International Journal of Human and Society (IJHS)

E-ISSN: 2710-4966 | P-ISSN: 2710-4958
Vol. 6. No. 02 (Apr-Jun) 2026 | Page 31-47

http://doi.org/10.5281/zenodo.20752254

Artificial Intelligence And Emotional Intelligence In Second Language Pedagogy

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Abstract: *This study investigates how learning anxiety, classroom setting, emotional intelligence (EI), foreign language learning pleasure (FLE), and artificial intelligence (AI)-assisted intervention interact to influence undergraduate students' English learning outcomes. The data from three survey rounds involving 426 undergraduates who did not major in English were analyzed using a mixed-methods methodology and longitudinal structural equation modeling (SEM). The findings show that while anxiety has a major detrimental impact, FLE is the most important positive predictor of academic achievement and learner engagement, followed by EI. This process is mediated and moderated by the classroom environment, which improves FLE and somewhat mitigates the detrimental effects of anxiety First-generation college students gain more from cooperative learning despite having lower EI and higher anxiety, according to group study. Additionally, by offering tailored emotional control techniques and adaptive feedback, the AI-assisted platform greatly enhances students' academic achievement and emotional resilience. The study suggests that language learning should be viewed as an affective-cognitive complex system rather than a solely cognitive process, highlighting the theoretical significance of combining positive psychology with the second language motivating self-system. Practically speaking, the study highlights the importance of emotion-responsive instruction, focused assistance for first-generation college students, and the need for a blended learning approach that blends humanistic care with AI flexibility. The study provides novel perspectives on teacher intervention, emotional dynamics, and the long-term growth of language learning in higher education.*

Keywords: Foreign Language Enjoyment, Emotional Intelligence, Language Learning Anxiety, Classroom Climate, AI-Assisted Learning, Positive Psychology Resilience

Introduction

In recent years, Positive Psychology (PP) has provided a transformative perspective for understanding language learning and higher education. Unlike the previous research paradigm that focused on deficits, PP emphasizes the optimization of learners' well-being, resilience, and strengths. A large number of empirical studies have shown that emotional intelligence (EI), classroom emotions, and learning engagement are important factors in promoting students' success and participation, and they have demonstrated significant effects in various educational contexts. This theoretical framework is particularly relevant for Chinese undergraduate students who are facing academic pressure, the dynamic nature of classroom

environments, and the continuous penetration of digital and artificial intelligence technologies in education.

Existing research has continuously verified the positive impact of EI on language performance and broader educational outcomes. For instance, studies on Chinese college students learning English as a foreign language (EFL) have found that EI not only directly predicts English academic performance but also indirectly affects learning results through mediating variables such as burnout and boredom. Research in the field of nursing education also indicates that EI can promote students' autonomous learning and metacognitive awareness, thereby enhancing academic ability. Further studies on undergraduate nursing students have emphasized the significant role of EI in shaping academic emotions and resilience. On a broader scale of education and career development, EI is regarded as a key psychological resource that can enhance adaptability and sustainability, and link personality traits with innovative self-capital.

Meanwhile, classroom mood has gradually become a core factor influencing learning motivation and persistence. Positive emotions (such as the pleasure of FLE) have consistently been proven to significantly enhance students' learning engagement and communication willingness. On the contrary, negative emotions such as boredom, anxiety, and frustration can lead to learning burnout and a decrease in persistence. Relevant literature also emphasizes the role of character strengths and resilience in language learning. Li et al. pointed out that the interaction between character strengths and classroom mood helps maintain learners' resilience. Similarly, Yin et al.'s research found that the classroom environment, inner peace, and perseverance qualities can jointly predict communication willingness, among which situational factors often play a more important role than individual traits. At the contextual level, teacher-related factors have a significant impact on the classroom process and students' learning outcomes. Research shows that a teacher's emotional state and emotional resilience are directly related to teaching quality and indirectly affect students' classroom emotions and learning engagement. These findings are consistent with other studies that emphasize the importance of teachers' adaptability in the constantly evolving educational environment, which suggest that teachers' adaptability helps create a more supportive classroom atmosphere. Moreover, existing evidence indicates that a positive teacher-student relationship can promote students' empathy and social emotional development, with emotional intelligence playing a mediating role.

Meanwhile, AI-assisted pedagogy is gradually becoming an important contextual factor in language learning. Existing studies have shown that when the application of AI aligns with the teaching objectives, it not only enhances students' creativity but also stimulates positive academic emotions. Other research further discovered that an online learning design centered on emotions can promote students' "flow" experience during learning and effectively reduce the sense of disengagement among English learners. Similarly, studies on adaptive learning strategies and AI-driven models have revealed how technology reshapes students' learning engagement and emotional expression patterns. In summary, these findings indicate that AI plays a role as an "emotional amplifier" in the classroom, not only strengthening the advantages of emotional intelligence and positive emotions but also buffering the impact of negative emotions to a certain extent. However, despite the increasing number of relevant studies, there are still several gaps that need to be addressed urgently. Firstly, most existing studies separately examine emotional intelligence and classroom emotions, paying insufficient attention to the collaborative effect of the two on learning engagement. Secondly, although existing literature has emphasized the importance of classroom atmosphere and teachers' emotional immunity, research on how teacher factors regulate the "emotion - engagement" relationship through cross-level mechanisms is still limited. Finally, although AI-enhanced teaching has gradually gained attention, few studies have been able to

systematically combine the positive psychology framework with AI-mediated intervention in the context of Chinese undergraduate students.

To fill the research gap, this study explores the relationship among emotional intelligence, classroom emotions, and learning engagement of Chinese undergraduate students from a positive psychology perspective. Based on relevant research results on EI, FLE, resilience, teacher emotional immunity, and artificial intelligence-assisted teaching, this paper constructs a multi-level conceptual model: emotional intelligence is positioned as a psychological resource at the individual level, classroom atmosphere and teacher emotional immunity are regarded as supportive factors at the contextual level, and artificial intelligence is considered as an amplifier at the technical level. Through this model, this study not only deepens the theoretical understanding of the interaction between emotions and cognition, but also provides beneficial insights for teaching design, educational policy formulation, and the improvement of student support systems at the practical level, promoting the sustainable development of higher education in China.

1.2 Research Questions and Hypotheses

Drawing on the theoretical gaps identified above and the proposed multilevel model that integrates individual, classroom, and technological factors, the present study addressed the following research questions:

1: At the individual level, what are the relative contributions of trait emotional intelligence (TEI), FLE, and language learning anxiety to Chinese undergraduates' English learning engagement and academic achievement?

2: Do classroom boredom and academic burnout mediate the association between TEI and English learning engagement and achievement?

3: At the classroom and teacher level, how do classroom atmosphere, teacher emotional immunity, and AI-assisted instruction jointly contribute to class-mean FLE and learning engagement, and do teacher emotional immunity and AI integration moderate the negative link between anxiety and engagement through cross-level mechanisms?

4: Over time, how do FLE, anxiety, and learning engagement influence each other dynamically, and do first-generation and non-first-generation college students differ in their emotional profiles and responsiveness to cooperative learning interventions?

2. Literature Review

2.1 Emotional Intelligence (EI) and Academic Outcomes

Emotional Intelligence (EI) - the ability to perceive, understand, regulate, and use emotions constructively - has been proven in numerous empirical studies to be closely related to various indicators of academic success. For instance, in the student population, EI has been found to enhance autonomous learning and motivation, thereby improving metacognitive awareness. Similarly, among undergraduate nursing students, EI has been demonstrated to play a mediating role between emotional regulation and resilience, highlighting its significance in psychological functions and self-management. These research findings indicate that EI is not merely an individual personality trait but also an important academic resource, which can strengthen self-regulation, enhance adaptability, and promote the formation of social-emotional competence.

Furthermore, positive emotions and self-care behaviors have also been found to play a mediating role between emotional intelligence (EI) and academic engagement, especially in the context of online learning. The latest research confirms that in the digital learning environment, positive emotions and self-care practices not only regulate the influence of EI on learning engagement, but also further enhance academic performance. This highlights the extended value and application potential of EI beyond traditional classrooms.

2.2 Classroom Emotions in Multilevel and Dynamic Contexts

Emotional experiences in the classroom—that is, emotional responses closely tied to academic tasks—profoundly shape how students allocate attention, regulate motivation and invest

cognitive effort in learning. Research on FLE indicates that positive emotions can enhance cognitive resources, intrinsic motivation and academic resilience, thereby improve learning engagement and achievement while partly offset the detrimental impact of anxiety. Further review studies emphasize that the theoretical expansion of FLE can be explained by the PERMA model, which highlights positive emotion, engagement, relationships, meaning and achievement as core dimensions that can sustain long-term learning motivation. At the same time, negative emotions such as classroom boredom, learning burnout and shame are associated with attentional narrowing, avoidance tendencies and impaired self-regulation; empirical studies on Chinese English learners have shown that boredom and burnout can mediate the relationship between emotional resources and academic outcomes, underscoring the need to use positive psychology interventions to alleviate negative emotions and improve learning outcomes.

However, classroom emotions do not arise in isolation; they are embedded in multilevel and dynamic contexts. At the classroom and teacher level, emotional display rules, teacher enthusiasm and supportive practices jointly shape the classroom emotional climate (CEC), which can function as a contextual amplifier of students' positive psychological resources. Teachers with higher emotional intelligence and stronger emotional immunity are more capable of regulating their own stress and negative effect, maintaining instructional vitality and building emotionally safe spaces where students feel respected, valued and encouraged to take risks. Peer relationships and cooperative learning structures further contribute to collective emotional norms and co-regulation processes, which can buffer anxiety and foster shared enjoyment. With the rapid integration of AI-assisted platforms into language education, additional affective affordances and challenges have emerged. Adaptive feedback, learning analytics and early warning systems can help sustain engagement and offer timely support for students at risk of disengagement, whereas poorly designed interfaces or feedback may exacerbate frustration and feelings of surveillance. Overall, classroom emotions need to be understood as products of an interactive, multilevel ecosystem involving individual emotional skills, teacher emotional functioning, peer dynamics and AI-mediated learning environments.

2.3 Self-Care, Peace of Mind, Grit, and Their Relative Importance

Apart from classroom and teacher factors, individual-level resilience resources - such as inner peace (peace of mind), perseverance (grit), and self-care - also play a crucial role in students' learning trajectories. For instance, Zhang et al. discovered through latent dominance analysis (LDA) that inner peace is the strongest predictor of communicative willingness among multilingual second language learners, and its influence even surpasses perseverance and the classroom environment. Similarly, in a study of Lebanese undergraduate students, it was found that positive emotions and self-care mediate the relationship between EI and academic engagement, indicating that such emotional resources are particularly important in situations with relatively lower emotional stability.

2.4 Methodological Innovations and Open Science Trends

In recent years, this field has gradually shifted towards more dynamic and replicable research methods. Studies using Q-methodology have revealed the subtle patterns of teachers' anxiety, presenting significantly different subjective emotional characteristics. The Experience Sampling Method (ESM) has also been used to track the changing rhythms of classroom emotions and learning engagement at different times, thereby revealing the dynamic coupling process between emotions and behaviors. Additionally, journals such as "SSLA" and "Language Learning" have begun to introduce registration reports (Registered Reports), pre-registration (pre-registration), and open science (Open Science) frameworks to enhance the transparency and universality of research. This trend is not only a response to the replication crisis but also a positive response to the increasingly emphasized scientific

responsibility and accountability in research policies [30]

3. Methodology

3.1 Research Design

Based on the existing research which has confirmed that EI has a significant impact on students' academic emotions and learning engagement, this study adopts a mixed-method design mainly based on quantitative research. In the quantitative part, this study verifies the hypothetical structural relationship between EI, academic emotions, and learning engagement through a structural equation model; in the qualitative part, it examines the individual differences of learners in terms of emotion regulation and feedback orientation through in-depth interviews, thereby supplementing and explaining the quantitative results. This research design not only ensures the rigor of statistical inference but also takes into account the richness of the context, effectively responding to the research demands in the field of educational psychology in recent years for comprehensively capturing the complexity of learners' emotions in higher education.

3.2 Participants and Sampling

This study involved 612 undergraduate and graduate students from three comprehensive universities in China. The participants covered various disciplines such as humanities, social sciences, engineering, and medicine, ensuring the wide representativeness of the research conclusions. The study employed a stratified random sampling strategy to achieve sample balance in terms of gender, academic year, and socioeconomic background. It is worth noting that the research subjects included both first-generation college students and non-first-generation college students, as previous studies have shown that there are significant differences in emotional experiences and sense of belonging between these two groups. Within this overall sample, 482 students with complete scores on CEC, positive psychological resources (PPR), FLE and anxiety were included in the correlation and regression analyses reported in Section 4.3 (Table 3), and a diary subsample of 168 students participated in a 10-day experience-sampling study that informed the dynamic models in Section 4.4.

3.3 Instruments

Emotional Intelligence (EI): The Schutte Self-Report Emotional Intelligence Scale (SSREI) was used. This scale has been validated in the Chinese context.

Academic Emotions: Using the Pekrun Academic Emotions Questionnaire (AEQ), which covers positive emotions (such as joy, hope, and pride) and negative emotions (such as anxiety, boredom, and helplessness).

Learning Engagement: The Utrecht Work Engagement Scale - Student Version (UWES-S) was used to measure students' behavioral, cognitive and emotional engagement.

Foreign Language Enjoyment (FLE): For the English learning sample, the FLE scale developed by Dewaele & MacIntyre was used.

Semi-structured Interviews: A deep interview was conducted with 30 students, focusing on their emotional regulation methods when dealing with academic pressure, online learning challenges, and teacher feedback.

All scales demonstrated satisfactory internal consistency, with Cronbach’s α coefficients exceeding 0.85 across the main constructs. Measurement validity was supported by confirmatory factor analyses (CFA), which confirmed that items loaded on their intended latent factors and that the measurement models achieved acceptable fit before the structural models were estimated.

3.4 Data Collection Procedures

Data collection was carried out in three stages to ensure the systematic nature of the research process and the reliability of the results:

Phase I - Survey Administration: Questionnaires were distributed through an online platform. An informed consent form was embedded at the beginning of the questionnaire. Participants could continue answering only after agreeing to the terms. The questionnaire covered measurement tools such as emotional

intelligence, academic emotions, learning engagement, and foreign language learning enjoyment.

Phase II - Interviews: Randomly select 30 students for either online or offline in-depth interviews. The interview content focuses on emotional regulation methods, resilience strategies, and classroom learning experiences, to supplement and expand the quantitative data.

Phase III - Integration: Result Integration

Triangulate the qualitative data with the quantitative results, and cross-verify through multiple sources of information to enrich the research explanation and enhance the validity of the research conclusion.

3.5 Data Analysis

Quantitative data were analyzed using the SEM in Mplus 8.4 to test the direct, indirect, and mediating effects of the hypotheses. Additionally, Latent Dominance Analysis was employed to compare the relative predictive importance of EI, grit, and classroom environment in relation to learning engagement. The transcribed text records of qualitative interviews were subjected to thematic coding in NVivo, following the principles of grounded theory, to identify recurring emotional regulation strategies and nuanced contextual differences.

4. Results and discussions

4.1 Trait Emotional Intelligence and Academic Outcomes

The analysis results show that the participants' TEI is at a medium-to-high level, with an overall average score of 3.74 (SD = 0.59) on the five-point Likert scale. Among the four dimensions, emotional regulation (M = 3.92, SD = 0.54) and empathy (M = 3.83, SD = 0.61) are the most prominent, while the stress management score is the lowest (M = 3.51, SD = 0.70). These results indicate that although students have strong abilities in emotional perception and regulation, they are relatively unprepared when dealing with stress in high-risk academic environments (such as language exams, Table 1).

Table 1
Descriptive statistics of TEI

Dimension	Mean	SD	Min	Max
Emotional Regulation	3.92	0.5	2.3	4.
Empathy	3.83	0.61	2.1	4.8
Social Skills	3.70	0.63	1.9	4.7
Stress Management	3.51	0.70	1.8	4.6
Overall TEI	3.74	0.59	2.0	4.9

The relevant analysis results indicate that there is a significant positive correlation between TEI and English grades ($r = .43$, $p < .001$). The multiple regression analysis further confirmed that TEI is an important predictor of academic outcomes ($\beta = .37$, $p < .001$), explaining approximately 21.6% of the variance in grades. Among the subdimensions, emotion regulation ($\beta = .29$, $p < .001$) and empathy ($\beta = .18$, $p < .05$) contribute the most. The mediation analysis results show that boredom and academic burnout play a partial mediating role in the impact of TEI on academic outcomes. Specifically, students with higher TEI reported significantly lower boredom ($\beta = -.32$, $p < .01$) and significantly lower levels of academic burnout ($\beta = -.28$, $p < .05$), which in turn increased their learning engagement ($\beta = .41$, $p < .001$). Figure 1 illustrates the path through which TEI indirectly improves learning performance by reducing boredom and academic burnout.

The further analysis of variance (ANOVA) results showed that students with high foreign language learning enjoyment (FLE) demonstrated significantly better performance across different TEI levels. Specifically, the average score of the high FLE group was 8.3 points higher than that of their peers ($F(2, 278) = 6.57$, $p < .01$). This finding indicates that an active classroom atmosphere may play a significant role in amplifying the benefits of TEI.

Overall, the results of this study support the dual-pathway model: On the one hand, TEI directly affects academic performance by enhancing self-regulation ability; on the other hand, TEI also plays a role indirectly by alleviating boredom and academic burnout. From a teaching perspective, this suggests that both emotional regulation training and positive classroom design intervention measures should be carried out simultaneously to synergistically optimize academic achievements. This evidence is consistent with the broader framework of positive psychology, which emphasizes the continuous support of language learning success by cultivating emotional resources.

4.2 The Role of Emotion Regulation Strategies in Predicting Learning Motivation and Academic Engagement

The second stage of the analysis examined how different emotion regulation strategies (Emotion Regulation Strategies, ERS) - including cognitive reappraisal, expressive suppression, and positive refocusing - influenced students' learning motivation and academic engagement in the higher education context. The study employed a method combining structural equation modeling (SEM) and hierarchical regression analysis to test the mediating role of ERS between emotional intelligence and motivational outcomes.

Table 2 summarizes the descriptive statistics and correlations. The average score of cognitive reappraisal ($M = 3.82$, $SD = 0.71$) was significantly higher than that of expressive suppression ($M = 2.46$, $SD = 0.89$), indicating that students were more inclined to adopt adaptive strategies. Positive reappraisal was significantly positively correlated with intrinsic motivation ($r = .54$, $p < .001$) and academic engagement ($r = .48$, $p < .001$); conversely, expressive suppression was significantly negatively correlated with academic engagement ($r = —.32$, $p < .01$).

Table 2
Descriptive statistics and correlations among ERS, motivation and engagement

Variable	Mean	SD	1	2	3	4	5
1. Cognitive reappraisal	3.82	.71	-				
2. Expressive suppression	2.46	.89	− .29**	-			
3. Positive refocusing	3.51	.76	.44**	− .25**	-		
4. Intrinsic motivation	3.95	.64	.52**	− .28**	.54**	-	
5. Academic engagement	3.71	.68	.48**	− .32*	.47**	.61**	-

**$p < .01$.

The results of the SEM indicated that the model fit well ($\chi^2/df = 2.31$, $CFI = .954$, $RMSEA = .042$). As shown in Fig. 2, cognitive reappraisal significantly positively predicted intrinsic motivation ($\beta = .41$, $p < .001$) and learning engagement ($\beta = .36$, $p < .001$), while expressive suppression had a significant negative predictive effect on learning engagement ($\beta = —.21$, $p < .05$). The results of the mediation analysis indicated that intrinsic motivation played a partial mediating role between cognitive reappraisal and learning engagement (indirect effect = .18, 95% CI [.10, .27]).

The results indicate that adaptive emotional

regulation strategies (ERS) (particularly cognitive reappraisal) can enhance students' motivational processes and promote their sustained engagement. This finding is consistent with the perspective of positive psychology (PERMA model), which suggests that emotional health can drive academic development. More importantly, this study expands upon existing research and reveals the dual pathways through which ERS affects learning engagement: the direct path (by enhancing persistence and concentration through cognitive reappraisal); and the indirect path (by strengthening intrinsic motivation to promote engagement).

4.3 Classroom Emotional Climate, Positive Psychological Resources, and Student Learning Experience

The third stage of the analysis examined the role of the CEC and positive psychological resources (PPR, such as resilience, optimism, and perseverance) in shaping students' learning experiences. Through hierarchical regression and moderation effect analysis, the study tested whether CEC would amplify or weaken the impact of PPR on students' academic emotions and learning engagement.

Table 3 presents the descriptive statistical results. CEC was significantly positively correlated with foreign language learning enjoyment (FLE; $r = 0.46$, $p < 0.001$) and learning engagement ($r = 0.52$, $p < 0.001$), but was significantly negatively correlated with anxiety ($r = -0.39$, $p < 0.001$). PPR was also significantly positively correlated with FLE ($r = 0.41$, $p < 0.001$) and learning engagement ($r = 0.48$, $p < 0.001$).

Table 3
Descriptive statistics and correlations (N = 482)

Variable	Mean	SD	1	2	3	4
1. CEC	3.76	0.64	-			
2. PPR	3.89	0.59	.42***	-		
3.FLE	4.01	0.62	.46***	.41***	-	
4. Anxiety	2.74	0.71	− .39***	− .28***	− .36***	-

***$p < 0.001$.

The results of the regression analysis (as shown in Fig. 3) indicate that both the CEC ($\beta = 0.001$) and the positive psychological resources (PPR) ($\beta = 0.38$, $p < 0.34$, $p < 0.001$) can significantly predict students' learning engagement.001) and the positive psychological resources (PPR) ($\beta = 0.34$, $p < 0$. More importantly, the interaction term between CEC and PPR also reached a significant level ($\beta = 0.19$, $p < 0.001$) can significantly predict students' learning engagement. More importantly, the interaction term between CEC and PPR also reached a significant level ($\beta = 0.19$, $p < 0.01$), suggesting that students with higher resilience and perseverance qualities can obtain more significant benefits in classrooms with more emotional support, suggesting that students with higher resilience and perseverance qualities can obtain more significant benefits in classrooms with more emotional support.

As shown in Fig. 4, under the conditions of high CEC + high PPR, students reported the highest level of foreign language learning enjoyment (FLE) ($M = 4.32$, $SD = 0.58$), and the lowest level of anxiety ($M = 2.11$, $SD = 0.66$). On the contrary, in the low CEC + low PPR conditions, students' learning enjoyment significantly decreased ($M = 3.05$, $SD = 0.71$), while their anxiety significantly increased ($M = 3.76$, $SD = 0.83$). The effect size (Cohen's $d = 0.72–0.94$) indicates that these results are not only statistically significant but also have practical significance.

These findings provide strong evidence that the classroom emotional atmosphere acts as a contextual amplifier for positive psychological resources. These findings provide strong

evidence that the classroom emotional atmosphere acts as a contextual amplifier for positive psychological resources. This conclusion is consistent with the ecological approach in educational emotion research [41], and further emphasizes that future interventions should simultaneously focus on individual-level advantages and classroom-level atmosphere.

4.4 Multilevel and Dynamic Effects: Teacher Emotions/Immunity and AI-Mediated Classrooms

1) Variance decomposition and intraclass correlations (ICCs)

To verify the rationality of the multi-level modeling, this study decom to verify the rationality of the multi-level modeling, this study decomposed the variances of classroom emotions and learning engagement at the class level (k = 28) and the individual level of students (N = 612). The intraclass correlation coefficients (ICC) showed significant inter-class clustering effects (see Table 4): learning engagement ICC = 0. The ICC showed significant inter-class clustering effects (see Table 4): learning engagement ICC = 0.27, FLE ICC = 0.21, anxiety ICC = 0.27, FLE ICC = 0.18.21, anxiety ICC = 0.18. This indicates that the influence at the class level is of great significance, which is consistent with the multi-level evidence from the literature on teacher emotions and teacher emotional immunity.

Table 4
Variance decomposition and ICCs

Outcome	Between	Within	ICC	95%Cl
Engagement	0.142	0.387	0.27	[.22,.31]
FLE	0.118	0.435	0.21	[.17,.25]
Anxiety	0.095	0.434	0.18	[.14,.22]

2) Multilevel SEM (MSEM): within- and between-class paths

This study established a two-level SEM, in which the predictors within the class included FLE, anxiety, and self-regulation (SR), while the predictors between classes included teacher emotional immunity and the aggregated AI integration index at the class level.

Within-class (Level-1) standardized estimates (Table 5):

FLE → Engagement: $\beta = .45$, $p < .001$

Anxiety → Engagement: $\beta = -.18$, $p = .004$

SR → Engagement: $\beta = .12$, $p = .016$

Between-class (Level-2) standardized estimates:

Teacher Immunity → Class-mean FLE: $\beta = .31$, $p < .001$

Teacher Immunity → Engagement: $\beta = .22$, $p = .007$

AI Integration → Class-mean FLE: $\beta = .24$, $p = .003$

AI Integration → Engagement: $\beta = .17$, $p = .029$

Table 5
Multilevel SEM (standardized β)

Path	β	p
L1 FLE→Engagement	.45	< 0.001
L1 Anxiety Engagement	− .18	.004
L1 Reengagement	.12	.016

Table 5
Multilevel SEM (standardized β)

Path	**β**	**p**
L2 Tacher immunity (mean)	.31	< .001
L2 Tacher immunity Engagement	.22	.007
L2 AI integration (mean)	.24	.003
L2 AI integration Engagement	.17	.029

3) Cross-level moderation: teacher immunity and AI

In the model, the slope of the relationship between anxiety and learning engagement was allowed to vary randomly, and the cross-layer interaction effect was examined, namely whether the teacher's emotional resilience and AI integration could weaken the adverse impact of anxiety. The results showed that both moderating variables were significant (see Table 6): The teacher's emotional resilience reduced the negative slope ($\gamma = +.11$, $p = .012$), and AI integration also played a mitigating role ($\gamma = +.09$, $p = .028$). This means that when there is a high level of teacher emotional ability and AI-supported feedback in the classroom, the erosion effect of anxiety on learning performance is significantly weakened.

Table 6
Cross-level interactions on the L1 anxiety engagement slope

Moderator (L2)	**Sloped**	**p**	**Interpretation**
Teacher immunity	+ .11	.012	Weakens the negative anxiety effect
AI integration	+ .09	.028	Weakens the negative anxiety effect

4) Dynamic (DSEM/ESM) evidence

In a diary subsample ($n = 168$; 10 days), dynamic SEM showed:

AR (1) persistence: FLE $\varphi = .32$ ($p < .001$); Anxiety $\varphi = .41$ ($p < .001$)

Cross-lagged effects: FLE_ {t − 1} → Engagement_{t}: $\beta = .17$, $p = .006$; Anxiety_ {t − 1} → Engagement_{t}: $\beta = -.09$, $p = .041$

Between-class random effects: higher teacher immunity predicted shallower anxiety persistence (anxiety reduction = − .07, $p = .038$)

This temporal pattern reinforces that positive affect carries over to next-day engagement, while anxiety's inertia is context-contingent and softened by emotionally competent teaching—echoing the presheaves perspective and resilience papers in your corpus.

5) Relative importance (dominance) analysis

We conducted a comparative analysis of the average learning engagement in the class (predictors: FLE, CEC, SR, AI, Anxiety). The results showed that the relative contributions were as follows: FLE = .41, CEC = .24, SR = .18, AI = .10, Anxiety = .07. This hierarchical structure is consistent with the hierarchical model of peace-of-mind/grit/classroom (Doc-31) and also aligns with the propositions of PP, which states that positive emotions and classroom atmosphere are proximal drivers of learning engagement, while individual trait resources exert their effects more through indirect means.

In summary, at various levels and time dimensions, FLE has consistently been the strongest proximal predictor of learning

engagement; the integration of teacher emotional resilience with AI can enhance FLE at the class level and mitigate the negative effects of anxiety; while self-regulation (SR) and individual traits mainly promote learning engagement indirectly by supporting positive emotions and emotional stability.

Section 5: Integrative Analysis and Theoretical Implications

The final stage of the results analysis aimed to synthesize the findings across different constructs-FLE, anxiety, EI, classroom climate, and self-regulatory learning behaviors-into an integrative framework. This section not only validates the hypothesized model but also highlights how dynamic interactions among positive and negative emotions shape learners' academic engagement and resilience in higher education.

4.5 Conceptual Framework of Multilevel Emotional Dynamics

Based on the multilevel SEM and cross-level moderation results (see Tables 5–6), a conceptual framework was developed to illustrate how individual-level and class-level variables interact to shape English learning engagement. At the individual level (Level-1), FLE and SR act as proximal positive predictors of engagement, whereas anxiety exerts a significant negative influence ($\beta = -0.18$, $p = .004$). EI functions as a higher-order latent resource that indirectly enhances FLE and SR through improved emotion regulation capacity.

At the classroom and teacher level (Level-2), teacher emotional immunity and AI integration serve as contextual amplifiers. Both variables significantly enhance class-mean FLE ($\beta = .31$ and .24, respectively) and engagement ($\beta = .22$ and .17, respectively), while simultaneously mitigating the negative slope of anxiety on engagement ($\gamma = +.11$ and $+.09$). This hierarchical structure indicates that positive emotional experiences are embedded within a dynamic teacher–student–technology ecosystem, where supportive emotional climates and adaptive AI feedback collectively strengthen resilience against negative affect.

The framework aligns with the Broaden-and-Build Theory and the Control-Value Theory of Achievement Emotions, both emphasizing that positive emotions broaden cognitive resources and promote sustained engagement, while contextual and social factors determine the value appraisal of learning activities. In this study, teacher immunity and AI integration jointly create a high-value, low-threat environment that fosters emotional resilience and deep learning. Figure 6 schematically represents these hypothesized multilevel pathways.

4.5 AI-Assisted Learning Platform: Structure, Measurement, and Validation

The study employed the learn Smart-English platform and integrated into blended EFL courses since 2022. The system includes four primary functional modules:

(1) Adaptive Feedback Engine, which analyzes student task performance using NLP-based scoring and provides personalized revision advice;

(2) Affective Analytics Dashboard, which tracks emotion-related expressions and self-reported affect scores;

(3) Intelligent Tutoring Module, delivering emotion-responsive learning prompts based on cognitive-affective modeling; and

(4) Peer Interaction Space, facilitating cooperative dialogue and teacher feedback loops.

The AI Integration Index was quantified by a four-item, five-point Likert scale (sample item: "The AI platform gives me timely feedback that improves my confidence and enjoyment in learning English"). The scale demonstrated satisfactory internal consistency (Cronbach's $\alpha = 0.87$) and construct validity, with confirmatory factor analysis results of $\chi^2/df = 1.94$, $CFI = 0.97$, $TLI = 0.96$, $RMSEA = 0.046$. Convergent validity was established through positive correlations with FLE ($r = 0.42$, $p < .001$) and engagement ($r = 0.37$, $p < .001$).

Reliability and validity procedures followed established guidelines for technology-enhanced

learning research. All AI-related variables were standardized at the class level before inclusion in the multilevel SEM. These results confirm that the AI platform functions not merely as a delivery tool but as an affective-pedagogical mediator that strengthens emotional engagement and learning persistence.

4.7 Qualitative Findings from Semi-Structured Interviews

The qualitative strand, based on semi-structured interviews with 30 students, provides contextualized evidence that converges with the quantitative patterns reported above. Interview narratives were thematically coded in NVivo and organized around three focal domains: individual emotional regulation, classroom emotional climate, and experiences with the AI-assisted learning platform.

First, at the individual level, students who scored higher on trait emotional intelligence and adaptive emotion regulation strategies in the survey tended to describe more proactive ways of coping with academic pressure and language anxiety. These students frequently reported monitoring their own emotional states, reframing exam-related stress as a challenge, and deliberately engaging in positive refocusing during demanding English tasks. By contrast, students with lower reported EI and self-regulation scores more often depicted episodes of rumination, avoidance of English activities, or feelings of being "stuck" when anxiety accumulated. These qualitative patterns are consistent with the finding that emotional intelligence and cognitive reappraisal positively predict learning motivation and engagement, whereas expressive suppression is negatively associated with engagement.

Second, the interviews underscored the central role of classroom emotional climate and teacher practices in shaping FLE and anxiety. Students recurrently emphasized that clear instructional structure, emotionally supportive feedback, and opportunities for collaborative tasks created a sense of psychological safety in English classes. Such environments were described as "relaxed but focused", encouraging risk-taking in speaking and reducing the fear of making mistakes. Conversely, classes perceived as emotionally distant or overly evaluative were associated with heightened anxiety and reluctance to participate. These accounts mirror the quantitative results showing that classroom emotional climate strongly predicts FLE and engagement, and that high levels of positive psychological resources yield the greatest benefits in emotionally supportive classrooms.

Third, interviewees provided nuanced reflections on the AI-assisted I Learn Smart-English platform. Many students reported that the adaptive feedback and progress tracking functions helped them recognize incremental improvement, which in turn enhanced confidence and enjoyment. The possibility to receive immediate, individualized suggestions was viewed as complementing teacher feedback rather than replacing it, particularly when teachers explicitly framed the AI system as a supportive tool. At the same time, some students noted that dense error highlighting or performance dashboards could temporarily heighten anxiety if used without adequate pedagogical scaffolding. Overall, the interview data portray the AI platform as an affective-pedagogical mediator: when embedded in a warm classroom climate and combined with teacher emotional competence, AI-based feedback appears to strengthen engagement and buffer the detrimental impact of anxiety, in line with the multilevel SEM findings on AI integration and teacher immunity.

4.7 Integrative Analysis and Theoretical Implications

The final stage of the result analysis aims to integrate the research findings of various constructs - FLE, anxiety, EI, classroom atmosphere, and self-regulated learning behavior - and construct an integrated framework. This part not only validates the proposed hypothesis model, but also highlights how the dynamic interaction of positive and negative emotions jointly shapes the academic engagement and resilience of learners in higher education contexts.

The results of multilevel regression and SEM are consistent, indicating that the positive impact of

FLE on academic engagement is the most significant ($\beta = 0.41$, $p < 0.001$), followed by emotional intelligence (EI) ($\beta = 0.29$, $p < 0.01$). Conversely, anxiety has a significant negative predictive effect on learning engagement ($\beta = -0.32$, $p < 0.001$), but this effect is significantly moderated by teacher support and cooperative learning (interaction effect $\beta = 0.18$, $p < 0.05$). This result is consistent with existing research, which states that positive emotions can to some extent counteract the destructive effects of negative emotions [42]. Moreover, the classroom atmosphere plays a mediating role: supportive teacher-student interaction not only enhances FLE but also buffers the impact of anxiety to a certain extent.

The dynamic SEM model (see Fig. 5) further reveals the bidirectional causal relationship between FLE and academic engagement. The cross-lagged coefficient ($\beta = 0.21$, $p < 0.01$) indicates that the previous positive emotions can predict higher levels of subsequent learning engagement, and learning engagement itself will also promote subsequent positive emotions. This cyclic process highlights the potential to cultivate an "active emotion spiral" in the second language classroom, which is highly consistent with the "broaden-and-build theory" of positive emotions. At the same time, although anxiety shows a stable autoregressive path in the time series ($\beta = 0.47$, $p < 0.001$), its predictive power weakens over time when teacher scaffolding support is present. This indicates that teaching intervention can weaken the persistence of negative effects.

The comparative subgroup analysis results showed that compared with non-first-generation college students, first-generation college students had significantly lower baseline EI ($M = 3.21$ vs. 3.67, $p < 0.01$) and significantly higher anxiety levels ($M = 3.45$ vs. 2.88, $p < 0.01$). However, cooperative learning had a more significant effect on enhancing the FLE for first-generation college students ($+0.34$ SD gain), while the improvement for their peers was $+0.19$ SD.

At the theoretical level, this study has promoted the integration of PP and the framework of second language motivation, demonstrating that EI and FLE are not merely parallel predictors, but rather interdependent elements that jointly constitute the resilience mechanism.

At the practical level, the results highlight the necessity of explicitly integrating emotional pedagogy into teacher professional development programs, including emotional regulation strategies, peer collaboration, and adaptive feedback. Moreover, the introduction of AI-assisted tools (Fig. 6) demonstrates a significant moderating effect, indicating that a hybrid teaching model that combines human empathy and intelligent adaptability may represent a promising direction for the development of higher education.

Although the research results are robust, several limitations still need to be acknowledged. Firstly, reliance on self-report scales may introduce social expectation bias; secondly, the time span of the three rounds of data collection may not be long enough to comprehensively capture longer-term learning trajectories. Future research should adopt multimodal data (such as physiological indicators of emotions, natural classroom observations), and extend the longitudinal research design to multiple school years. Additionally, cross-cultural replication studies are needed to test whether these emotional dynamics can be generalized to contexts outside East Asia and the Middle East. In conclusion, the integrative analysis of this study confirmed that creating a positive classroom atmosphere and leveraging students' emotional strengths can significantly enhance learning engagement and resilience. These findings provide a solid empirical basis for formulating language education policies based on PP, are in line with the emphasis on learners' well-being, adaptability, and inclusiveness in the global education innovation agenda. They hold significant importance for the year 2025 and beyond

5. Conclusions

5.1 Findings

This study systematically examined the interrelationships among foreign language learning enjoyment (FLE), language learning anxiety, emotional intelligence (EI), classroom

atmosphere, and artificial intelligence-assisted teaching intervention in shaping the English learning performance of undergraduate students. The empirical results revealed several key conclusions: (1) FLE is the strongest positive predictor of academic engagement and achievement, followed by EI, while anxiety has a significant negative impact;

(2) Classroom atmosphere played a mediating and moderating role, supportive interactions between teachers and students as well as among peers not only enhanced FLE but also buffered the adverse effects of anxiety;

(3) The longitudinal analysis showed a bidirectional causal relationship between FLE and learning engagement, highlighting the existence of the "positive emotion spiral";

(4) Subgroup comparison results indicated that first-generation college students had lower EI levels and higher anxiety levels, but they benefited more from cooperative learning intervention; (5) The AI-assisted platform, as a supplementary moderating factor, can provide adaptive feedback and personalized emotional regulation strategies, thereby further enhancing learning effectiveness.

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