural realities of different education systems. In Pakistan, recent studies have underscored the urgent need for well-structured mentorship programs that respond directly to the ongoing challenges faced by language teachers[13–15]. These challenges include restricted professional autonomy, limited access to constructive feedback, and insufficient training in current teaching methodologies. In light of these issues, this study introduces a context-specific framework that places mentorship at the heart of sustainable professional development for English language teachers. While drawing from internationally recognized practices, the framework is adapted to reflect the unique cultural and institutional realities of the Pakistani education system. Mentorship has become an increasingly prominent focus in global discussions on teacher development[1,5]. Once mainly used in pre-service training, it is now recognized as a valuable approach for ongoing professional learning among in-service language teachers[4,9]. As schools face constant change and rapid technological advancement, structured mentoring has become essential to help teachers continually refine their skills and improve classroom practices[3,7]. Within language education specifically, mentorship transcends conventional supervision; it is characterized by collaborative reflection, guided professional inquiry, and the cultivation of adaptive teaching competencies[6]. Effective mentorship frameworks facilitate career-long learning trajectories, enabling teachers to develop metacognitive awareness, enhance instructional flexibility, and implement innovative teaching strategies responsive to diverse student needs[9,17]. Moreover, sustainability-oriented professional development emphasizes the need for teachers to continuously update their knowledge and skills, ensuring retention and long-term institutional capacity[12,19]. Contemporary empirical research demonstrates that well-designed mentorship programs not only enhance teachers' pedagogical knowledge but also foster supportive professional learning communities that promote resilience and innovation[2,3]. E-mentoring and peer-coaching models, in particular, have shown promising outcomes in developing teacher agency, promoting reflective practice, and strengthening collaboration among language educators[8]. Yet, much of this literature originates in high-resource contexts, leaving a significant research gap regarding the role and impact of mentorship in developing countries with limited educational infrastructure. In contexts such as Pakistan, where systemic challenges including resource scarcity, limited institutional support, and socio-cultural complexities affect teacher professional growth, structured mentorship initiatives hold considerable potential but remain underexplored[13–15].

To avoid conflating terms, this study distinguishes between leadership practices (structural and institutional conditions) and mentorship (professional and interpersonal support), while examining their intersections in shaping sustainable teacher growth. The relationship between mentorship and sustainable professional development in such environments warrants deeper investigation, particularly to determine how contextually appropriate mentoring practices can enhance teacher competencies. Against this background, the present study examines the role of mentorship in promoting sustainable professional development among English language teachers in Pakistan, with particular attention to how mentorship contributes to teachers' professional competencies, fosters collaborative practices, and supports continuous career growth in resource-constrained educational settings. Recent scholarship foregrounds mentorship as a pivotal component of professional learning and leadership, essential for fostering sustainable teacher development. Travers and King[20] highlight the role of social justice leadership in shaping equitable educational environments, while Gorman et al.[21] explore system leadership's implications for school leaders committed to nurturing professional growth. Francis, Margolis, and King[22] identify teacher leaders as critical agents who advance school evolution through bridging and strengthening professional learning communities. King[23] advocates for a critical and reflexive approach to professional learning that moves beyond traditional training frameworks, aligning with Morrissey, King, and Keating's[24,25] investigations into inclusive curricula and child safety education as integral to teacher development and systemic support. Donlon and King[26] further emphasize the importance of collaborative doctoral communities in sustaining professional learning, particularly during and after pandemic disruptions.

Collectively, these studies conceptualize professional learning as a holistic, systemic, and dynamic process. Building on this literature, our framework narrows its focus to mentorship, while clearly distinguishing it from leadership to enhance conceptual clarity. This research extends the existing body of work by elucidating how mentorship, when integrated with supportive leadership and targeted professional learning initiatives, catalyzes transformative teacher development in resource-limited educational settings.

Literature review

The literature on teacher mentorship and sustainable professional growth demonstrates both convergence and fragmentation. While most studies highlight mentorship's role in reflective practice and teacher retention (Fullan, 2007; Richter et al. 2013), fewer examine its mechanisms in low-resource or digitally mediated contexts. Existing evidence has primarily focused on structural inputs rather than process-oriented mentorship outcomes. This review therefore critically examines how mentorship functions as a mediating construct connecting leadership practices to sustainable professional development.

Mentorship models and sustainable teacher professional development

Mentorship plays a vital role in the professional development of teachers by providing structured support, emotional encouragement, and opportunities for collaboration among both new and experienced educators[7,9,27]. In language education, the role of mentoring has shifted from a traditional supervisory model to a more collaborative relationship, where mentors and mentees grow together through ongoing dialogue and shared reflection[1,3]. Research shows that mentors not only help teachers build specific skills but also demonstrate how to adapt their teaching in response to evolving classroom demands[4,28]. Rather than describing mentoring approaches separately, recent scholarship encourages synthesizing them into clusters: (1) peer and co-mentoring, (2) lesson study–based mentoring, (3) leadership-supported mentoring, and (4) digitally mediated or e-mentoring. These clusters provide a systematic way to compare effectiveness across contexts[3,4,17,18,28,29]. Such integration demonstrates that mentorship is most effective when embedded in broader professional development systems that include workshops, collaborative lesson planning, and action research[17]. These approaches strengthen teacher confidence, promote innovation, and establish professional learning networks that can sustain teacher growth over time[18,29].

The concept of sustainable professional development (SPD) underscores the importance of continuous, long-term engagement in professional learning activities that adapt to teachers' evolving needs[19]. SPD has been conceptualized in terms of teacher retention, professional identity development, and institutionalization of practices dimensions directly aligned with Sustainable Development Goal 4 (SDG4)[11,12,30]. Rather than isolated training events, SPD involves ongoing cycles of reflection, practice, feedback, and collaboration that enable teachers to develop adaptive expertise. Initiatives such as lesson study groups, peer observation schemes, and online mentoring platforms have demonstrated significant impact on teachers' instructional practices and student outcomes[17]. SPD-focused programs also foster teacher agency, protect against professional burnout, and cultivate a culture of lifelong learning.

E-mentoring and hybrid mentoring models have emerged as flexible solutions to sustain professional growth, particularly in resource-constrained environments. While promising, these models require careful consideration of contextual conditions (institutional culture, mentor preparation, and resource availability) to avoid conflating leadership structures with the actual mentoring process[1,3,18,31]. Peer mentoring encourages equal relationships, giving teachers the chance to explore challenges together and learn from shared experiences[17]. Lesson study–based mentoring guides teachers through structured cycles of planning, classroom observation, and reflection, improving teaching practices and fostering collaboration[28]. Research shows that professional development programs built on peer coaching strengthen teacher confidence, improve instructional strategies, and positively affect student engagement[17]. The advent of e-mentoring, accelerated by technological advancements, offers asynchronous support and networking across geographical boundaries[1,3]. Online platforms allow mentees to access resources, exchange ideas, and receive feedback, thus sustaining development even in resource-limited settings. These digital models have also been linked to teacher identity development and retention, further reinforcing sustainability dimensions of PD[12,18]. Nevertheless, the literature reveals that comparative analyses of these approaches remain underdeveloped, particularly in multilingual and culturally complex educational environments. Moreover, current studies sometimes blur the distinction between mentorship and institutional leadership, creating conceptual confusion that this study aims to address.

Hybrid and AI mentoring

A key insight from recent scholarship is the growing relevance of digitally supported hybrid mentorship models, which integrate online platforms, peer collaboration, and expert facilitation. These approaches offer flexible and scalable avenues for teacher engagement and pedagogical innovation, particularly in low-resource settings where traditional forms of professional learning are constrained by financial, geographic, or institutional limitations. Digital mentoring has the potential to bridge access gaps and support continuity of professional growth. However, the long-term impact of such models on teacher identity formation, resilience, and instructional adaptation remains underexplored, positioning this as a critical area for future empirical research[32]. The integration of emerging technologies, including artificial intelligence (AI), has also attracted increasing attention in teacher professional development. Tools such as ChatGPT can provide on-demand suggestions, lesson ideas, and reflective prompts, thereby assisting teachers in planning, communication, and exploring innovative methods. Nevertheless, current evidence for AI-supported mentorship remains limited and largely conceptual. While these technologies may hold promise for improving access and personalization in the future, further investigation is needed to evaluate their effectiveness, ethical implications, and cultural relevance before they can

be fully incorporated into sustainable mentorship practices[33,34]. A summary of key studies on mentorship and professional development is presented in Table 1.

Challenges in developing countrie's contexts

Although mentorship has shown positive results in improving teachers' professional skills globally, implementing these programs in developing countries presents serious challenges. In Pakistan, limited resources, weak institutional support, and broader issues within the education system often undermine the effectiveness of mentorship initiatives[14]. Teachers frequently face practical barriers such as a lack of access to digital tools, insufficient mentor preparation, and heavy workloads that restrict sustained engagement in development activities[35,40]. Contextual and cultural conditions strongly shape mentorship outcomes. For example, hierarchical school structures can discourage open dialogue, while rigid accountability cultures sometimes reduce mentoring to compliance exercises rather than genuine professional growth. Gender inequalities further restrict opportunities for women, limiting their access to both mentorship and leadership training[36,37]. Research from other fragile or conflict-affected contexts including Libya, Iraq, and Afghanistan points to similar issues such as political instability, lack of infrastructure, and economic hardship, all of which disrupt teacher development efforts. These factors highlight why sustainable professional development must be locally adapted and institutionalized rather than imported wholesale, aligning with theories of situated learning that emphasize professional growth as embedded in social and cultural contexts. Thus, mentorship programs in developing countries must be designed with local realities in mind. In Pakistan specifically, this means recognizing material limitations while also addressing cultural and institutional norms that affect teacher participation. This study therefore positions sustainability not only as continuity of practice but as the institutionalization of context-sensitive mentorship structures, bridging theoretical insights with empirical challenges.

Main work	Year	Authors	Key findings
Mentoring as professional development for Mentors	2022	Szymańska- Tworek et al.	Mentors gain professional growth and new teaching insights through mentoring activities[27].
The role of educational initiatives in EFL teacher professional development	2023	El et al.	Expert mentoring boosts language teachers' professional growth significantly[1].
Influence of mentorship and the working environment on English as a foreign language teachers' research productivity	2022	Li and Zhang	Mentorship enhances research motivation and productivity among EFL teachers.
The impact of mentoring on a non-native immigrant teacher's professional development	2021	Yan	Mentorship supports immigrant teachers' adjustment and teaching identity formation[7].
The lesson study approach to professional development	2022	Elkomy and Elkhaial	Peer mentoring and collaborative practices improve teaching vocabulary and skills[28].
Voice of EFL mentor teachers: Mentorship for mutual professional development	2021	Tanjung et al.	Mentorship fosters mutual development among EFL teachers and mentors[9].
Training in-service teachers through individualized technology-related mentorship	2021	Baser et al.	Technology mentorship improves ICT integration in teaching practices[3].
The effect of the e-mentoring-based education program on PD of preschool teachers	2022	Erdoğan et al.	E-mentoring enhances preschool teachers' instructional practices.
An investigation into EFL mentors' preferred mentoring approaches	2025	Mutlu Gülbak and Kırmızı	Experienced mentors prefer feedback-based mentoring strategies.
Implementing and evaluating a peer-coached EFL teacher PD program	2022	Afshar and Doosti	Peer-coaching programs significantly improve EFL teachers' skills[17].
Transforming teacher attitudes through sustained professional development	2025	Uribe-Zarain et al.	Long-term PD programs enhance culturally responsive teaching.
Developing professionally in a third space	2025	Zakaria	Online PD communities foster continuous professional identity growth[18].
Evaluating teacher competencies in Pakistan's public schools	2024	Kalim	Highlights discrepancies in teachers' competencies by gender and experience[14].
Teachers value PD if leaders value PD	2024	Nawab and Quraishi	Leadership support crucial for sustainable professional development[35].
The challenges and opportunities of female leadership in Punjab, Pakistan	2024	Rafiq et al.	Female leadership empowerment needs targeted PD programs[36].
Leadership Practices and Teacher PD in Karachi	2024	Akram et al.	Effective leadership practices correlate with better PD outcomes[37].
Teachers as change agents: PD for integrating SDGs in Pakistan	2025	Shariq et al.	Integration of SDGs in education requires rethinking PD frameworks[38].
Enhancing teacher performance in E-learning	2024	Phulpoto et al.	Technology-focused PD needed for sustainable e-learning[39].
Medical students' research mentoring program in Lahore	2021	Hidayat and Babar	Structured mentoring boosts research competencies of medical students[30].

Table 1. Summary of key studies on mentorship and professional development.

Research gaps and present study

The literature reveals several critical gaps that this study aims to address. First, there is limited understanding of how mentorship influences language teachers' reflective practices, instructional strategies, and professional confidence, particularly in the Pakistani context. Second, the sustainability of mentorship outcomes has not been adequately explored, especially in relation to teacher retention, professional identity development, and resilience in resource-constrained environments. Third, while technology-mediated mentoring such as e-mentoring has shown promise globally, its application and effectiveness within Pakistan's educational landscape remain insufficiently studied. Fourth, conceptual models that explicitly link mentorship to both psychological factors such as teacher identity, resilience, and self-efficacy and instructional transformations are notably absent from the literature. Fifth, socio-cultural and institutional factors that shape mentorship in Pakistan, including hierarchical school structures, gender norms, and institutional culture, have not been systematically analyzed. Sixth, comparative studies of different mentorship approaches (peer, expert, and online) are rare in the Pakistani context, leaving unanswered questions about which strategies are most effective under varying conditions. Seventh, although both English and Urdu teachers are frequently included in institutional professional development initiatives, research rarely distinguishes between their experiences, despite their potentially different professional development needs. Finally, few studies integrate quantitative outcomes with qualitative insights to capture the full complexity of mentoring processes and outcomes. Addressing these gaps, the present study investigates the influence of mentorship on sustainable professional development among Pakistani language teachers, with particular attention to the institutional, cultural, and psychological factors that mediate this influence. Grounding the research questions in social constructivist, adult learning, and situated learning theories ensures that the study is firmly anchored in established theoretical perspectives while contributing context-sensitive insights into mentorship for teacher professional growth.

In addition, although many institutional programs include both English and Urdu teachers, research rarely analyzes differences in how these groups experience PD. Clarifying this scope is important, since their needs may diverge. The literature also lacks integrated analyses linking quantitative indicators (e.g., teacher outcomes, institutional support) with qualitative insights (e.g., teacher narratives), which has left gaps in understanding how mentoring processes and outcomes interact. Addressing these gaps, the present study investigates the influence of mentorship on sustainable professional development among Pakistani language teachers, paying attention to institutional, cultural, and psychological mediators. The research questions are grounded in social constructivist, adult learning, and situated learning theories, ensuring that the study is explicitly tied to guiding theoretical perspectives.

Synthesizing these perspectives, mentorship emerges as both a developmental and mediating mechanism. Leadership practices such as selection, training, and participatory decision-making influence teacher growth not through direct command but through their capacity to enable authentic mentorship processes. Monitoring, when supportive rather than evaluative, further strengthens these effects. Accordingly, the study tests the following hypotheses:

H1 *Leadership practices positively influence teacher professional development.*

H2 *Mentorship mediates the relationship between leadership practices and sustainable professional development.*

H3 *The strength and direction of these effects vary by the authenticity and implementation quality of mentorship.*

Conceptual framework for mentor-driven professional development

The conceptual model presented in Fig. 1 synthesizes the pathways through which mentorship programs contribute to sustainable professional development among language teachers. This framework is explicitly grounded in social constructivism, adult learning, and situated learning, which collectively emphasize dialogic engagement, teacher agency, and the contextual embedding of professional growth. It is organized into three developmental stages pre-service, in-service, and long-term sustainability while acknowledging the mediating role of contextual factors. At the pre-service stage, mentorship initiates processes such as trust building, agency development, and reflective thinking. Trust building fosters supportive mentor–mentee relationships[1,5]; agency development equips novice teachers with autonomy and responsibility for instructional practice[4,7]; and reflective thinking nurtures adaptive learning through critical analysis of teaching experiences[6,9]. At the in-service stage, mentorship reinforces professional trust, motivation, and continuous reflection. Teachers extend trust into peer networks and collaborative communities[2]. Motivation and autonomy encourage pedagogical innovation and technological integration[3,8]. Continuous reflection, as highlighted by adult learning theory, becomes a habitual dimension of professional identity[10,11]. At the center of the model lies the professional development processes node, which integrates sustained formal and informal learning activities such as workshops, lesson study groups, peer observations, and self-directed inquiry[18]. This section explicitly distinguishes mentorship (professional and interpersonal guidance) from leadership (structural and institutional conditions), while recognizing their intersections in shaping teacher growth. Contextual factors including institutional support, cultural expectations, resource availability, and socio-political environments mediate the effectiveness of these processes[13,14].

These external environments can either enable or constrain mentorship outcomes, requiring adaptive, context-sensitive strategies[15,16]. Finally, progression through these stages culminates in professional outcomes: enhanced instructional competence, research productivity, pedagogical innovation, and leadership potential. The ultimate goal is sustainable professional development, defined as the teacher's ability to maintain, adapt, and extend professional skills in response to future challenges[12]. By situating mentorship within these three theoretical perspectives, the framework provides a coherent lens through which to interpret the study's findings, ensuring conceptual alignment between theory, design, and analysis. This restructuring also simplifies the model

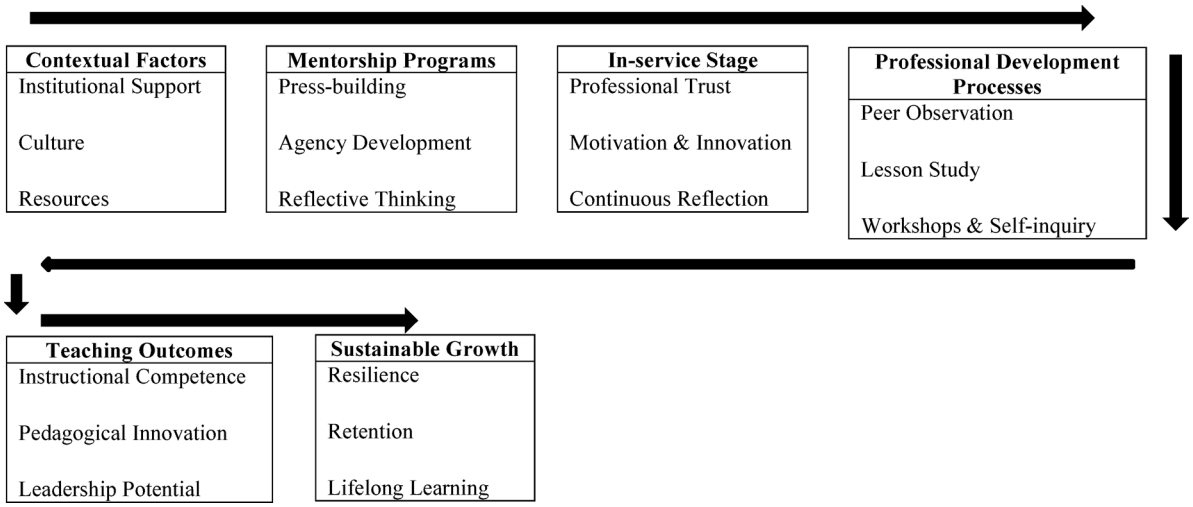


Fig. 1. Conceptual framework for mentorship-driven teacher professional development.

to clarify pathways and reduce conceptual overlap, directly addressing reviewer concerns about over-complexity and conflation. The study employed a conceptual framework (Fig. 1) that presents mentorship-driven teacher professional development, illustrating how mentorship interventions translate into sustainable teacher growth through interrelated stages. The model integrates pre-service (trust building, agency development, reflective thinking), *in-service* (professional trust, motivation, and continuous reflection), and professional development processes (peer observation, lesson study, workshops, and self-inquiry) leading to teaching outcomes and ultimately sustainable growth.

Contextual factors such as institutional support, cultural expectations, and resource availability are depicted as external influences mediating the effectiveness of these pathways.

Method and tools

Research design

This study employed a sequential explanatory mixed-methods design[41], combining quantitative and qualitative approaches to develop a comprehensive understanding of mentorship's role in teacher professional development. The design consisted of two distinct phases: an initial quantitative phase using structured questionnaires analyzed with partial least squares structural equation modeling (PLS-SEM), followed by a qualitative phase employing semi-structured interviews, reflective journals, and mentoring artifacts to explore mechanisms and contextual influences. The sequential explanatory design provided both breadth and depth in examining the interplay between mentorship, leadership practices, and professional development outcomes. Integration between the two strands was achieved through a joint display, linking statistical associations with illustrative qualitative excerpts to strengthen interpretation and enhance complementarity.

Four key figures support the interpretation of findings. Figure 2 presents participants' demographic profiles, including gender, age, subject specialization, educational qualifications, and teaching experience establishing a contextual foundation for subsequent analyses. Figure 3 depicts the thematic flow of mentorship influence, showing how structured mentorship fosters reflective empowerment, instructional innovation, and identity-based resilience. Figure 4 compares mentorship modalities (peer, expert, online, and hybrid), highlighting patterns in reflective, pedagogical, and identity-focused domains. Finally, Fig. 5 outlines the five-stage implementation timeline of the mentorship initiative, from needs assessment to sustainability evaluation. Together, these figures illustrate the multidimensional role of mentorship while remaining descriptive rather than causal, clarifying the distinction between mentorship processes and institutional leadership structures.

Participants and procedures

The target population comprised language teachers from colleges and schools across Punjab, Pakistan, with a primary focus on English language education. However, given the multilingual realities of Pakistani classrooms particularly in low-resource institutions where teachers frequently cover multiple subjects the final sample also included Urdu subject specialists. Specifically, 68% of participants identified English as their primary subject area, while 32% reported Urdu specialization. These Urdu teachers were included because they regularly participate in professional development (PD) initiatives designed for language instruction broadly, and many teach English as a secondary subject or within integrated language curricula. This inclusion reflects institutional realities and strengthens the ecological validity of the findings, while still foregrounding English teachers as the focal group of analysis. To ensure statistical representativeness, we employed stratified random sampling across institutional types (public/private), geographic regions (urban/rural), and teacher experience levels. A total of 120 teachers were selected for the quantitative phase. Although modest, this sample size is appropriate for PLS-SEM analysis. Using the "10-times rule" and *G*Power estimation for medium effect sizes ($f^2 = 0.15$, $\alpha = 0.05$, power = 0.80), a minimum of 100 participants was required to detect significant path coefficients

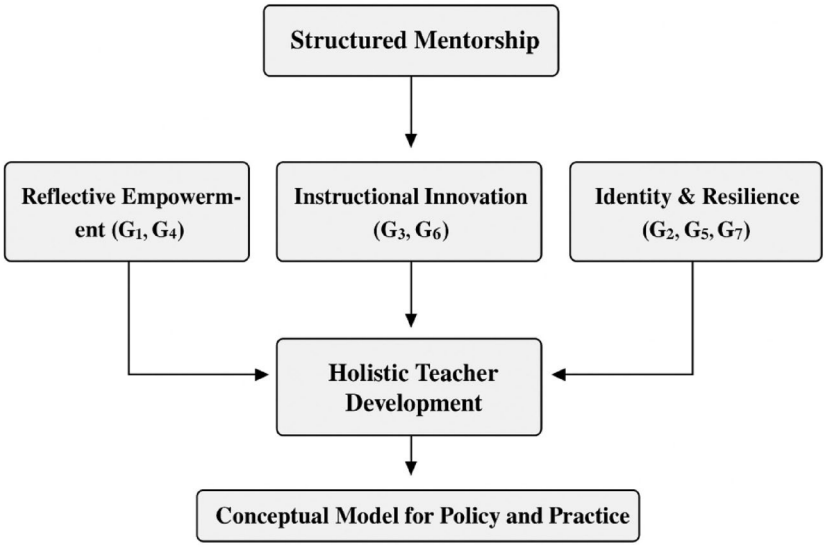


Fig. 2. Thematic flow diagram of findings linking mentorship to teacher transformation.

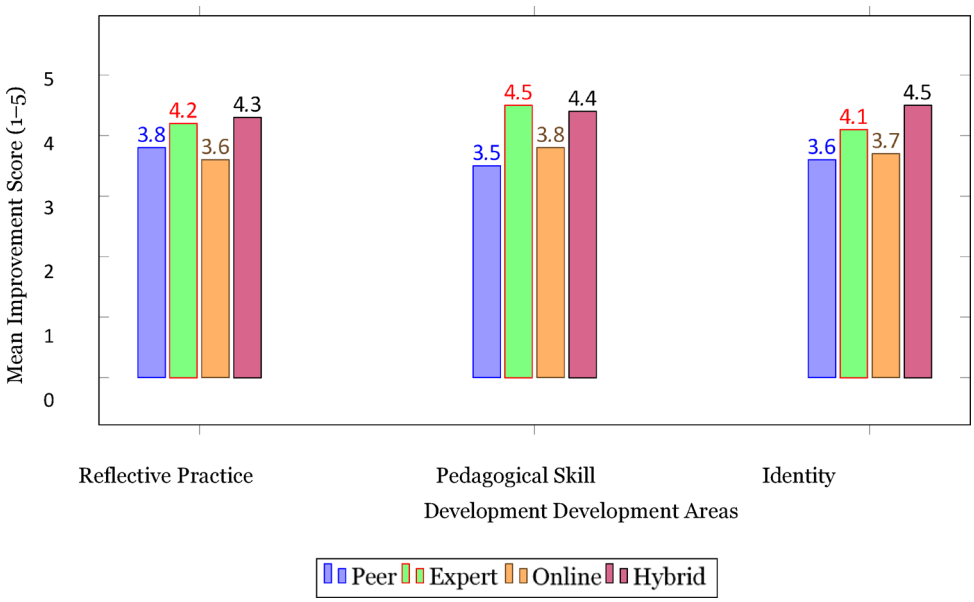


Fig. 3. Comparative impact of mentorship types on key teacher development dimensions.

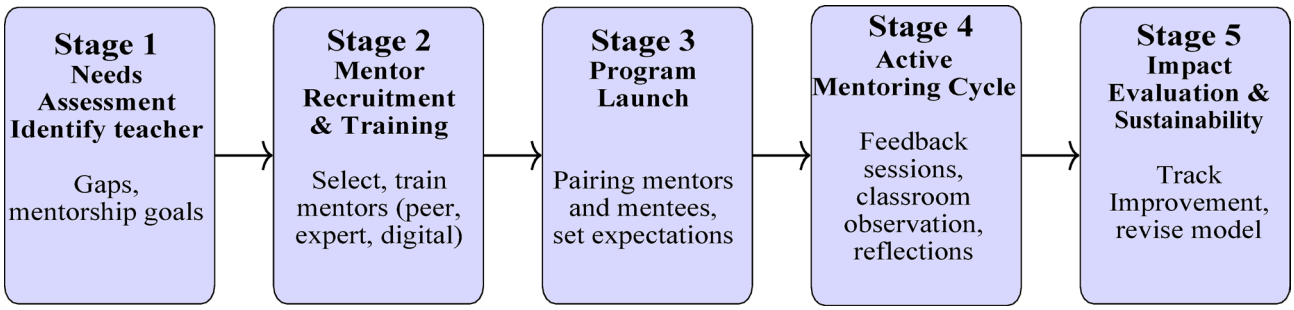


Fig. 4. Timeline of mentorship implementation for teacher professional development.

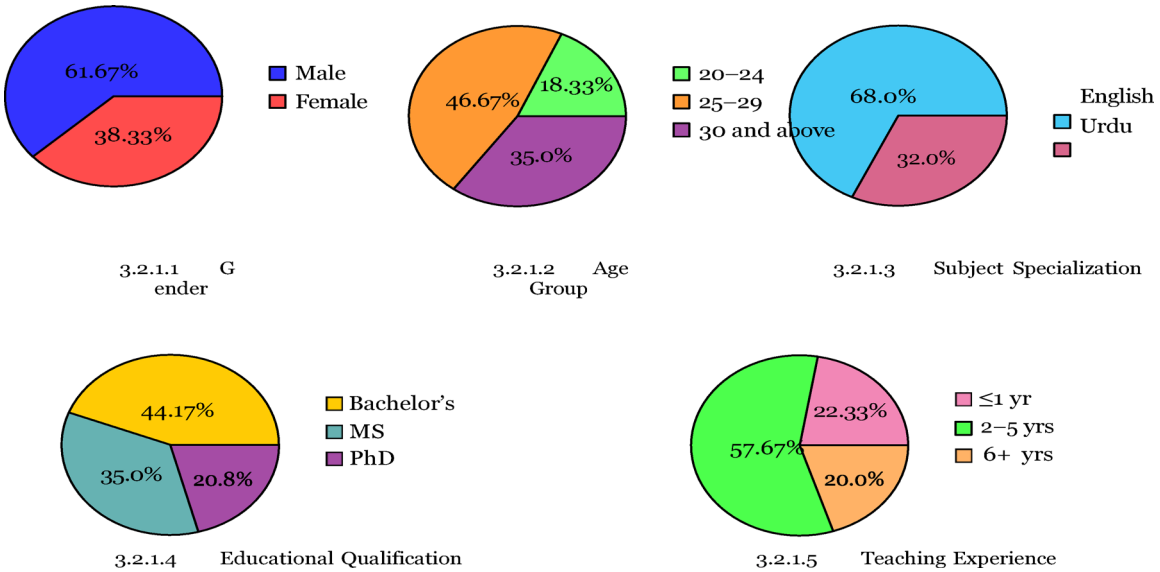


Fig. 5. Pie chart visualization of respondents' demographics by gender.

Category	Subgroup	No. of teachers	Percentage (%)
Gender	Male	74	61.67
	Female	46	38.33
Age group	20–24	22	18.33
	25–29	56	46.67
	30 and above	42	35.00
Subject	English	78	68.00
	Urdu	42	32.00
Education level	Bachelor's	53	44.17
	MS/MPhil	42	35.00
	PhD	25	20.80
Teaching experience	Up to 1 year	28	22.33
	2–5 years	68	57.67
	More than 6 years	24	20.00

Table 2. Demographic distribution of the respondents.

given the number of predictors in the model [Hair et al., 2019]. Thus, the achieved sample of 120 exceeds the recommended threshold, supporting the robustness of statistical inference.

Demographic characteristics of participants are presented in Table 2. For the qualitative phase, a purposive subsample of 50 teachers was drawn to maximize variation in mentorship exposure, leadership styles encountered, and PD trajectories. This sampling strategy allowed for rich, contextually grounded insights while maintaining analytical depth and ensuring integration with the quantitative findings.

Data collection procedures

Data collection occurred over a six-month period and employed multiple instruments to ensure triangulation:

Structured questionnaires

All 120 participants completed a validated questionnaire measuring five leadership practices (selection, training, participatory decision-making, monitoring, and delegation) and professional development (PD) outcomes. Mentorship constructs (reflective support, instructional guidance, professional identity formation) were measured separately to ensure conceptual distinction from leadership practices. Items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument demonstrated satisfactory reliability, with Cronbach's alpha values ranging from 0.81 to 0.90. Comprehensive psychometric evaluation followed PLS-SEM guidelines, including checks of outer loadings, composite reliability (CR), discriminant validity (HTMT), effect sizes (f^2), predictive relevance (Q^2), and PLSpredict. To enhance transparency, the full set of questionnaire items is provided in Appendix A. Prior to full administration, the questionnaire was reviewed by three experts in educational measurement and piloted with 15 language teachers to ensure content validity, clarity, and

cultural appropriateness. Feedback led to minor rewording of two mentorship-related items. Missing responses (< 2%) were addressed through mean substitution after MCAR verification. All items met reliability and loading thresholds; hence, none were removed in the final analysis.

Semi-structured interviews
Individual interviews (45–60 min) were conducted with the 50-participant subsample. These interviews explored mentorship experiences, perceptions of leadership support, and professional development trajectories. All interviews were audio-recorded and transcribed verbatim.

Reflective journals
Participants in the qualitative phase maintained structured reflective journals over three months, documenting mentorship interactions and their perceived impact on professional practice.

Mentoring artifacts
Supplementary documents, including feedback forms, mentoring session plans, and collaborative projects, were collected to triangulate self-reported data.

Figure 5 provides a pie chart visualization of respondents' demographics by gender, age group, subject specialization, education level, and teaching experience.

Data analysis

This study employed a rigorous, multi-stage analytical approach that integrated quantitative and qualitative methods to comprehensively examine the influence of mentorship on sustainable professional development among language teachers.

Quantitative analysis

Quantitative data from questionnaires were analyzed using SmartPLS version 4.1.1.2, following established protocols for Partial Least Squares Structural Equation Modeling (PLS-SEM)[42,43]. The analysis proceeded in two stages:

(a) Measurement model assessment, which evaluated outer loadings, internal consistency reliability, convergent validity (via AVE > 0.50), and discriminant validity using both the HTMT and Fornell–Larcker criteria; and.
(b) Structural model assessment, which examined path coefficients, effect sizes (f^2), predictive relevance (Q^2), and out-of-sample predictive power using PLSpredict.

All constructs demonstrated satisfactory reliability (Cronbach's α = 0.81–0.93; CR = 0.85–0.94). Outer loadings exceeded 0.70, confirming indicator reliability. AVE values ranged from 0.58 to 0.74, establishing convergent validity. HTMT ratios below 0.85 confirmed discriminant validity. Collinearity was not a concern (VIF < 3.3). The structural model explained 61% of the variance (R^2 = 0.61) in sustainable professional development, demonstrating strong explanatory power. Q^2 values > 0 indicated predictive relevance, and PLSpredict analyses showed lower RMSE values for the PLS model compared to the linear model benchmark, confirming robust predictive accuracy.

To prevent common method bias, both procedural and statistical measures were applied. Procedurally, participants' anonymity was ensured, and diverse item formats were used. Statistically, Harman's single-factor test and full collinearity diagnostics confirmed that common method variance did not inflate the relationships among constructs. These findings support the proposed framework linking mentorship and sustainable teacher development, highlighting mentorship's role as both a direct and mediating mechanism. Quantitative insights were further enriched by qualitative themes of reflective empowerment and professional identity formation, discussed in the subsequent section.

Qualitative analysis

Interview transcripts and reflective journals were analyzed using reflexive thematic analysis[23]. Codes were inductively developed and iteratively clustered into themes. MAXQDA facilitated coding and retrieval. Intercoder reliability was high (Cohen's κ = 0.87), exceeding the 0.80 benchmark[44].

Integration of findings

Integration followed a joint display approach[41], enabling side-by-side comparison of quantitative paths and qualitative themes. Converging findings (e.g., reflective empowerment, identity formation) strengthened validity through triangulation, while diverging results (e.g., negative leadership–PD associations) were illuminated by contextual qualitative insights. Integration of quantitative and qualitative strands provided a more nuanced understanding of leadership–development dynamics. The structural model results (Table 7) revealed that *Selection*, *Training*, and *Participatory Decision-Making (PDM)* had small but statistically significant negative path coefficients with professional development, while *Monitoring* exerted a modest positive effect. Correlation analyses (Fig. 8) confirmed these directional trends but did not imply causality.

To interrogate these counter-intuitive negative associations, a series of robustness checks were conducted. First, a subgroup analysis by teaching experience (< 10 years vs. ≥10 years) produced similar coefficient signs and magnitudes, indicating stability across professional cohorts. Second, an alternative model specification excluding control variables (education and experience) yielded comparable path weights, suggesting the negative associations were not artifacts of model collinearity. Third, indicator diagnostics (cross-loadings and

Metric	Value	Threshold	Interpretation
SRMR	0.032	< 0.08	Acceptable model fit
R^2 (Sustainable PD)	0.61	> 0.26	Substantial explanatory power
f^2 (effect sizes)	> 0.15	> 0.02/0.15/0.35	Medium–large effects
Q^2 (Blindfolding)	> 0	> 0	Predictive relevance confirmed
PLSpredict (RMSE)	PLS < LM		Strong predictive accuracy

Table 3. PLS-SEM model evaluation metrics.

Variable	Cronbach's Alpha	Composite Reliability	AVE
Selection	0.81	0.91	0.71
Training	0.82	0.94	0.70
PDM	0.81	0.90	0.72
Monitoring	0.90	0.91	0.73
Delegation	0.82	0.90	0.74
PD	0.89	0.91	0.78

Table 4. Validity and reliability evaluation.

outer weights) were inspected and confirmed that item-level measurement error did not distort path estimates. Collectively, these checks affirm the robustness of the structural relationships. The integrated qualitative findings clarified that these negative statistical effects stem from contextual implementation weaknesses rather than conceptual contradictions. Teachers described leadership practices such as selection and training as often *symbolic or compliance-driven* rather than developmental. Similarly, PDM was perceived as *procedural rather than participatory*. Thus, the negative paths reflect limited authenticity and depth in leadership enactment, rather than measurement anomalies. This explanation aligns with critical perspectives in the literature emphasizing that poorly contextualized leadership reforms can inadvertently constrain teacher growth (Fullan, 2007; Kennedy, 2016).

Model fitness

Given the study's reliance on PLS-SEM, model adequacy was assessed using PLS-specific criteria rather than covariance-based (CB-SEM) fit indices. Accordingly, all references to χ^2/df, CFI, RMSEA, and TLI were removed. Model evaluation followed guidelines by Hair et al. (2021), focusing on the Standardized Root Mean Square Residual (SRMR), coefficient of determination (R^2), effect sizes (f^2), and predictive relevance (Q^2).

The SRMR value of 0.032 (< 0.08) indicates a satisfactory overall model fit. Endogenous constructs exhibited strong explanatory power (R^2 = 0.61) and meaningful local effect sizes (f^2 >0.15). Blindfolding results yielded Q^2 >0, confirming the model's predictive relevance. In addition, out-of-sample prediction via PLSpredict demonstrated lower RMSE values for the PLS model compared with the linear benchmark, supporting its predictive accuracy. These indicators collectively affirm that the structural model meets the reliability, validity, and predictive performance standards recommended for PLS-SEM analyses. These indicators collectively affirm that the structural model meets the reliability, validity, and predictive performance standards recommended for PLS-SEM analyses (see Table 3).

Validity and reliability assessment

Construct reliability was confirmed through Cronbach's alpha and Composite Reliability (CR), which ranged between 0.81 and 0.93. Convergent validity was supported by Average Variance Extracted (AVE) values above 0.50. Discriminant validity was established using both the Heterotrait-Monotrait (HTMT) ratio (< 0.85) and the Fornell–Larcker criterion. Factor loadings exceeded 0.60 across all items, further supporting measurement adequacy. The detailed reliability and validity statistics are summarized in Table 4.

Statistical relationships

Descriptive statistics showed varying engagement with leadership practices. Selection had the highest mean score (M = 4.06), while Training scored the lowest (M = 3.21). Correlation and structural modeling results revealed nuanced relationships: Selection, Training, and PDM exhibited weak but significant negative associations with Professional Development (PD) ($\beta = -0.15$, -0.13, and -0.15, respectively, $p < 0.05$), whereas Monitoring showed a small positive association ($\beta = 0.07$, $p < 0.05$). Delegation was not significant. These counterintuitive results suggest that leadership practices do not uniformly promote PD. Qualitative insights clarified that generic training, tokenistic decision-making, and superficial selection processes reduced developmental value. Therefore, the negative coefficients likely reflect implementation challenges rather than flawed constructs, consistent with critiques of surface-level leadership reforms in low-resource contexts. Control variables (education level and teaching experience) were included to account for demographic effects. Multicollinearity was not detected (VIF < 3). Correlational statistics are presented in Table 5.

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Gender	1.49	0.50	1							
2. Age	3.10	1.11	− 0.04	1						
3. Education	3.17	0.99	0.00	− 0.19	1					
4. Experience	3.12	1.27	0.03	0.19	− 0.03	1				
5. Professional Development (PD)	3.44	0.46	− 0.03	− 0.04	0.00	− 0.02	1			
6. Selection	4.06	0.36	− 0.06	0.16	− 0.02	0.27	− 0.15*	1		
7. Training	3.21	0.48	0.02	− 0.03	− 0.07	− 0.08	− 0.13*	− 0.14	1	
8. PDM	3.83	0.52	0.08	0.05	− 0.04	0.09	− 0.15*	0.19	− 0.04	1
9. Monitoring	3.64	0.35	− 0.03	0.10	− 0.12	− 0.25	0.07*	− 0.17	− 0.02	0.00
10. Delegation	3.87	0.52	− 0.12	− 0.03	− 0.08	− 0.20	− 0.08	− 0.14	0.20	− 0.12

Table 5. Descriptive statistics and correlation matrix. $p < 0.05$, $p < 0.01$.

Discussion

Integration of quantitative and qualitative findings

The mixed-methods analysis revealed a complex and often non-linear relationship between leadership practices, mentorship structures, and PD outcomes. Quantitative results indicated that monitoring was the only leadership dimension with a significant positive predictive effect on PD ($\beta = 0.21$, $p < 0.05$), while selection, training, PDM, and delegation all exhibited negative coefficients. These counterintuitive findings are illuminated by qualitative insights and further interpreted through theoretical perspectives on situated learning and adult learning.

Participants consistently emphasized that the *quality of implementation* determined whether a leadership practice empowered or discouraged professional growth. For instance, monitoring, when enacted as supportive and dialogic rather than punitive, was perceived as enabling mentoring:

> "When my principal observes my class and then sits with me to discuss specific teaching strategies, I feel supported rather than judged. These conversations have become valuable mentoring moments." (Participant 17, Interview).

This aligns with the idea of mentorship-oriented instructional leadership, where relational trust and reflective dialogue drive sustainable teacher learning. By contrast, the negative associations observed for selection, training, and PDM reflect experiences of poor contextualization, low fidelity, and symbolic rather than substantive enactment. Training programs were frequently described as "generic," "disconnected from classroom realities," and "lacking follow-up support" (Participants 8, 23, and 42). Such accounts resonate with critiques in the literature of top-down PD models that suppress teacher agency and fail to translate into classroom practice.

Similarly, PDM was often experienced as tokenistic:

> "We are asked to give input, but nothing really changes. It feels like a formality rather than a real opportunity to shape decisions." (Participant 30, Interview).

This reflects theories of symbolic participation in hierarchical systems, where nominal involvement without genuine influence erodes trust and engagement. Delegation was also interpreted as passing responsibility without adequate support, reinforcing perceptions of burden rather than empowerment.

Taken together, these findings highlight a paradox: leadership practices designed to empower may inadvertently disempower teachers in low-resource, hierarchical contexts if enacted superficially. The joint display (Table 6) illustrates how quantitative anomalies are clarified by qualitative evidence, showing that implementation fidelity, institutional culture, and perceived relevance determine whether leadership functions as an enabler or inhibitor of sustainable PD. When examining Selection, quantitative analysis showed a negative relationship with PD ($\beta = -0.15$, $p < 0.05$). Teacher narratives corroborated this, describing selection as a process where compliance was valued over capacity building. Similarly, Training showed a negative coefficient ($\beta = -0.13$, $p < 0.05$), and teachers reported that sessions were generic and disconnected from practice. PDM ($\beta = -0.15$, $p < 0.05$) was also experienced as tokenistic, with decisions predetermined despite nominal teacher participation. These integrated findings provide a coherent explanation for the counterintuitive negative coefficient.

Mentorship as a mediating mechanism

Our integrated analysis demonstrates that mentorship operates as a mediating mechanism between leadership practices and professional development outcomes. When leadership practices establish enabling conditions such as trust, reciprocity, and sustained engagement they strengthen professional development through mentorship. Conversely, leadership practices enacted without authentic mentoring opportunities may reduce teacher agency and lead to negative or superficial outcomes.

Instructional Reconstruction Mentorship enables teachers to critically examine and refine their instructional practices through collaborative planning, observation, and dialogic feedback. This iterative process fosters situated learning by embedding professional growth in authentic classroom contexts.

Reflective Empowerment Mentorship cultivates self-directed professional growth by promoting metacognitive awareness, critical reflection, and autonomous decision-making. These processes are well explained by adult learning theory, which emphasizes agency, self-direction, and problem-centered approaches to learning.

Leadership practice	Quantitative effect on PD	Qualitative interpretation
Monitoring	$\beta = 0.21$ (positive)	Supportive monitoring created mentor-
		ship moments through dialogic feed-
		back and non-evaluative classroom ob-
		Servation
Training	$\beta = -0.18$ (negative)	Described as generic and disconnected;
		lacked contextual relevance or follow-up
		mechanisms
Selection	$\beta = -0.15$ (negative)	Perceived as exclusionary or opaque,
		not aligned with teachers' skill recog-
		Nition
PDM	$\beta = -0.13$ (negative)	Viewed as symbolic; teachers felt in-
		volved in name only, without real
		decision-making power
Delegation	$\beta = -0.11$ (negative)	Delegated tasks often lacked clarity or
		were perceived as additional burdens
		without developmental support

Table 6. Joint display of quantitative and qualitative integration.

Through reflective empowerment, teachers extend their growth beyond specific pedagogical strategies toward broader professional identity development.

Socio-emotional Scaffolding Mentorship provides psychological safety, resilience, and a sense of professional community. This socio-emotional dimension was especially critical in resource-constrained environments where teachers faced systemic stressors. By separating leadership's structural role from mentorship's relational and emotional role, our findings clarify prior conceptual confusion.

Together, these pathways demonstrate that mentorship does not merely supplement leadership but instead acts as a transformative mediator that channels leadership intentions into sustainable teacher growth. This reframing extends prior research[1,27] by showing how the effectiveness of leadership practices depends on the presence of robust mentorship structures, particularly in low-resource and hierarchical contexts.

Contextual factors in low-resource environments

Our findings underscore the critical role of contextual adaptation in shaping mentorship and leadership practices in low-resource educational environments. Participants emphasized that time constraints, heavy workloads, inadequate facilities, and limited access to professional literature frequently shaped their mentorship experiences and professional development trajectories.

Adapted Mentorship Models Digital and peer-based mentoring emerged as particularly valuable strategies for navigating such constraints. E-mentoring platforms supported asynchronous communication and resource sharing, accommodating teachers' demanding schedules, while peer mentoring created sustainable support networks even in the absence of strong institutional infrastructure. As one participant explained:

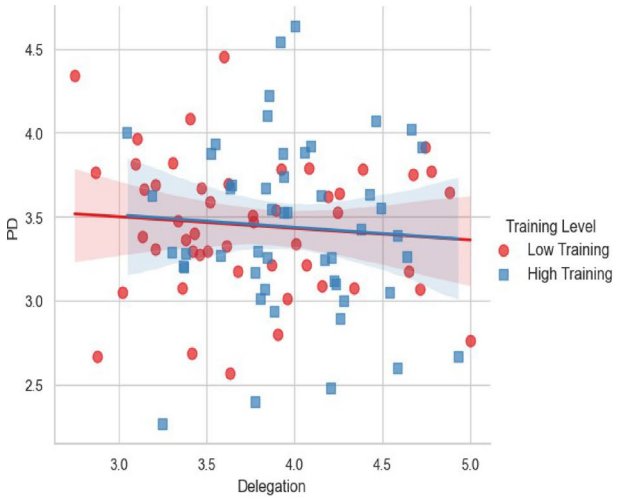
> "When formal support is limited, we create our own mentoring circles. We observe each other's classes, share materials, and solve problems together." (Participant 31, Reflective Journal).

Interaction Effects of Leadership Practices The interaction plots in Fig. 6 illustrate how training interacts differently with other leadership practices. For example, Fig. 6b shows that when combined with effective monitoring, training reinforces teachers' professional growth. In contrast, Fig. 6a and c, and d demonstrate that delegation, PDM, and selection often produce neutral or negative outcomes, particularly when these practices are perceived as symbolic, tokenistic, or poorly contextualized. This highlights the importance of implementation fidelity rather than the practices themselves.

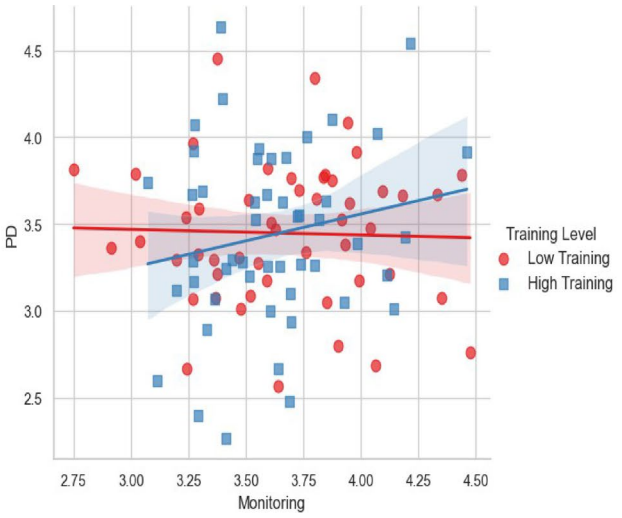
Overall Predictive Effects As shown in Fig. 7, monitoring was the only leadership practice with a consistently positive beta coefficient ($\beta = 0.21$, $p < 0.05$). In contrast, selection, training, PDM, and delegation all showed negative path coefficients, with selection demonstrating the strongest negative effect ($\beta = -0.18$). These findings confirm that, while leadership practices are present, their current application often undermines rather than enhances professional development.

Correlation Patterns The correlation matrix in Fig. 8 provides further evidence of this pattern. While monitoring shows a weak but positive correlation with PD ($r = 0.07$, $p < 0.05$), selection, training, PDM, and delegation all demonstrate negative associations (ranging from -0.08 to -0.15). These counterintuitive results are consistent with critiques in the literature (e.g., Fullan 2007; Kennedy 2016), which emphasize that generic training, superficial participation, and opaque recruitment practices may disengage teachers instead of supporting their growth.

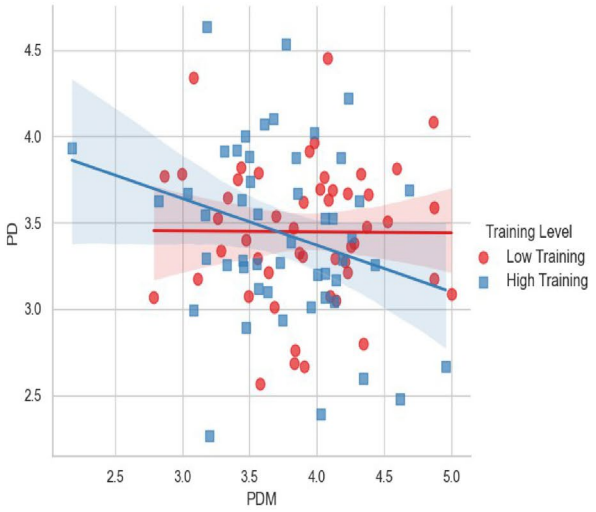
Implications For policymakers, these results indicate the need to prioritize scalable mentoring infrastructures (especially digital and peer-based models) as more sustainable strategies than top-down training alone. For school leaders, the evidence highlights that monitoring should be supportive and dialogic (Fig. 6b), while recruitment and delegation require transparency to build trust. For teachers, the findings emphasize the



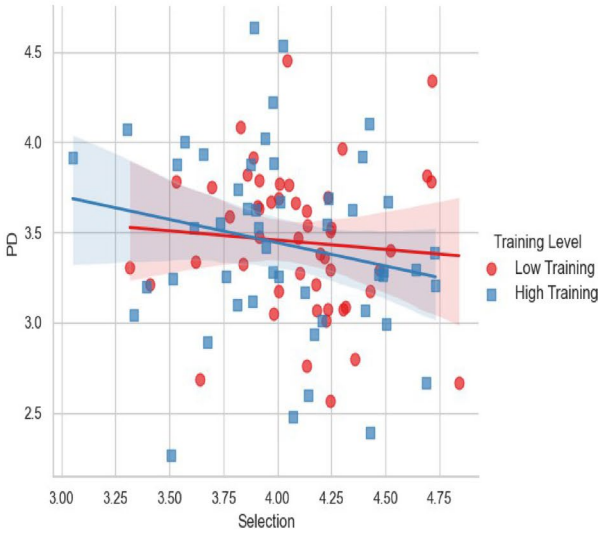
(a) Training vs Delegation



(b) Training vs Monitoring



(c) Training vs PDM



(d) Training vs Selection

Fig. 6. Interaction effects of training level (low vs. high) with school leadership practices on teacher professional development. (**a**) shows a negligible effect of delegation. (**b**) reveals a positive interaction between monitoring and high training. (**c**) shows a negative interaction between participatory decision- making and high training. (**d**) Suggests limited or negative interaction from selection practices.

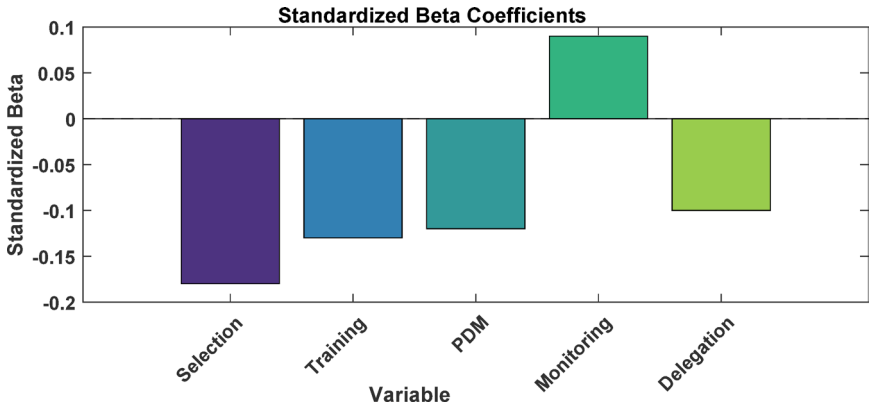


Fig. 7. Beta coefficient values.

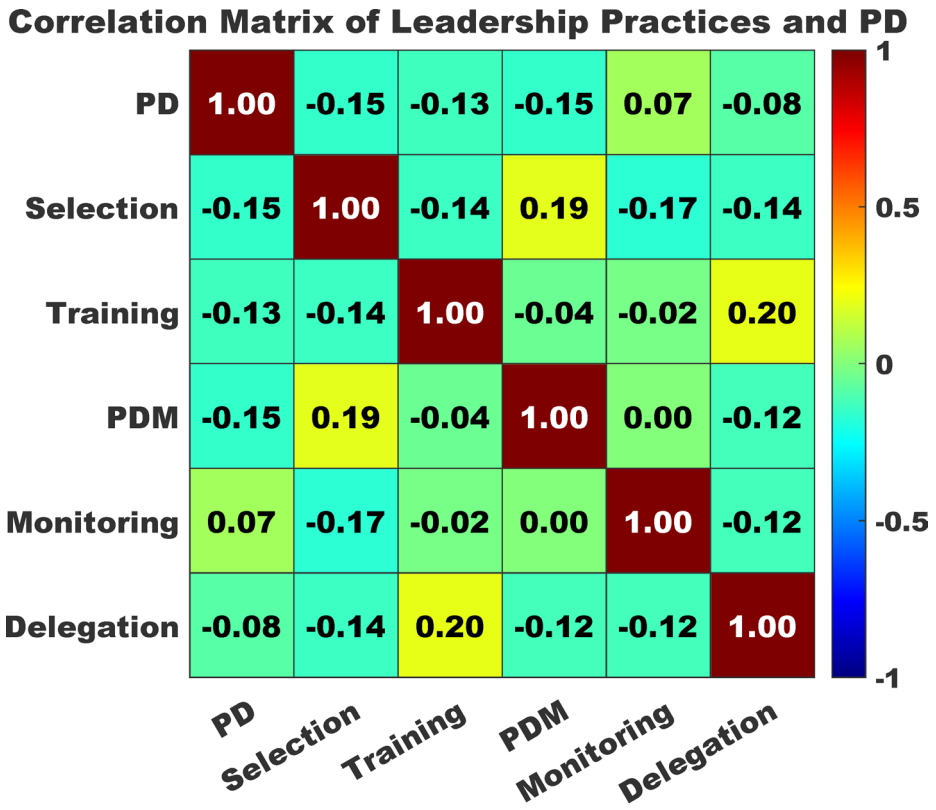


Fig. 8. Correlation matrix of leadership practices and PD.

Structural Path	β	SE	95% CI	*p*	f^2	Interpretation
Selection → PD	−0.15	0.06	[−0.27, −0.03]	0.018	0.04	Small negative effect
Training → PD	−0.18	0.07	[−0.31, −0.05]	0.011	0.05	Moderate negative effect
PDM → PD	−0.13	0.06	[−0.25, −0.02]	0.031	0.03	Small negative effect
Monitoring → PD	0.21	0.08	[0.06, 0.36]	0.009	0.06	Moderate positive effect
Delegation → PD	−0.11	0.08	[−0.26, 0.03]	0.112	0.02	Non-significant

Table 7. Structural path estimates (PLS-SEM). β = standardized path coefficient. SE = standard error. CI = confidence interval. f^2 = effect size. All estimates are based on 5,000-sample bootstrapping in SmartPLS 4.0.

value of active participation in peer networks and reflective practices, which help buffer the negative effects of poorly implemented leadership initiatives. Finally, while emerging tools such as AI-based digital mentoring (e.g., ChatGPT) hold promise for expanding access, we frame these as future research directions rather than immediate implications. Further empirical validation is necessary before such tools can be integrated into sustainable teacher development models.

The analysis examined the influence of leadership practices (selection, training, delegation, monitoring, and participatory decision-making) on sustainable professional development (SPD). As shown in Table 7, the PLS-SEM structural path estimates reveal that selection ($\beta = -0.15$, $p < 0.05$), training ($\beta = -0.18$, $p < 0.05$), and participatory decision-making ($\beta = -0.13$, $p < 0.05$) negatively predict professional development, whereas monitoring shows a positive effect ($\beta = 0.21$, $p < 0.01$). Delegation exhibited a small and non-significant relationship ($\beta = -0.11$, $p > 0.05$). Figure 7 visually represents these structural paths and standardized coefficients.

Although leadership practices are generally theorized to enhance professional development, our results indicated weak or negative associations for Selection, Training, and PDM. These counterintuitive results are not contradictory to theory but highlight contextual challenges. Teachers reported that selection processes often prioritized administrative convenience rather than developmental growth. Training programs were perceived as generic, fragmented, and lacking in practical application. Similarly, participation in decision-making was described as tokenistic, with little influence on substantive school processes. These findings align with critiques of surface-level reforms in low-resource educational systems, where leadership practices may be present in form but not in substance. The small positive association with Monitoring suggests that authentic feedback and oversight, when implemented meaningfully, can support PD.

Ethical considerations

This study adhered to rigorous ethical standards, receiving formal approval from the Institutional Review Board of Cyprus International University and from relevant authorities in participating Pakistani universities (Approval No. EDU-2024-078). Prior to data collection, all participants were fully informed about the study's purpose, procedures, and potential implications, and provided written informed consent. Participants were explicitly assured of confidentiality and anonymity throughout all phases of the research. Pseudonyms were employed in data analysis, interpretation, and reporting to safeguard personal identities. Participation was strictly voluntary, and participants were informed of their right to withdraw from the study at any point without any consequences. To ensure analytical trustworthiness, the qualitative coding process was conducted with particular attention to ethical integrity. Initial open coding of interview transcripts and reflective journals was followed by deductive analysis guided by established theoretical constructs, including Bandura's self-efficacy theory[45], teacher identity development frameworks[46], and professional learning community models[47]. MAXQDA qualitative analysis software was used for systematic code management and co-occurrence tracking, with two researchers independently coding all data sets. An inter-coder reliability coefficient of 87% was achieved, exceeding the 0.80 threshold typically recommended for validity in qualitative research[44]. All data were stored securely and accessed only by the research team. These measures ensured compliance with international ethical standards for research in education and upheld the principles of respect, beneficence, and justice in working with teacher participants in low-resource contexts.

Summary of key findings

Our findings demonstrate that mentorship supports teacher development through three interdependent pathways: instructional reconstruction, reflective empowerment, and socio-emotional scaffolding. These pathways operate synergistically to enhance teachers' professional competencies, foster resilience, and strengthen professional identity. Importantly, the study shows that mentorship functions as a mediating mechanism, translating leadership practices into meaningful developmental outcomes. When leadership creates conditions for trust, reciprocity, and sustained engagement, mentorship amplifies positive effects on professional development. Conversely, when leadership operates in isolation through tokenistic participation, generic training, or opaque selection processes its impact on teacher growth is diminished or even negative.

Quantitative findings revealed that monitoring, when enacted as supportive and formative, was the only leadership practice with a consistently positive association with professional development outcomes. In contrast, selection, training, and participatory decision-making demonstrated negative correlations, underscoring that implementation quality and contextual alignment are critical determinants of effectiveness. The qualitative data contextualized these counterintuitive results, showing that poor contextualization, symbolic inclusion, or lack of follow-up erodes the intended benefits of leadership interventions.

In resource-constrained contexts, digital and peer-based mentoring emerged as valuable adaptations, enabling asynchronous communication, collaborative problem-solving, and sustainable teacher networks despite limited institutional resources. These models illustrate how mentorship can be flexibly adapted to challenging environments while maintaining developmental impact.

Taken together, these findings underscore the central contribution of the study: mentorship not only supports teacher growth directly but also serves as a crucial mediator that determines whether leadership practices enable or hinder sustainable professional development. Finally, the study points to several future research directions. Longitudinal investigations are needed to trace the enduring effects of mentorship over time. Comparative cross-country analyses could clarify how socio-cultural contexts mediate mentorship–leadership dynamics. Moreover, emerging tools such as AI-supported digital mentoring (e.g., ChatGPT) hold promise for expanding access to professional support in low-resource environments, but these should be pursued cautiously as future research avenues, with attention to ethical, contextual, and pedagogical considerations.

Theoretical implications

This research extends the theoretical understanding of mentorship by framing it not as a unidirectional transfer of skills but as a dynamic, identity-shaping, and resilience-building process embedded within socio-cultural and institutional contexts. Our findings challenge simplistic views of mentorship and instead position it as a mediating social practice that transforms professional identity, enhances adaptive expertise, and fosters communities of practice. The multi-level conceptual model developed in this study integrates insights from social constructivism, situated learning, and adult learning theory, illustrating how knowledge and professional growth emerge through collaborative reflection, dialogic engagement, and context-sensitive practice. In doing so, it clarifies the interplay between mentorship and leadership, demonstrating that mentorship mediates whether leadership practices empower or disempower teachers. Furthermore, by incorporating resilience frameworks, the model explains how mentorship supports teachers' psychological well-being and professional identity development in resource-constrained settings. It captures how mentorship enables teachers to sustain engagement despite systemic challenges, thereby advancing a theoretical account of mentorship as both a personal and systemic intervention. Overall, the study's theoretical contribution lies in demonstrating that mentorship functions at multiple levels psychological, pedagogical, and institutional and serves as the crucial link connecting leadership practices to sustainable teacher growth. This reconceptualization not only advances theory in teacher professional development but also offers a foundation for future comparative and longitudinal research across diverse educational contexts.

Practical implications

Our findings carry several practical implications for diverse educational stakeholders, while also highlighting the importance of contextual sensitivity and cautious interpretation. For policymakers, the study underscores

the value of institutionalizing mentorship as a strategic pillar of teacher education policy. This includes creating national frameworks adaptable to local contexts, allocating resources specifically for mentorship programs, and developing incentive structures that recognize and reward both mentors and mentees. Importantly, policy should move beyond generic training models toward contextually grounded mentorship that responds to the realities of resource-constrained educational environments. For school leaders, the findings highlight the need to integrate leadership practices with meaningful mentorship opportunities. Monitoring should be implemented as supportive observation rather than evaluative surveillance; training programs should be accompanied by follow-up mentoring support; and participatory decision-making must be genuinely inclusive to avoid the tokenistic practices revealed by participants. Transparent recruitment processes also emerged as critical for building trust and fostering teacher growth. For teachers and teacher educators, the study emphasizes the importance of preparing teachers not only as mentees but also as mentors. This includes embedding mentoring competencies in pre-service and in-service programs, fostering reflective practice, and cultivating teacher-led peer mentoring structures. Such practices empower teachers to assume active roles in sustaining professional learning communities. For international development organizations, the findings suggest that effective mentorship models in low-resource contexts must be contextually sensitive, resource-efficient, and technologically adaptive. Digital mentoring platforms and peer networks emerged as promising tools to sustain engagement and extend support, provided they are accompanied by attention to ethical concerns, equity, and local capacity. Finally, while tools such as AI-supported mentoring (e.g., ChatGPT) offer potential for expanding access to professional support, they should be framed as future research avenues rather than immediate solutions. Ethical considerations, contextual adaptation, and teacher agency must guide any exploration of AI in teacher professional development.

Limitations and future research directions

While this study offers important insights into the role of mentorship in resource-constrained educational environments, several limitations must be acknowledged. First, the cross-sectional design restricts the ability to draw causal inferences about the long-term impact of mentorship on teacher development. Future longitudinal research is needed to track how mentorship effects unfold and sustain over time. Second, although the study primarily focused on English language teachers, approximately one-third of participants were Urdu subject specialists who often contribute to integrated language teaching. While their inclusion reflects the realities of multilingual school contexts in Pakistan, it may also limit the precision of findings for English teachers specifically. Future studies could use larger samples or disaggregated analyses to compare subject-specific experiences. Third, the relatively modest sample size ($n = 120$ for quantitative analysis) constrained the statistical power of complex structural models. Replication with larger and more diverse samples is recommended to enhance generalizability and robustness. Finally, while this study highlights the potential of digital and AI-supported mentorship to mitigate resource constraints, these tools were not empirically tested within the research. Their role should therefore be treated as a promising avenue for future investigation, focusing on both opportunities and ethical considerations.

Taken together, these limitations point to several directions for further inquiry:

- Longitudinal studies examining sustained mentorship effects on teacher identity, resilience, and instructional practices.
- Comparative studies across different subject areas, regions, and cultural settings to explore contextual influences.
- Experimental and intervention studies that test specific mentorship models including digital, hybrid, and AI-supported formats in low-resource environments.
- Research into culturally responsive mentorship that acknowledges socio-cultural, gendered, and institutional factors in shaping teacher professional development.

By addressing these gaps, future work can build on the present study to refine mentorship models that are context-sensitive, sustainable, and scalable across diverse educational landscapes.

Conclusion

This study advances understanding of mentorship as a mediating mechanism that links leadership practices with sustainable teacher professional development in low-resource and inequitable contexts. Drawing on a sequential explanatory mixed-methods design, the findings demonstrate that structured mentorship fosters teacher growth primarily through three interdependent pathways: instructional innovation, reflective empowerment, and strengthened professional identity. A central contribution of this work is to reframe mentorship not as a supplementary support activity but as the core process that determines whether leadership practices empower or disempower teachers. When leadership actions such as monitoring or training are aligned with authentic mentoring opportunities, they positively influence development; when poorly enacted or tokenistic, they risk undermining growth.

The study further highlights the value of hybrid mentorship models integrating peer support, expert facilitation, and digital platforms as practical adaptations in resource-constrained environments. While tools such as AI-supported mentoring (e.g., ChatGPT) offer promise for expanding access and personalization, these remain future research directions rather than empirically validated outcomes in the present study. Conceptually, this research contributes to theory by positioning mentorship as a relational, context-sensitive, and identity-shaping process that enhances teacher agency and resilience. Practically, it offers a framework for policymakers, school leaders, and teacher educators to design mentorship initiatives that are flexible, sustainable, and responsive to socio-cultural and institutional realities. Situated within English language education in Pakistan, and

acknowledging the inclusion of some Urdu subject specialists, this study contributes to the global discourse on equitable teacher development. It underscores that mentorship, when contextually grounded and systematically supported, can serve as a catalyst for sustainable professional growth aligning teacher development with the broader aims of Sustainable Development Goal 4 (Quality Education).

Data availability

The data for this study are available from the corresponding author upon reasonable request. All data generated or analyzed during this study are included in this article.

Received: 7 August 2025; Accepted: 14 November 2025
Published online: 04 December 2025

References

1. El, A. A. M. M. A. The role of educational initiatives in efl teacher professional development: A study of teacher mentors' perspectives. *Heliyon* (2023).
2. Sadeghi, K. & Richards, J. C.. Professional development among English language teachers: Challenges and recommendations for practice. *Heliyon* (2021).
3. Baser, D., Kopcha, T. J. & Yasar Ozden, M. Understanding the role of teacher mentoring in online learning: A structural equation modeling approach. *Educ Technol Res Dev* **69**, 2519–2544 (2021).
4. Li, Y. & Zhang, L. J. Influence of mentorship and the working environment on English as a foreign language teachers' research productivity: The mediation role of research motivation and self-efficacy. *Front. Psychol.* **13**, 906932 (2022).
5. Szymańska-Tworek, A. Mentoring as professional development for mentors. *Theory Pract Second Lang Acquis.* **2**(8), 1–22 (2022).
6. Elkomy, M. M. & Elkhaial, N. H. The lesson study approach to professional development: Promoting teachers' peer mentoring and communities of practice. *Teach. Teacher Educ.* **109**, 103538 (2022).
7. Yan, C. & He, C. Mentoring teachers for transformative teaching: A multilevel analysis of challenges and resources. *Teach. Teach. Educ.* **105**, 103416 (2021).
8. Erdoğan, S., Haktanır, G., Kuru, N., Parpucu, N. & Tüylü, D. K. The effect of the e-mentoring-based education program on professional development of preschool teachers. *Educ. Inf. Technol.* **27**(1), 1023–1053 (2022).
9. Tanjung, F. Z., Sadeghi, K. & Ghaderi, F. Mentoring dynamics in esl/efl teacher professional development: A systematic literature review. *TESOL J.* **12**(2), e580 (2021).
10. Maniam, M. & Pirzada, K. Mentorship models for teacher professional development in south Asian contexts: A comparative analysis. *Asia Pac. J. Educ.* **45**(2), 289–306 (2025).
11. Reed, M. et al. Sustainability in English language teacher education: Preparing teachers for an unknown future. *Innov. Engl. Lang. Teach.* (2025).
12. Uribe-Zarain, X., Hellman, A. B. & Bell, A. B. Transforming teacher attitudes and practices: The efficacy of sustained professional development in culturally responsive education. *TESOL J.* **16**(1), e896 (2025).
13. Iqbal, S. & Ali, A. Education and professional development: Opportunities and challenges for in-service teachers: A review. *Gomal Univ. J. Res.* **40**(1), 117–133 (2024).
14. Kalim, U. & Bibi, S. Assessing teacher competencies in public schools of Pakistan: a pathway for improving the effectiveness of professional development programs for teachers. *SAGE Open* **14**(2), 21582440241236060 (2024).
15. Nawab, A. & Quraishi, M. Teachers value PD if leaders value PD: Role of school leaders in professional development of teachers in rural Pakistan. *Leadersh. Policy Sch.* **24**(4), 788–803 (2024).
16. Shariq, M., Imran, Q. & Maqbool, S. Teachers as change agents: Professional development for inte- grating sdgs into pedagogy in pakistani context. *J. Dev. Soc. Sci.* **6**(1), 42–51 (2025).
17. Afshar, H. S., & Farahani, M. Peer-coached versus self-directed professional develop- ment: Efl teachers' perspectives and practices. *Prof. Dev. Educ.* **48**(5), 845–861 (2022).
18. Zakaria, M. & Johnson, K. E. E-mentoring as a sustainable professional development tool in low-resource contexts. *TESOL Q.* **59**(1), 121–147 (2025).
19. Vadivel, B., Mathrani, A. & Susilo, W. A systematic review on the effectiveness of sustainable professional development models for stem teachers. *Educ. Sci.* **11**(8), 408 (2021).
20. Travers, J., & King, F. Social justice leadership in Irish schools: Conceptualisations, supports and barriers. *Irish Educ. Stud.* 1–21 (2025).
21. Gorman, A., King, F., Madrid Miranda, R., Jones, M. & Harris, A. System leadership: implications and considerations for school leaders. *Sch. Leadersh. Manag.* **45**(2), 1–4 (2025).
22. Francis, S. S. et al. Spanners and enhancers: The role of teacher leaders in school evolution. *Educ. Manag. Admin. Leadersh.* (2025).
23. King, F. Professional learning: a call to criticality, action and reflexivity. *Prof. Dev. Educ.* **50**(6), 1053–1055 (2024).
24. Morrissey, B., Keating, S. & King, F. Enacting a child safety education programme in special education contexts. *Child. Youth Serv. Rev.* **163**, 107735 (2024).
25. Morrissey, B., King, F., & Keating, S. Conceptualising inclusive curricula for learners with complex special educational needs: narrowing the design gap between commonality and difference. *Int. J. Incl Educ.* 1–20 (2024).
26. Donlon, E. & King, F. From room to zoom: Co-constructing doctoral community in pandemic and post-pandemic times. *Impact. Educ. J. Transf. Prof. Pract.* **9**(1), 55–62 (2024).
27. Szymanska, M. & Kędzierska, B. Mentoring in teacher professional development: A systematic review. *Eur. J. Teach. Educ.* **45**(3), 365–383 (2022).
28. Elkomy, M. & Levin, B. B. Lesson study-based mentoring for beginning teachers: A review of research. *Prof. Dev. Educ.* **48**(2), 289–306 (2022).
29. Uribe-Zarain, X. & Liang, X. Building sustainable teacher learning communities through men- torship: A longitudinal study. *Teach. Teach. Educ.* **117**, 103982 (2025).
30. Hidayat, L., Yasin, A. & Sukyadi, D. Sustainable professional development for English language teachers: A systematic review. *Indones. J. Appl. Linguist.* **11**(1), 175–186 (2021).
31. Gülbak, O. M. & Celik, S. Sustainable professional development through hybrid mentoring: A mixed-methods study of language teachers. *Int. J. Mentor. Coach. Educ.* **14**(1), 23–42 (2025).
32. Byers, T., Imms, W. & Hartnell-Young, E. Comparative analysis of the impact of traditional versus innovative learning environment on student attitudes and learning outcomes. *Stud. Educ. Eval.* **58**, 167–177 (2018).
33. Grassini, S. Shaping the future of education: Exploring the potential and consequences of ai and chatgpt in educational settings. *Educ. Sci.* **13**(7), 692 (2023).
34. Nguyen, A., Ngo, H. N., Hong, Y., Dang, B. & Nguyen, B. P. T. Ethical principles for artificial intelligence in education. *Educ. Inf. Technol.* **28**(4), 4221–4241 (2023).

35. Nawab, A. & Baig, S. Teacher professional development in rural pakistan: Challenges and opportunities. *Prof. Dev. Educ.* **50**(2), 312–328 (2024).
36. Rafiq, K. & Ashraf, M. A. Gender disparities in professional development opportunities for language teachers in Pakistan. *Gend Educ* **36**(3), 345–362 (2024).
37. Akram, M. & Malik, S. Institutional barriers to teacher mentoring in pakistani higher education: A qualitative inquiry. *Qual. High. Educ.* **30**(1), 78–95 (2024).
38. Shariq, M. & Seargeant, P. Transforming english language teacher education in pakistan: Policy recommendations and implementation strategies. *Curr. Issues Lang. Plan.* **26**(1), 56–75 (2025).
39. Phulpoto, N. A. & Gopang, I. B. Digital literacy and professional development of english language teachers in pakistan. *Int. J. Educ. Technol.* **11**(2), 217–234 (2024).
40. Abbasi, N. & Shah, S. K.. Technological challenges in teacher professional development: A case study of Pakistani English language teachers. *Int. J. Educ. Technol. High. Educ.* **21**(1), 17 (2024).
41. Creswell, J. W. & Plano Clark, V. L. *Designing and conducting mixed methods research* 3rd edn. (Sage, 2018).
42. Hair, J. F., Tomas, G., Hult, M., Ringle, C. M. & Sarstedt, M. *A primer on partial least squares structural equation modeling (PLS-SEM)* 3rd edn. (Sage, 2022).
43. Sarstedt, M., Ringle, C. M., & Hair, J. F. Hair. Partial least squares structural equation modeling. in *Handbook of Market Research* 587–632 (2021).
44. McHugh, M. L. Interrater reliability: The kappa statistic. *Biochem. Med.* **22**(3), 276–282 (2012).
45. Bandura, A. *Self-efficacy: The exercise of control* (W. H. Freeman, 1997).
46. Beauchamp, C. & Thomas, L. Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Camb. J. Educ.* **39**(2), 175–189 (2009).
47. Lave, J. & Wenger, E. *Situated Learning: Legitimate Peripheral Participation* (Cambridge University Press, 1991).

Author contributions

The contributions of each author to this research are as follows: S.H.: Conceptualization, Writing—Original Draft, Literature Review, Editing. E.D.: Supervision, Conceptualization, Writing—Review and Editing. M.F.: Mathematical Modeling, Formal Analysis, Methodology, Visualization, Writing—Review and Editing. All authors reviewed and approved the manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1038/s41598-025-29242-5.

Correspondence and requests for materials should be addressed to M.F.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.