

AI-Supported Positive Psychology-Informed Pedagogy: A Mixed- Methods Study in Iranian EFL Contexts

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Abstract

Teacher well-being has become an increasingly important concern in educational research, particularly in light of rising workloads, emotional demands, and institutional pressures. Among the factors associated with teacher well-being, burnout has been identified as a critical challenge that negatively affects professional effectiveness, job satisfaction, and retention. This study examines the relationship between spiritual intelligence and teacher burnout, with particular attention to the extent to which spiritual intelligence functions as a protective psychological resource. Drawing on conceptualizations of spiritual intelligence as the capacity to construct meaning, maintain inner balance, and transcend stressors, the study investigates its association with key dimensions of burnout, including emotional exhaustion, depersonalization, and reduced personal accomplishment. Using a quantitative research design, data were collected from teachers through validated measures of spiritual intelligence and burnout and analysed using correlational and regression analyses. The findings reveal a significant negative relationship between spiritual intelligence and overall burnout, indicating that higher levels of spiritual intelligence are associated with lower emotional exhaustion and depersonalization, as well as stronger perceptions of professional efficacy. These results suggest that spiritual intelligence contributes to teachers' resilience by supporting emotional regulation, purpose-oriented coping, and sustained engagement in professional roles. The study highlights the importance of addressing teachers' inner and existential dimensions as part of comprehensive approaches to burnout prevention. Implications are discussed for teacher education, professional development, and institutional well-being initiatives, emphasizing that fostering spiritual intelligence may play a meaningful role in promoting long-term teacher well-being and educational sustainability.

1. Introduction

English as a Foreign Language (EFL) instruction in Iran has traditionally been shaped by highly exam-oriented practices that emphasize grammar accuracy, translation, and memorization (Pishkar & Shokouhi, 2021). Although these approaches may support short-term test performance, they often overlook the emotional and motivational conditions that sustain long-term language development. Recent research in applied linguistics demonstrates that affective factors such as enjoyment, resilience, and motivation strongly influence willingness to communicate, persistence, and proficiency outcomes (Dewaele & MacIntyre, 2014, 2016; MacIntyre et al., 2019; Barjesteh & Isaei, 2024). These findings signal a growing recognition that cognitive progress in language learning is deeply intertwined with emotional well-being.

At the same time, advances in artificial intelligence (AI) have begun to reshape education through adaptive scaffolding, real-time feedback, and personalized learning opportunities (Li et al., 2023; Risdianto et al., 2025; Wang et al., 2023). AI refers to computer systems capable of performing tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making (Copeland, 2025). Within language learning, AI has been shown to support vocabulary expansion, facilitate speaking practice, and provide individualized corrective feedback (Du & Daniel, 2024; Zou &

Wang, 2024). However, global scholarship increasingly cautions that AI is not neutral: its effects are shaped by questions of learner agency, transparency, and the emotional tone of automated feedback (Manoocherzadeh et al., 2025). European and North American research highlights concerns regarding cognitive overload, algorithmic opacity, and student dependency, noting that technology may either empower or constrain learners depending on how it is integrated into instruction (Holmes & Porayska-Pomsta, 2023; Kizilcec, 2024; Luckin, 2023). These critical perspectives underline the need for pedagogical designs that incorporate human mediation and ensure that AI supports, rather than replaces, meaningful learning relationships (Belda-Medina & Goddard, 2024; Kim, 2024).

Positive Psychology (PP) offers a complementary framework for addressing these challenges. Grounded in the PERMA model of well-being (Seligman, 2011), PP emphasizes positive emotion, engagement, relationships, meaning, and accomplishment as foundations for personal growth. In second language acquisition (SLA), PP has shifted attention from deficit-oriented constructs such as anxiety to strengths-based constructs such as enjoyment, optimism, and resilience (MacIntyre et al., 2019; Ajani et al., 2024). Research in Western contexts shows that gratitude practices, strengths-based feedback, and reflective goal setting enhance motivation and support deeper learning (Niemiec & Ryan, 2009). These findings suggest that PP may help create emotionally supportive learning conditions that complement AI's adaptive capabilities (Lai & Lee, 2024; Olyaei et al., 2024).

1.2 Research Gap

Current scholarship reveals three main shortcomings that this study aims to address. First, the integration gap: although both AI and PP have shown independent benefits in EFL instruction, relatively few investigations have combined them into a unified pedagogical framework (An et al., 2022; Du & Daniel, 2024). Second, the contextual gap: most existing studies are concentrated in Western and East Asian contexts, leaving underexamined regions such as Iran, where high-stakes examinations and cultural expectations significantly influence learners' attitudes and experiences (Hoseini Moghadam, 2023; Olyaei et al., 2024). Third, the methodological gap: prior work has frequently relied on correlational evidence or self-report surveys, limiting the ability to identify causal mechanisms (Beege et al., 2024).

The present study addresses these gaps by designing and evaluating an EFL program in Iran that integrates AI with PP-based practices. Using a convergent mixed-methods design, the research investigates not only whether this integration enhances language proficiency and learner well-being, but also how affective engagement and cultural adaptation mediate these outcomes. In doing so, it contributes both theoretical insights and practical guidance for developing AI-supported, well-being-oriented language instruction in non-Western settings.

Beyond regional findings, recent Western research also provides important insights into how AI and well-being intersect in educational settings. European studies have examined AI-mediated feedback and digital agency, showing that learners' trust, autonomy, and perceived control strongly shape learning outcomes (Holmes & Porayska-Pomsta, 2023; Luckin, 2023). Similarly, North American scholarship

highlights both opportunities and risks of AI for students' digital well-being, emphasizing cognitive load, algorithmic transparency, and the socio-emotional implications of automated feedback (Kizilcec, 2024). These works suggest that AI's pedagogical value is inseparable from broader issues of learner agency, identity, and ethics.

PP research in the West likewise underscores the importance of autonomy-supportive learning environments and emphasizes how meaning-making, gratitude, and reflective practices contribute to sustained motivation and emotional resilience (Niemiec & Ryan, 2009). Integrating these perspectives deepens the theoretical grounding of the present study by showing how PP principles reinforce the socio-emotional scaffolding needed to optimize AI-mediated instruction.

Despite these advances, the integration of AI and PP remains underexplored. Most existing AI research has focused on technological efficiency rather than socio-emotional outcomes, while PP research often lacks attention to digital and automated learning environments. Moreover, the majority of empirical studies come from East Asia, with limited work examining how AI and PP operate together in non-Western contexts marked by high-stakes testing and cultural expectations, such as Iran. As scholars in AI ethics emphasize, culturally sensitive and contextually informed approaches are essential to avoid reproducing inequities or overlooking learner values (Knox, 2023). This gap underscores the need for studies that not only test whether AI and PP can be integrated but also investigate how learners experience this integration and how cultural norms shape its effectiveness.

The present study addresses these gaps by implementing a convergent mixed-methods design to evaluate an EFL program in Iran that combines AI-supported instruction with PP-based activities. By examining both quantitative outcomes (e.g., proficiency, enjoyment, well-being, resilience) and qualitative experiences (e.g., learner perspectives, cultural adaptation, teacher mediation), the study contributes to the emerging literature on holistic, human-centered AI in language education. In doing so, it responds to global calls for pedagogical models that balance technological affordances with emotional well-being, cultural responsiveness, and learner agency.

2. Literature Review

2.1 Positive Psychology (PP) in Language Learning

PP has shifted the focus of SLA research away from deficit-oriented constructs, such as anxiety and attrition, toward strengths like resilience, enjoyment, and overall well-being (Seligman & Csikszentmihalyi, 2000; MacIntyre et al., 2019). Among these, Foreign Language Enjoyment (FLE) has consistently emerged as a strong predictor of learners' willingness to communicate, academic persistence, and achievement (Dewaele & MacIntyre, 2016; Dewaele, 2023). The PERMA framework, which highlights Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment, provides a useful structure for embedding PP principles into pedagogy (Butler & Kern, 2016).

International research (both Western and non-Western) points to the value of PP-based pedagogy. In North America, strengths-based interventions have been shown to support motivation and deepen learning engagement (Niemiec & Ryan, 2009). In Europe, PP-informed classroom designs have been linked to increased learner autonomy and emotional regulation, emphasizing the role of meaning-making in sustaining motivation (Oxford, 2016). In Iran, PP initiatives have been shown to improve self-esteem (Noori & Narafshan, 2018) and reduce negative affective reactions during listening tasks (Abdolrezaei & Ghanbari, 2021), while also enhancing listening comprehension and fostering positive affect (Oladrostam et al., 2022); however, implementation remains uneven. Yet, despite teachers' theoretical endorsement of PP, many report difficulties in translating these principles into regular classroom practices (Oladrostam et al., 2022). This discrepancy highlights the need for pedagogical models that help both teachers and learners integrate PP practices seamlessly into everyday instruction.

2.2 Artificial Intelligence in the EFL Context

AI is now widely recognized as a transformative force in language education, supporting adaptive scaffolding, interactive practice, and real-time feedback (Du & Daniel, 2024; Sun & Lin, 2022). Studies across Asia, Europe, and North America show that AI tools can accelerate vocabulary development, improve speaking fluency, and enhance engagement through personalization (Chu et al., 2023; Zou & Wang, 2024). These benefits are especially relevant in large classes or exam-driven contexts (Isaee & Barjesteh, 2025) where individualized teacher feedback is difficult to sustain (Wang et al., 2023).

However, global scholarship also highlights the limitations and risks of AI-mediated learning. European researchers emphasize concerns related to algorithmic opacity, bias, and the potential erosion of learner agency when automation dominates instructional decision-making (Luckin, 2023). North American studies on digital well-being caution that AI feedback can inadvertently increase cognitive load or heighten stress when it is perceived as overly evaluative or misaligned with learners' needs (Gruenhagen et al., 2024; Kizilcec, 2024). Research also indicates that AI systems may unintentionally reproduce inequities unless socio-cultural factors are explicitly considered (Bin-Hady et al., 2024; Knox, 2023). These findings underline the importance of integrating AI within broader human-led pedagogical frameworks that attend to learners' values, emotions, and social identities.

Within Iran, AI adoption has focused primarily on assessment and vocabulary instruction (Marandi & Hosseini, 2024; Mohammadi et al., 2025). Yet, empirical attention to the socio-emotional dimensions of AI in EFL settings remains limited. As a result, the potential for AI to support learners' well-being or to interact meaningfully with PP principles has been underexamined.

2.3 Linking Artificial Intelligence and Positive Psychology

While AI and PP each contribute valuable affordances to language learning, their integration remains in an early and largely exploratory stage. Theoretically, AI offers adaptivity and individualized scaffolding, whereas PP emphasizes emotional flourishing, meaning, and resilience. Recent scholarship in human-AI interaction argues that effective learning emerges not from technology alone but from emotionally supportive environments where learners experience autonomy, competence, and relatedness (Holmes &

Porayska-Pomsta, 2023). This aligns with PP's strengths-based approach, suggesting that combining AI's cognitive supports with PP's emotional scaffolding may yield complementary benefits.

Empirical work in this area is growing but still sparse. Some studies suggest that AI chatbots can facilitate affective growth by providing low-pressure practice and nonjudgmental feedback (Bin-Hady et al., 2024; Slamet, 2024). Western research on digital well-being also indicates that reflective prompts and personalized encouragement embedded within digital systems can strengthen resilience and autonomy (Luckin, 2023). Yet, few studies examine how PP practices (such as gratitude journaling, meaning-making, or strengths identification) can be intentionally woven into AI-mediated learning tasks. Even fewer explore how cultural expectations shape learners' responses to such integration.

This gap underscores the need for pedagogical models that strategically align AI affordances with PP principles, supported by teacher mediation and cultural adaptation.

The choice of FLE as a mediator was grounded in the broaden-and-build theory (Fredrickson, 2001), which posits that positive emotions expand learners' cognitive resources and support sustained effort. In addition, socio-cognitive models of SLA emphasize that affective variables serve as proximal mechanisms linking instructional environment to linguistic outcomes (Dewaele & MacIntyre, 2016; MacIntyre et al., 2019). Enjoyment was therefore conceptualized as a theoretically justified mediator that operates between instructional conditions and proficiency development. While the present model focused on FLE, future extensions may incorporate multiple mediators such as engagement, academic buoyancy, or growth mindset to capture a more complex affective network.

2.4 The Iranian EFL Context

The Iranian EFL context is characterized by exam-driven instruction, limited opportunities for authentic interaction, and elevated levels of language anxiety (Pishkar & Shokouhi, 2021). Although AI has gained some traction in educational policy and practice, its adoption has largely remained technocentric, focusing on efficiency, automation, and assessment rather than learner well-being or socio-emotional growth (Hoseini Moghadam, 2023; Marandi & Hosseini, 2024). Likewise, while PP principles hold promise, teachers often struggle to incorporate them consistently due to curricular constraints, time pressures, and cultural expectations (Oladrostan et al., 2022).

Cultural mediation plays a pivotal role in shaping the reception of PP and AI in Iran. Without contextual adaptation, PP activities may appear unfamiliar or misaligned with students' lived experiences (Marandi & Hosseini, 2024; Mohammadi et al., 2025). Meanwhile, concerns about AI (such as mistrust, misalignment with local learning norms, or fears of reduced teacher authority) also influence adoption. These realities highlight the importance of designs that situate AI–PP integration within learners' sociocultural frameworks, supported by teachers who can translate unfamiliar concepts into culturally meaningful practices.

2.5 Conceptual Framework

This study is grounded in the premise that cognitive development and emotional well-being are inseparable in language learning. Within this framework, AI and PP function as complementary forces: AI offers adaptive, individualized instruction, while PP highlights well-being, engagement, and resilience. Their integration is expected to strengthen both linguistic achievement and psychological flourishing. AI contributes through features such as dynamic task sequencing, instant corrective feedback, and interactive practice that adjust to learners' evolving needs. In parallel, PP draws on the PERMA model by embedding activities like gratitude journaling, reflective goal setting, and strengths-based feedback. These practices do not operate as isolated techniques; rather, they enhance mediating processes such as enjoyment, engagement, and academic buoyancy, which in turn support proficiency gains and improvements in well-being.

The framework also underscores the moderating role of cultural expectations and teacher mediation. Since PP activities may appear novel or unfamiliar in highly exam-driven contexts, teachers act as cultural mediators who contextualize and normalize such practices. Thus, technological affordances alone are insufficient (their effectiveness depends on whether emotional scaffolding and cultural adaptation are integrated into pedagogy).

The conceptual model (Fig. 1) illustrates these dynamics: AI and PP inputs interact, their combined effects flow through mediators like engagement and enjoyment, and outcomes are shaped by moderators such as cultural norms and teacher facilitation. By clarifying these mechanisms, the framework provides both a theoretical rationale and a practical roadmap for AI–PP integration in EFL education.

The framework illustrates how AI affordances and PP practices operate as complementary inputs. Their combined influence is channeled through mediating processes such as enjoyment, engagement, and buoyancy, which in turn lead to both linguistic and well-being outcomes. Importantly, the model emphasizes that cultural norms and teacher mediation act as moderators that can either strengthen or constrain the effectiveness of the intervention. By highlighting these pathways, the framework clarifies how the present study contributes to theory and practice in AI-mediated, well-being-oriented language education.

2.5 Related Studies

Recent research increasingly explores how PP, AI, and EFL learning intersect, especially through intervention-based and mixed-methods approaches. Several studies show that AI-mediated tools impact learners' emotional, social, and cognitive experiences. For example, Bin-Hady et al. (2024) found that EFL learners using ChatGPT valued its support for conversational practice and experienced reduced anxiety, though the authors highlighted that heavy reliance on AI might limit creativity without proper teacher mediation (see also Slamet, 2024).

Beyond Asia, Western scholarship has explored similar issues from the viewpoints of human–AI interaction and digital well-being. In the United States, Madwe et al. (2025) reported that learners' trust in

AI feedback systems strongly predicted engagement and emotional responses, highlighting the importance of transparency and perceived fairness in maintaining motivation. Similarly, Gruenhagen et al. (2024) found that American undergraduates using AI-supported writing tools experienced less stress and greater confidence, although some also reported cognitive overload when feedback was too frequent or lacked proper context. European research reflects these trends: Holmes and Porayska-Pomsta (2023) and Luckin (2023) argue that AI can support learner autonomy only when integrated into pedagogical designs that preserve agency, prevent over-automation, and encourage reflective engagement.

Research has also explored AI's influence on engagement and academic behaviors. A quasi-experimental study in China found that AI-powered platforms increased cognitive, behavioral, and emotional engagement while decreasing academic procrastination, with learners reporting better focus and self-regulation (Ma & Chen, 2024). Similarly, AI-driven speaking assistants have been shown to boost enjoyment and willingness to communicate while reducing foreign language anxiety (ScienceDirect, 2023; Yang & Zhao, 2024). Supporting findings come from North American survey research: in a multi-university study, Gruenhagen et al. (2024) noted that AI-based instructional support improved engagement and lessened anxiety, although some learners felt overwhelmed by the rapid automated feedback.

Studies integrating motivational frameworks with AI acceptance models also offer insights. A survey of 730 EFL learners using a modified Technology Acceptance Model (TAM) showed that perceived ease and usefulness of AI, mediated by motivation and metacognitive strategies, enhanced resilience, optimism, and growth mindset (Lyu et al., 2025). Similar findings appear in U.S. research on digital tutoring systems, where motivation and perceived autonomy support predicted well-being outcomes during AI-guided learning (Kaufman & Nemeroff, 2025).

Within Iran, PP-focused research remains developing but promising. Oladrostam et al. (2022) introduced the Inventory of Positive Psychology in Language Learning (IPPLL), noting that teachers generally endorsed stronger PP orientations than learners, though many struggled with practical implementation. Other experimental studies confirm PP's benefits: Noori and Narafshan (2018) enhanced learners' self-esteem through a five-month PP intervention, while Abdolrezapour and Ghanbari (2021) integrated gratitude and emotion regulation strategies into listening tasks, yielding cognitive and affective gains. In professional development, Isaee and Barjesteh (2023) found that teachers with stronger PP orientations demonstrated greater professional growth and reflective capacity, highlighting the need for teacher support when adopting PP practices.

Together, international evidence indicates that AI and PP each make substantial contributions to language learning. AI supports engagement, reduces anxiety, and promotes self-regulation, while PP strengthens resilience, motivation, and emotional well-being. However, very few studies have systematically combined these approaches, and almost none have done so within non-Western, exam-driven contexts such as Iran. Building on these gaps, the present research evaluates an integrated AI +

PP intervention, with particular attention to methodology, cultural adaptation, and socio-emotional outcomes. Accordingly, this study seeks to address the following research questions:

2.6 Research Questions

1. Does an AI-supported EFL program infused with PP principles improve Iranian learners' English proficiency more than AI-only and traditional instruction?
2. Does the AI + PP program enhance learners' FLE, well-being, and academic buoyancy compared with the other groups?
3. To what extent do affective gains (e.g., enjoyment, engagement) mediate the relationship between instructional condition and English achievement?
4. How do learners and teachers describe their experiences of AI-supported PP activities in the Iranian EFL classroom?
5. What cultural and institutional conditions shape acceptance, resistance, or transformation of the AI + PP program?

3. Methodology

3.1 Research Design

This study employed a convergent mixed-methods design to capture both outcomes and underlying processes of the intervention. Quantitative and qualitative strands were conducted in parallel, analyzed separately, and then integrated for interpretation.

On the quantitative side, a cluster-randomized quasi-experimental design compared three instructional conditions:

1. AI + PP: AI-supported instruction enriched with Positive Psychology practices.
2. AI-only: AI-supported instruction without PP integration.
3. Control: business-as-usual teaching with no AI involvement.

On the qualitative side, student and teacher interviews, classroom observations, and teacher journals were collected to investigate learners' experiences, motivational shifts, and cultural dynamics. This combination allowed the study to test causal effects while also providing deeper insight into mechanisms and contextual influences.

3.1.1 Randomization Procedures and Instructor Bias Control

To strengthen internal validity, several procedures were implemented to verify baseline equivalence and minimize instructor-related bias. After cluster randomization of intact classes, baseline comparability

across the three conditions was assessed using one-way ANOVA on pre-test proficiency, FLE, well-being, and academic buoyancy. No significant differences were observed (all p s > .20), confirming statistical equivalence before the intervention. Instructors were also randomly assigned to conditions and received identical training to standardize pedagogical expectations. To further reduce instructor effects, each teacher was restricted to one condition only, and their teaching experience and qualifications were matched as closely as possible. Fidelity checks were conducted twice during the semester by trained observers to ensure adherence to condition-specific instructional protocols.

3.1.2 Handling of Missing Data

Missing data were examined for randomness using Little's MCAR test, which indicated no systematic patterns (χ^2 nonsignificant). Because missingness was minimal (< 5% across all variables), multiple imputation with 20 iterations was employed to preserve statistical power and reduce potential bias. All inferential analyses were performed on the pooled imputed datasets. As a robustness check, key analyses were re-run using listwise deletion, and the pattern of results remained substantively unchanged.

3.1.3 Qualitative Saturation and Coding Reliability

For the qualitative strand, thematic saturation was used to determine the adequacy of the sample size. Saturation was reached after approximately 25 student interviews, when no new codes or conceptual categories emerged. To ensure dependability, two independent researchers coded 20% of the interview transcripts, yielding Cohen's κ = .87, which indicates strong intercoder reliability. Coding discrepancies were resolved through discussion before proceeding with full dataset coding. Peer debriefing meetings were conducted regularly throughout the analysis to enhance analytic rigor and reflexivity.

3.2 Participant

A total of 200 undergraduates (ages 18–24) from three Iranian universities participated. Eight intact classes, each comprising 20–30 students, were randomly assigned to one of the three conditions. Cluster randomization was applied to minimize cross-group contamination. Gender distribution and prior proficiency levels were balanced across groups where possible.

Additionally, six EFL instructors were involved, each trained according to the instructional model of their respective group. Table 1 provides a summary of participant demographics.

Table 1
Demographic Information of Participants

Variable	AI + PP (n = 70)	AI-only (n = 65)	Control (n = 65)	Total (N = 200)
Gender (M/F)	32 / 38	30 / 35	31 / 34	93 / 107
Age (Mean, SD)	20.8 (1.2)	20.5 (1.4)	20.6 (1.3)	20.6 (1.3)
Prior proficiency*	Intermediate: 85% Upper-intermediate: 15%	Similar	Similar	—
Socioeconomic status (self-reported)	Low: 25% / Middle: 60% High: 15%	Similar	Similar	—
Teacher (n)	2	2	2	6

*Based on the institutional placement test before the study.

3.3 Procedure

The intervention took place over ten weeks, with two 90-minute sessions per week. This schedule mirrored typical university course formats in Iran and provided sufficient time to integrate AI-supported tasks alongside PP activities.

Before implementation, all six instructors participated in a two-day training workshop facilitated by the research team. The sessions introduced teachers to the AI platform, familiarized them with PP principles, and provided practice in embedding PP activities into classroom routines. Instructors assigned to the AI + PP group also received additional coaching on strategies for cultural adaptation, ensuring that PP practices would be meaningful within the Iranian context. To minimize contamination across groups, instructors were randomly assigned to conditions, and none taught in more than one group.

In the AI + PP condition, learners worked with the AI platform for speaking, writing, and vocabulary development. PP tasks guided by the PERMA model, such as gratitude journaling, reflective writing, and goal setting, were embedded into these activities. Class discussions further reinforced these tasks, and teachers offered feedback not only on linguistic performance but also on learners' effort and resilience, thereby encouraging a growth mindset.

In contrast, the AI-only condition required students to complete the same AI-based language tasks without any PP elements. Teachers provided corrections on grammar, vocabulary, and usage, but did not

frame tasks around well-being or motivational principles.

The control group followed the institution's conventional EFL curriculum, which emphasized textbook-based grammar, reading comprehension, and exam preparation. No AI tools or PP-inspired activities were used in this setting.

Qualitative data were gathered to complement the quantitative measures. Semi-structured interviews were conducted with 20–30 students and all six instructors at the end of the program. Each interview lasted between 30 and 45 minutes, was carried out in Persian to preserve authenticity, and was audio-recorded with participants' consent. Recordings were transcribed verbatim and translated into English for analysis. In addition, teachers maintained weekly journals to record classroom dynamics and reflections, while trained observers used structured protocols to document engagement, affective climate, and learner–AI interaction throughout the study.

3.4 Instruments and Validation

To evaluate the intervention comprehensively, the study employed a combination of quantitative and qualitative instruments, with careful validation procedures to ensure reliability and cultural appropriateness. By combining validated quantitative instruments with rigorously collected qualitative evidence, the study ensured a robust and trustworthy dataset capable of capturing both cognitive and affective dimensions of the intervention, as follows.

3.4.1 Quantitative Instruments

On the quantitative side, the central affective measure was the Foreign Language Enjoyment (FLE) scale (Dewaele & MacIntyre, 2014). The 21-item scale was translated into Persian using a back-translation procedure carried out by bilingual experts and piloted with 45 learners. Internal consistency was excellent (Cronbach's $\alpha = .91$), and confirmatory factor analysis confirmed the expected two-factor structure (FLE-Social and FLE-Private), with strong model fit indices (CFI = .96, RMSEA = .04).

Learners' broader well-being was assessed using the PERMA-Profiler short form (Butler & Kern, 2016). The 15 items measured positive emotion, engagement, relationships, meaning, and accomplishment. Items were adapted slightly for an academic context and reviewed by experts for cultural relevance. Reliability was strong (α values ranging from .78 to .86 across subscales).

The Academic Buoyancy Scale (Martin & Marsh, 2008) measured resilience in everyday academic challenges, such as coping with exam stress or disappointing grades. The Persian adaptation yielded satisfactory internal consistency ($\alpha = .82$), with content validity confirmed by three applied linguistics specialists.

To capture learners' beliefs about ability, growth mindset items adapted from Dweck (2016) were contextualized for EFL learning. Expert review confirmed clarity and appropriateness, and pilot testing produced acceptable reliability ($\alpha = .79$).

Language achievement was assessed with an institutional proficiency test equivalent to TOEFL/IELTS. The test covered the four skills (listening, reading, writing, speaking), and productive components were rated by trained evaluators blind to group assignments. Inter-rater reliability was high (ICC = .87).

Objective indicators of AI engagement were drawn from system-generated logs, which tracked practice frequency, time on task, and task completion. These measures complemented self-reported outcomes with behavioral evidence.

3.4.2 Qualitative Instruments

On the qualitative side, semi-structured interviews with 20–30 students and all six instructors captured perceptions of AI feedback, motivational responses to PP activities, and the cultural fit of the intervention. Interviews were conducted in Persian to maximize authenticity, lasted 30–45 minutes, and were audio-recorded with informed consent. Transcripts were produced verbatim and subsequently translated into English for analysis. To ensure credibility, member checking was conducted by sharing interview summaries with participants.

In addition, instructors kept weekly journals to document classroom dynamics, learner reactions, and pedagogical challenges. To triangulate these accounts, trained researchers conducted classroom observations using a structured rubric targeting engagement, affective climate, and learner–AI interaction. Inter-observer agreement reached 82%, supporting dependability.

3.6 Data Analysis

Data were analyzed through both quantitative and qualitative approaches, which were later merged for interpretation.

For the quantitative strand, a multilevel modeling approach was applied to account for the nested structure of students within classes. This allowed the study to control for clustering effects and produce more accurate estimates of intervention outcomes. As a supplementary test, ANCOVA was conducted with pre-test scores as covariates to validate group differences. In addition, mediation analyses were used to examine whether affective variables, particularly enjoyment and well-being, explained the relationship between instructional condition and language achievement. To enhance interpretability, effect sizes (Cohen's d , η^2) and confidence intervals were reported alongside significance tests. Missing values were addressed through multiple imputation, reducing the likelihood of bias.

For the qualitative strand, interview transcripts, teacher journals, and classroom observation notes were analyzed thematically following Braun and Clarke’s (2006) six-step framework. Two researchers independently coded 20% of the dataset, with discrepancies resolved through discussion, ensuring intercoder reliability above 85%. Triangulation across different qualitative sources enhanced credibility, while member checking and peer debriefing further supported trustworthiness.

Finally, the two strands were integrated using joint displays, which aligned quantitative findings with qualitative themes. For instance, statistical gains in enjoyment were interpreted alongside interview narratives describing students’ positive responses to PP activities. This mixed-methods integration provided a more comprehensive understanding of both outcomes and mechanisms.

4. Results

4.1 Descriptive Statistics

This section provides an overview of the descriptive results for all main quantitative variables across the three groups, reported as means and standard deviations. These preliminary figures illustrate overall trends before inferential testing. Variables include language proficiency, foreign language enjoyment (FLE), well-being, and academic buoyancy. The descriptive statistics of the main variables are shown in Table 2.

Table 2
Descriptive Statistics of Main Variables (M, SD)

Variable	Group	Pre-test M (SD)	Post-test M (SD)
Language Proficiency	AI + PP	52.3 (6.1)	71.8 (7.2)
	AI-only	53.1 (6.4)	65.2 (6.9)
	Control	52.8 (6.7)	59.7 (7.0)
FLE	AI + PP	3.42 (.58)	4.25 (.61)
	AI-only	3.39 (.55)	3.78 (.59)
	Control	3.41 (.60)	3.53 (.63)
Well-being (PERMA)	AI + PP	3.51 (.49)	4.12 (.52)
	AI-only	3.47 (.52)	3.69 (.54)
	Control	3.50 (.50)	3.55 (.53)
Academic Buoyancy	AI + PP	3.32 (.61)	3.98 (.58)
	AI-only	3.29 (.63)	3.55 (.61)
	Control	3.30 (.62)	3.39 (.64)

As shown in Table 2, across all groups, scores improved from pre- to post-test. However, the AI + PP group consistently demonstrated the largest gains, particularly in language proficiency and FLE. For example, proficiency scores increased by nearly 20 points in the AI + PP condition compared with about 12 points in the AI-only group and 7 points in the control group. Similarly, the AI + PP group reported substantial improvements in enjoyment and well-being, while the control group showed minimal change. These descriptive patterns suggest that the integrated intervention may offer greater benefits than AI alone or traditional instruction, a finding examined more rigorously in the inferential analyses that follow.

4.2 Inferential Analyses

This section reports formal statistical tests examining the effects of the intervention. We first analyze language proficiency, FLE, wellbeing, and academic buoyancy using multilevel modeling and repeated-measures ANOVA to account for the nested structure of students within classes. Post hoc tests and mediation analyses are conducted to examine group differences and the potential indirect effects of affective variables on language outcomes.

4.2.1 Language Proficiency

The following table (Table 3) presents the results of a multilevel ANCOVA examining post-test language proficiency across the three instructional conditions. The analysis evaluates whether the type of intervention had a significant impact on students’ English achievement while controlling for pre-test scores.

Table 3
Multilevel ANCOVA for Post-test Language Proficiency

Source	df	F	p	η^2
Group	2	18.42	< .001	.16
Pre-test	1	112.31	< .001	.36
Error	197	—	—	—

As shown in Table 3, a multilevel ANCOVA was conducted to compare post-test proficiency across the three instructional groups while controlling for pre-test scores. Results showed a significant main effect of group membership, $F(2,197) = 18.42$, $p < .001$, $\eta^2 = .16$. This effect was not only statistically reliable but also educationally meaningful. The difference between the AI + PP and control groups represented nearly one standard deviation ($d = 0.85$), while the gap between the AI + PP and AI-only groups was moderate-to-large ($d = 0.60$).

Post hoc comparisons using Bonferroni adjustments indicated that the AI + PP group outperformed both the AI-only and control groups at post-test ($p < .01$ and $p < .001$, respectively). These results confirm that embedding PP activities into AI-supported instruction significantly boosted students’ language

proficiency beyond what was achieved with AI alone or traditional methods. Figure 2 visualizes the group differences in post-test proficiency scores.

4.2.2 Foreign Language Enjoyment (FLE)

A repeated-measures ANOVA was performed to examine changes in FLE from pre- to post-test across groups as shown in Table 4. This analysis explores how FLE evolved from pre- to post-test and whether the intervention conditions produced differential effects on learners’ enjoyment.

Table 4
Repeated-Measures ANOVA for FLE

Source	df	F	p	η²
Time	1	54.12	< .001	.22
Group	2	9.76	< .001	.11
Time × Group	2	9.76	< .001	.11
Error	197	—	—	—

According to Table 4, The analysis revealed significant main effects of time, $F(1,197) = 54.12, p < .001, \eta^2 = .22$, and group, $F(2,197) = 9.76, p < .001, \eta^2 = .11$. Most importantly, the interaction between time and group was also significant, $F(2,197) = 9.76, p < .001, \eta^2 = .11$, indicating that improvements in enjoyment varied across conditions. In practical terms, the AI + PP group reported the largest increase in enjoyment, with scores rising by nearly a full point ($\Delta M = 0.83$). The AI-only group experienced a smaller but noticeable gain ($\Delta M = 0.39$), while the control condition showed minimal change ($\Delta M = 0.12$). These results suggest that incorporating PP-based activities into AI-supported instruction substantially enhanced learners’ enjoyment, an effect not achieved through AI use alone. Figure 3 illustrates the divergence in trajectories across groups.

4. 2.3 Wellbeing and Academic Buoyancy

The next table (Table 5) reports post-test scores for well-being (PERMA) and academic buoyancy across the three groups. The analysis examines the extent to which the interventions influenced students’ emotional functioning and resilience, highlighting differences between integrated and single-component approaches.

Table 5
Post-test PERMA Wellbeing and Academic Buoyancy

Variable	Group	Post-test M (SD)
Wellbeing (PERMA)	AI + PP	4.12 (.52)
	AI-only	3.69 (.54)
	Control	3.55 (.53)
Academic Buoyancy	AI + PP	3.98 (.58)
	AI-only	3.55 (.61)
	Control	3.39 (.64)

The Post-test comparisons of well-being and academic buoyancy revealed significant differences among groups. Learners in the AI + PP condition reported the highest scores, with well-being levels averaging 0.4 points higher than the AI-only group and 0.6 points higher than the control group. For academic buoyancy, the advantage of the AI + PP group over the control was even more pronounced ($\Delta M = 0.59$).

These differences were not only statistically significant ($p < .05$) but also educationally meaningful. The results suggest that integrating PP elements into AI-supported instruction bolstered learners' resilience and overall psychological functioning more effectively than AI alone or traditional teaching. In contrast, the control group showed only marginal improvements, underscoring the added value of combining cognitive and affective supports.

4.2.4 Mediation Analysis

To explore the mechanisms underlying proficiency gains, a multilevel mediation analysis was conducted. The model examined whether increases in FLE accounted for part of the effect of instructional condition on post-test proficiency. Results are presented in Table 6.

Table 6
Mediation Analysis of FLE on the Relationship Between Instructional Condition and Language Proficiency

Path	Estimate	SE	95% CI	p-value
AI + PP → FLE (a)	0.83	0.14	[0.56, 1.11]	< .001
FLE → Proficiency (b)	2.57	0.48	[1.63, 3.51]	< .001
AI + PP → Proficiency (direct effect, c')	7.42	1.38	[4.71, 10.13]	< .001
Indirect effect (a × b)	2.14	0.72	[1.02, 3.89]	.002

The mediation analysis revealed that FLE served as a significant partial mediator of the relationship between instructional condition and language proficiency. Specifically, students in the AI + PP condition reported higher enjoyment ($a = 0.83$, $p < .001$), and greater enjoyment in turn predicted stronger

proficiency outcomes ($b = 2.57, p < .001$). The indirect effect was statistically significant (estimate = 2.14, 95% CI [1.02, 3.89], $p = .002$), confirming that part of the proficiency gains in the AI + PP group were explained by increases in enjoyment.

At the same time, the direct effect of the AI + PP intervention on proficiency remained significant ($c' = 7.42, p < .001$), indicating that enjoyment was not the sole pathway through which learning gains occurred. This pattern suggests a partial mediation, where affective benefits amplified but did not fully account for the impact of PP-infused AI instruction.

4.3 Qualitative Findings

The qualitative data were analyzed thematically following Braun and Clarke (2006). Interviews, teacher journals, and classroom observations were coded iteratively. Initial codes were generated based on repeated readings and then clustered into themes through discussions among researchers. Credibility was enhanced via triangulation and member checking. Three major themes emerged, which are depicted in Fig. 4 and explained in the following sub-sections.

4.3.1 Theme 1: AI as Supportive Coach

Students frequently described the AI system as resembling a patient tutor who provided timely and corrective feedback without judgment. This perception reduced speaking anxiety and encouraged risk-taking in language use. The role of the AI system is aligned with the idea of scaffolding in sociocultural theory, where guidance tailored to learners' current abilities supports gradual autonomy.

Extract 1:

The AI corrected my mistakes, but it also encouraged me to keep trying. I felt less afraid of speaking because it never judged me.

Extract 2:

Whenever I made an error, the AI gently guided me to the right answer. It felt like having a personal tutor available anytime.

4.3.2 Theme 2: Positive Psychology as Motivation

Activities rooted in Positive Psychology principles enhanced students' self-confidence, engagement, and willingness to participate. Writing about strengths, expressing gratitude, and setting personal goals helped learners reframe challenges as opportunities. This resonates with the PERMA model, which emphasizes the role of positive emotion and meaning in sustaining motivation.

Extract 1:

Writing about my strengths made me feel confident to speak in English. I started looking forward to each session.

Extract 2:

The gratitude exercises made me notice my progress and kept me motivated to participate actively in class.

4.3.3 Theme 3: Cultural Adaptation and Fit

While initially unfamiliar, PP tasks became meaningful when contextualized by teachers. This reflects the concept of cultural mediation in language learning, where teachers play a crucial role in adapting content to be culturally relevant and accessible to students. By aligning PP activities with students' cultural contexts, educators facilitate deeper engagement and understanding, fostering a sense of belonging and relevance in the learning process. Furthermore, the broaden-and-build theory suggests that positive emotions, such as those elicited through culturally adapted PP activities, can expand learners' awareness and build lasting psychological resources, enhancing overall well-being and resilience.

Extract 1:

Some activities felt unusual at first, but later we saw they helped us connect and communicate better.

Extract 2:

The teacher explained how these exercises relate to our daily lives, which made them more engaging and easier to understand.

These themes collectively highlight how the intervention's success depended not only on technological features but also on *affective scaffolding* and *cultural mediation*, both of which reinforced learners' engagement and well-being.

4.4 Integration of Quantitative and Qualitative Results

Bringing together the quantitative and qualitative strands highlights how the intervention produced both measurable outcomes and meaningful experiences. Statistical analyses showed that the AI + PP group outperformed the other conditions in proficiency, enjoyment, well-being, and buoyancy, with mediation tests confirming that enjoyment partially explained proficiency gains.

The qualitative findings provided depth to these patterns. Students described the AI as a supportive coach, underscored the motivational impact of PP activities, and emphasized the importance of cultural contextualization. These narratives illuminate the mechanisms behind the quantitative gains: affective engagement, motivation, and teacher mediation were not ancillary factors but central pathways through which the intervention enhanced learning.

Taken together, the integration of results demonstrates that cognitive and affective dimensions of language learning are deeply intertwined. The success of the AI + PP condition can therefore be understood as the result of both technological affordances and the emotional scaffolding introduced by PP activities.

5. Discussion

This study set out to examine whether integrating AI-assisted instruction with PP principles could enhance the linguistic and socio-emotional development of Iranian EFL learners. By comparing the AI + PP condition with AI-only and traditional instruction, the study sought to understand not only whether such integration works, but also *how* learners and teachers experience it within a context shaped by exam pressure and culturally embedded expectations. The discussion below follows the order of the research questions.

The findings for the first research question (i.e., Does an AI-supported EFL program infused with PP principles improve Iranian learners' English proficiency more than AI-only and traditional instruction?) provide strong support for the integrated approach. Learners in the AI + PP group made significantly larger gains in proficiency than their peers in the AI-only and control groups. While earlier studies show that AI systems can help learners improve vocabulary, speaking fluency, and task engagement (Chu et al., 2023; Zou & Wang, 2024), the present results indicate that AI's contributions are amplified when paired with PP principles. The AI-only group also improved, which is consistent with research reporting that adaptive digital platforms offer valuable individualized practice (Du & Daniel, 2024). However, the added emotional scaffolding in the AI + PP condition translated into noticeably greater learning gains.

Mediation analysis showed that enjoyment partly explained the proficiency improvements, reinforcing the idea that emotion is not merely a by-product of instruction but a central mechanism driving academic outcomes. This aligns with the broaden-and-build theory (Fredrickson, 2001) and with SLA research demonstrating that positive emotions promote attention, persistence, and willingness to communicate (Dewaele & MacIntyre, 2016; Dewaele, 2023). The Iranian context makes this particularly meaningful; given the prevalence of exam-driven instruction and anxiety (Isaee & Barjesteh, 2025), the combination of adaptive AI tasks and PP activities appears to counterbalance the negative affective climate that often characterizes EFL classrooms. In short, while AI offers cognitive efficiency, PP provides the emotional conditions that help learners use those affordances more effectively.

The second research question examined whether the AI + PP condition improved enjoyment and well-being more than the other instructional modes. Quantitative findings showed substantial increases in both FLE and PERMA scores for the AI + PP learners, whereas the AI-only group displayed only moderate gains and the control group remained largely unchanged.

The qualitative data added important nuance to these results. Students repeatedly reported that PP activities (particularly gratitude writing, strengths-based reflection, and goal setting) made learning feel more meaningful and personally relevant. Teachers' journals pointed to more positive classroom interactions and greater student participation. These observations resonate with PP literature showing the importance of positive emotion for sustained engagement (MacIntyre et al., 2019) and align with Western research highlighting the relationship between trust, transparency, and emotional responses to AI feedback systems (Madwe et al., 2025; Gruenhagen et al., 2024; Sumakul et al., 2022).

The findings contrast somewhat with studies suggesting that AI alone can reduce anxiety (Yang & Zhao, 2024) or increase engagement (Risdianto et al., 2025). In this study, the AI-only condition produced milder emotional benefits, and some learners still perceived the system as mechanical or overly evaluative. This echoes Western research showing that AI feedback may inadvertently cause cognitive overload or stress when not embedded within humanizing frameworks (Luckin, 2023; Kizilcec, 2024). By integrating PP principles, the AI + PP program appeared to soften these concerns, allowing learners to experience the AI as more supportive and less intimidating.

For Iranian learners, many of whom are accustomed to high-stakes assessments and teacher-centered instruction, the emotional dimension is not a luxury but a necessity. The results suggest that AI-mediated instruction becomes more effective when paired with activities that cultivate positive affect and psychological safety.

The third research question focused on academic buoyancy and resilience. Here again, the AI + PP group outperformed both comparison groups. Learners reported feeling more capable of managing academic challenges, and qualitative insights help explain why. Students described the PP activities as helping them recognize personal strengths, reframe setbacks, and maintain optimism as the features that mirror the constructs of buoyancy identified in educational psychology (Martin & Marsh, 2008). Teachers similarly noted that students in the AI + PP classes showed greater persistence when encountering difficult tasks and displayed more constructive responses to errors.

These outcomes align with international PP research demonstrating the power of positive emotions and strengths-based practices to bolster psychological resilience (Niemiec & Ryan, 2009). They also extend AI-in-education studies that have primarily emphasized engagement and cognitive benefits rather than emotional coping (Holmes & Porayska-Pomsta, 2023). Within Iran, where learners experience substantial pressure to perform and where failure carries significant social consequences, the value of fostering buoyancy is especially salient. The AI + PP program appears to have provided students with both the linguistic support and the emotional tools to navigate these challenges more effectively.

The fourth research question explored whether enjoyment mediated the relationship between the AI + PP intervention and language proficiency. The mediation results confirmed that enjoyment served as a significant partial mediator: learners in the AI + PP group experienced higher enjoyment, and this heightened emotional state helped explain their proficiency gains.

This pattern supports the central premise of broaden-and-build theory (Fredrickson, 2001), which suggests that positive emotions widen learners' cognitive and attentional bandwidth, allowing them to engage more deeply with learning tasks. The findings also echo earlier SLA studies showing that enjoyment fosters motivation, reduces avoidance, and enhances willingness to communicate (Dewaele & MacIntyre, 2016; Dewaele, 2023). Interestingly, enjoyment did not account for the entire effect, indicating that the cognitive benefits of AI (e.g., adaptivity, immediate feedback) and the emotional benefits of PP (e.g., meaning-making, strengths-based reflection) each contribute uniquely to learning.

Together, they create an environment where learners can engage more fully and persistently with challenging material.

The final research question concerned perceptions of the integrated program. Learners and teachers generally viewed the AI + PP condition favorably. Students appreciated the AI platform's immediate, private feedback and often described it as a nonjudgmental "coach" that encouraged risk-taking. This perception is consistent with research showing that AI tools can support confidence when feedback is framed constructively (Yang & Zhao, 2024). Teachers also noted that the AI system helped students practice independently and allowed class time to be used more efficiently.

At the same time, students emphasized the motivational value of the PP activities. Gratitude writing and reflective journaling helped them monitor progress, recognize strengths, and maintain a sense of purpose. Teachers reported that these activities improved the emotional tone of the class and fostered stronger teacher–student relationships. This is in line with the PP scholarship, suggesting that positive relationships and meaning contribute to perseverance and well-being (Oxford, 2016).

Cultural adaptation emerged as an important theme. Several learners initially found some PP activities foreign or unusual. However, once teachers contextualized them within Iranian values (such as academic responsibility, self-improvement, and collective resilience), the activities became more meaningful. These insights echo calls in the literature for culturally responsive approaches to both AI integration and PP implementation (Ma & Chen, 2024; Holmes & Porayska-Pomsta, 2023). The findings highlight that technology cannot be separated from the cultural contexts in which it is implemented and that teacher mediation is central to negotiating these cultural nuances.

5.1 Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, the intervention was conducted over a relatively short period (10 weeks), which restricts the ability to determine the long-term sustainability of language gains and well-being improvements. Future longitudinal studies are needed to assess whether the observed benefits persist beyond the intervention.

Second, the sample was drawn from three Iranian universities, which may limit generalizability to other educational contexts, proficiency levels, or cultural settings. While the study highlights the importance of cultural adaptation, further cross-cultural research is necessary to examine whether similar effects would emerge in diverse sociolinguistic environments.

Third, although the mixed-methods design allowed for triangulation, the reliance on self-reported measures for constructs such as FLE, well-being, and buoyancy may introduce social desirability bias. Despite careful translation and validation procedures, learners may have over- or under-reported their affective experiences.

Fourth, the AI platform used in this study provided adaptive tasks and feedback, but was not explicitly designed with Positive Psychology principles from the outset. Instead, PP activities were embedded externally through classroom tasks and teacher mediation. This hybrid design raises questions about scalability and whether fully integrated AI + PP systems would yield stronger or different effects.

Finally, teacher mediation played a critical role in facilitating cultural adaptation and learner acceptance. While this underscores the importance of teachers in AI adoption, it also suggests that results may vary depending on teacher expertise, enthusiasm, and professional development. More research is needed to explore how teacher-related variables influence outcomes in AI + PP interventions.

6. Conclusion

This mixed-methods study provides robust evidence that integrating PP with AI-supported EFL instruction enhances both language achievement and learner well-being in the Iranian higher education context. Quantitative findings revealed significant improvements in proficiency, enjoyment, well-being, and resilience in the AI + PP group compared with the AI-only and traditional instruction, with mediation analyses confirming the central role of affective engagement. Qualitative results reinforced these outcomes, highlighting learners' perceptions of AI as a supportive coach, the motivational impact of PP activities, and the importance of cultural adaptation.

Theoretically, the study advances technology-enhanced language learning research by illustrating that AI and PP are not parallel but complementary paradigms. Practically, the results suggest that language programs should move beyond purely efficiency-driven AI tools and instead incorporate PP-based activities that foster enjoyment, meaning, and resilience. Teacher mediation and cultural contextualization remain essential to maximize benefits and ensure acceptance.

Future research should explore long-term sustainability, potential risks of overreliance on AI, and how teacher professional development can best prepare educators for integrating PP into AI-based pedagogy. Comparative studies across diverse cultural settings would further clarify whether these findings generalize beyond the Iranian context.

In conclusion, the study demonstrates that designing AI-mediated environments through the dual lens of cognitive support and positive affect can cultivate both linguistic competence and psychological flourishing. Such integrative approaches may represent a promising pathway for more human-centered, culturally responsive, and sustainable innovations in language education.

Declarations

Competing Interests

All of the authors declare no conflict of interest.

Consent to Publish

The authors affirm that all individual participants provided informed consent for publication of this paper.

Consent to Participate

The authors affirm that informed consent to participate in the study was obtained from all the individual participants. Participation was voluntary. Before data collection, all participants received a detailed explanation of the study's objectives, procedures, risks, and rights. Written informed consent was obtained from each participant. Students were explicitly informed that they could decline or withdraw at any stage without academic penalty, and interview participation was optional.

Ethics statement

This study was reviewed and approved by the Ethics Committee of Islamic Azad University, Ayatollah Amoli Branch (Approval No. 2025 – 512). All participants provided written informed consent before taking part in the research. This study was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Confidentiality and Anonymity

All personal information was anonymized using numeric participant codes. Audio recordings, transcripts, and digital data were stored on encrypted drives accessible only to the research team. Identifying information was removed before analysis, and confidentiality was strictly maintained throughout the project.

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Data Availability

The data is available through correspondence with the corresponding author.

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Figures

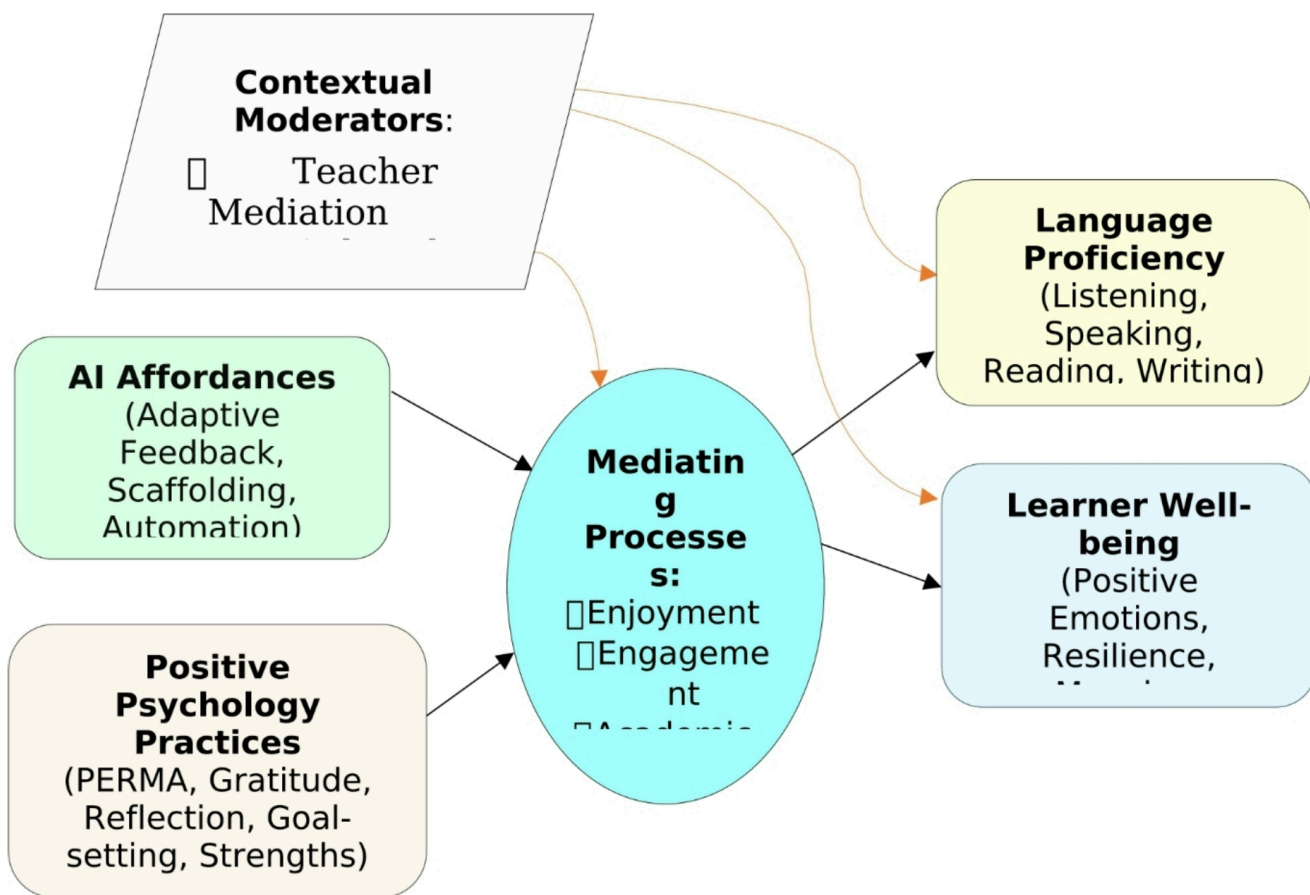


Figure 1

Conceptual framework of AI-PP integration in EFL instruction

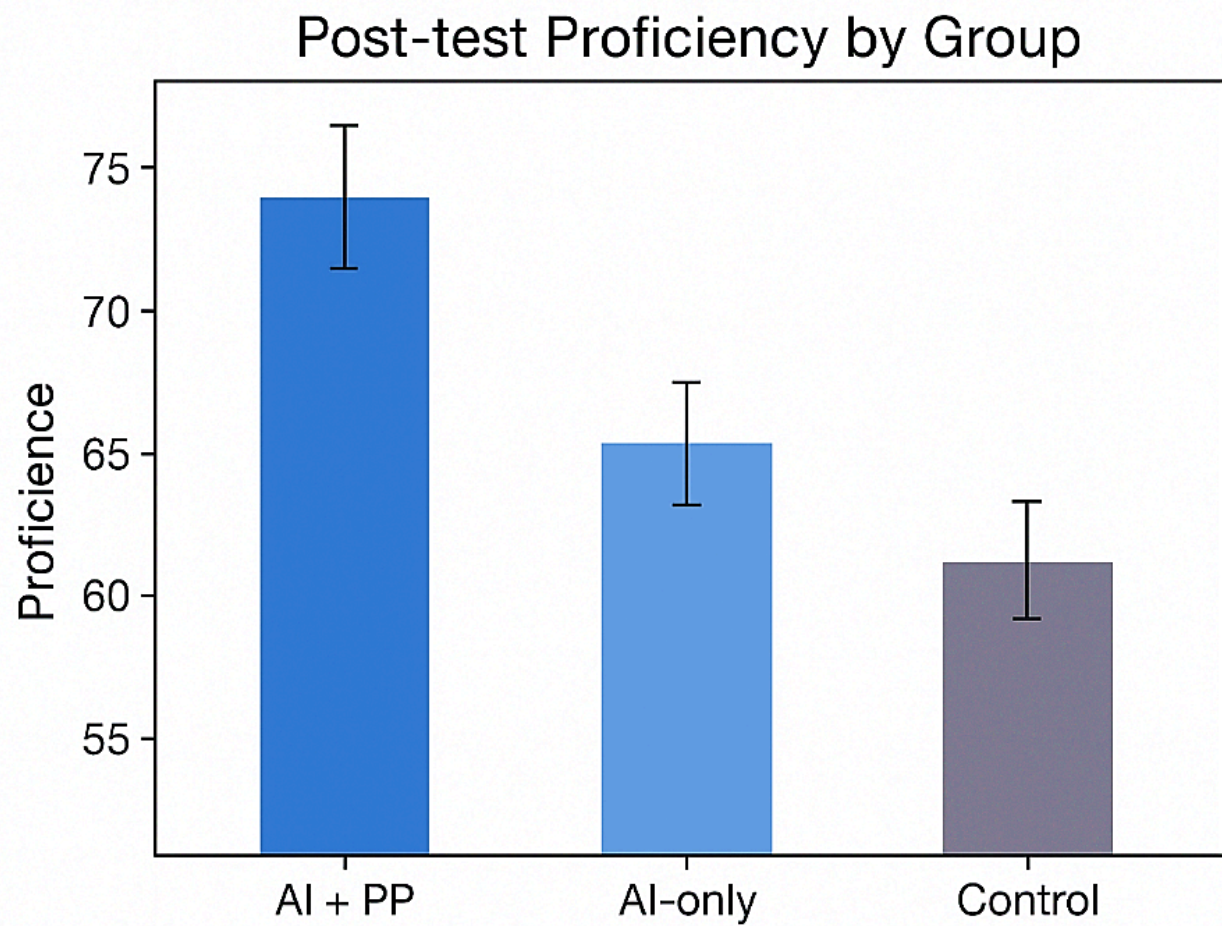


Figure 2

Post-test Proficiency by Group

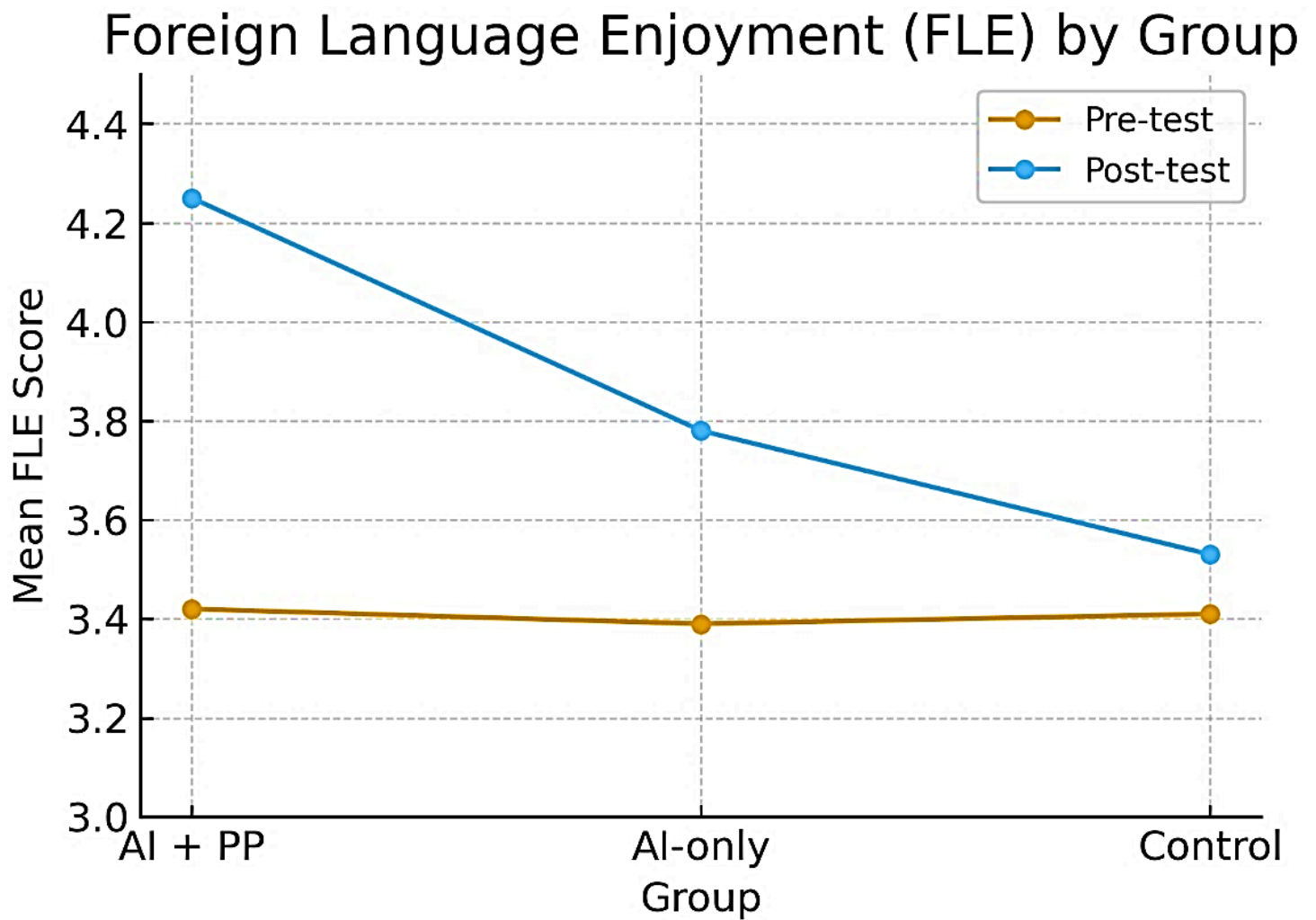


Figure 3

Changes in FLE across groups from pre-test to post-test

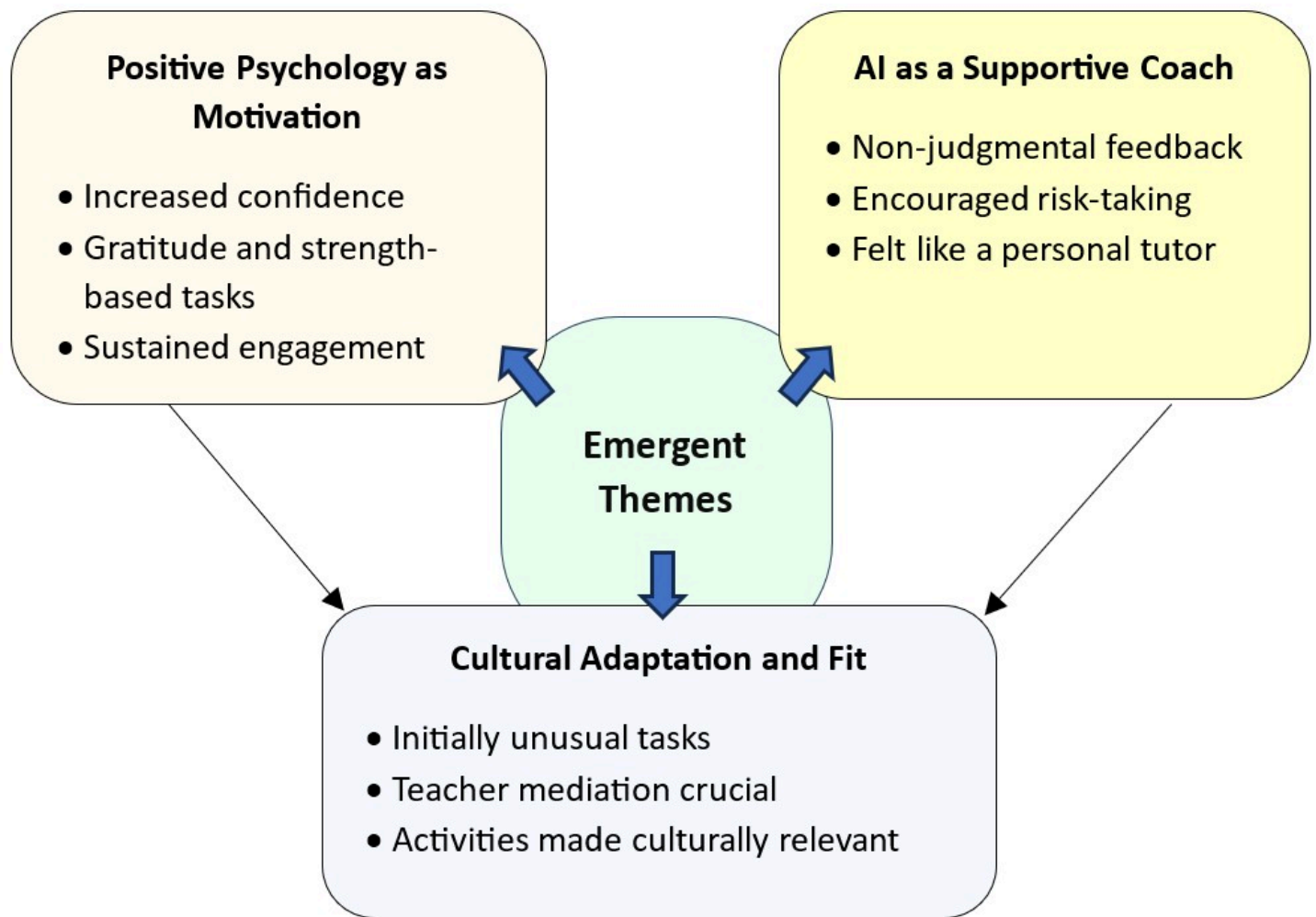


Figure 4

Emergent Themes from Qualitative Findings