frontiers | Frontiers in Education

TYPE Original Research
PUBLISHED 14 July 2025
DOI 10.3389/feduc.2025.1618239

OPEN ACCESS

EDITED BY
José Luis Ortega-Martín,
University of Granada, Spain

REVIEWED BY
Alberto Fernández Costales,
University of Oviedo, Spain
Pedro Ureña Gómez-Moreno,
University of Granada, Spain

*CORRESPONDENCE
Mingjin Lin
✉ mingjinlin@163.com

RECEIVED 23 May 2025
ACCEPTED 23 June 2025
PUBLISHED 14 July 2025

CITATION
Liu X and Lin M (2025) An empirical study on flow experience regulation in reducing English listening anxiety among high school students. *Front. Educ.* 10:1618239.
doi: 10.3389/feduc.2025.1618239

An empirical study on flow experience regulation in reducing English listening anxiety among high school students

Xiu Liu and Mingjin Lin*

Department of Foreign Languages, Fujian Normal University, Fuzhou, China

This study investigates the moderating effect of flow experience on English listening anxiety in the context of high school English instruction in China. A total of 105 first-year high school students participated in the experiment. Quantitative data collected through tests and questionnaires revealed that flow experience significantly reduced listening anxiety by enhancing learners' concentration, task engagement, and intrinsic motivation. Moreover, flow, as a positive psychological state, was associated with improved listening comprehension. Among students with higher levels of anxiety, flow played a crucial regulatory role by buffering the negative effects of anxiety through cognitive, emotional, and behavioral mechanisms. These findings suggest that incorporating flow-based strategies into listening instruction may serve as an effective approach to reducing anxiety and improving learning outcomes.

KEYWORDS

flow experience, English listening anxiety, listening comprehension, positive psychology, listening instruction, anxiety regulation, English as a second language (ESL), teaching suggestions

1 Introduction

Listening skills have always been one of the most significant challenges faced by students and teachers in the context of English language instruction. According to the "General Senior High School Curriculum Standards English (2017 Edition, 2020 Revision)," the goal of senior high school English teaching is to comprehensively enhance students' language ability, cultural awareness, thinking capacity, and learning ability, with a particular emphasis on the balanced development of listening, speaking, reading, viewing and writing skills. As a crucial component of language learning, listening not only serves as the primary pathway for students to receive linguistic input but also forms the foundation for the overall improvement of their language proficiency. Previous research has shown that listening comprehension ability is closely related to students' language proficiency (Rost, 2002). However, despite the critical role of listening in English learning, current high school English listening instruction still faces certain challenges. Conventional approaches that prioritize knowledge transmission over learner engagement, which may tend to underestimate their listening abilities and develop excessive concerns about their exam results. These negative emotions frequently prevent students from concentrating, affecting their comprehension of the listening materials and their overall learning effectiveness (MacIntyre and Gardner, 1994). Consequently, finding effective ways to alleviate English listening anxiety in high school students has become an urgent issue that needs to be solved in current English education.

In recent years, advancements in educational psychology have led to the integration of the concept of "flow experience" into English listening instruction. Originally introduced by Csikszentmihalyi (1990), flow experience refers to a state of optimal psychological engagement in which individuals are fully immersed in an activity. This state is typically marked by intense concentration, a loss of self-consciousness, a distortion of time perception, and intrinsic satisfaction. Such characteristics are especially relevant to language learning environments, which often require sustained mental effort and real-time processing.

According to flow theory, this immersive state arises when specific conditions are met, typically structured around nine core dimensions. Among these, challenge–skills balance, clear goals, and immediate feedback are most applicable to classroom settings (Nakamura and Csikszentmihalyi, 2002; Egbert, 2003).

Challenge–skills balance refers to the alignment between the perceived difficulty of a task and the learner's perceived competence. When a task is appropriately challenging but is manageable, students are more likely to feel confident and engaged. If the task exceeds their skill level, it induces anxiety; if it falls below, it leads to boredom. In the context of English listening instruction, maintaining this balance involves balancing task difficulty through pre-listening support, material segmentation, or scaffolding strategies. It is through this balance that flow effectively regulates anxiety, enabling learners to sustain focus without being overwhelmed by fear of failure.

Clear goals give learners a focused direction for action. In listening tasks, explicitly defined objectives, such as identifying main ideas, tracking argument structure, or noting key details, enhance attention and goal-oriented effort.

Immediate feedback allows learners to recognize progress, detect comprehension gaps, and make strategic adjustments in real time. This dimension promotes a sense of control and encourages persistence, both of which are essential for reducing affective barriers.

In conclusion, these dimensions foster a psychologically safe and cognitively stimulating environment where learners can fully engage in decoding, interpreting, and retaining listening content. From an affective perspective, flow contributes to anxiety reduction by enhancing learners' perceived control, minimizing self-consciousness, and suppressing intrusive worry.

However, most empirical research has focused on university students, with relatively few studies addressing its application in high school listening instruction. One notable exception is the study by Elkhafaifi's (2005) investigation of Arabic learners, which confirmed a significant negative correlation between listening anxiety and comprehension scores. This research integrates both affective and cognitive frameworks, such as flow theory within secondary-level listening instruction. Then, Zhang (2015) explored the relationship between flow and English listening anxiety in college students and identified a significant negative correlation. While these studies have laid important groundwork, they were largely correlational in nature and did not explore the mechanisms through which flow experience reduces anxiety, nor did they propose instructional models for applying flow in senior high school.

To address this gap, the present study investigates how flow-based instructional strategies can regulate affective responses and promote deeper cognitive engagement in English listening tasks among high school learners. Rather than focusing solely on performance outcomes, this research aims to explore the underlying mechanisms through which flow experience influences learners' emotional and attentional states. Specifically, we examine how challenge–skills balance, goal clarity, and real-time feedback interact to shape learners' listening behaviors, attentional focus, and anxiety regulation.

2 Literature review

2.1 Current research on the relationship between flow experience and listening anxiety

English listening anxiety refers to the negative emotional response experienced by foreign language learners when performing English listening tasks, often due to concerns about not understanding the content or achieving unsatisfactory exam results. This anxiety not only affects learners' listening comprehension abilities but also potentially weakens their motivation to learn, then hindering their overall learning effectiveness (Horwitz et al., 1986; Elkhafaifi, 2005). From a neuroscientific perspective, the synergy of these instructional components promotes functional coupling between the prefrontal cortex and limbic system (Etkin et al., 2011). This co-activation allows learners to sustain attention while experiencing positive affect. Specifically, when cognitive resources are effectively aligned with task demands, the amygdala's anxiety response is inhibited, while dopaminergic reward circuits are strengthened, generating a cycle of "focus-success-enjoyment." These brain-level effects explain how flow experience not only boosts comprehension but also mitigates listening-related anxiety. Therefore, these foundational works have highlighted the importance of addressing affective factors in listening instruction, laying the groundwork for further inquiry into emotion-based interventions.

As research on positive emotional experiences has deepened, flow experience has emerged as a valuable perspective in educational research. In particular, international scholars have increasingly integrated flow theory into foreign language instruction to examine its potential in alleviating students' anxiety. Ibrahim and Al-Hoorie (2019) found that shared, sustained flow is highly influenced by positive emotions and motivation within group learning activities. They highlighted that flow experiences are more likely to occur when learners form a group identity, attach personal value to the task, and have partial autonomy over the learning process. The study emphasizes that lowering anxiety and enhancing engagement can increase the likelihood of flow, which informs the motivational out-of-class activities design. Similarly, Dewaele and MacIntyre (2024) emphasized that emotional factors such as enjoyment and anxiety have a marked influence on foreign language

achievement and learner engagement. Reducing anxiety while increasing enjoyment not only enhances academic performance but also fosters flow experiences, which in turn stimulate learning potential. This insight not only aligns with the present study's emphasis on emotional regulation but also justifies flow as an intervention target.

Recent empirical studies have further confirmed the significance of flow in English listening contexts. Mystkowska-Wiertelak and Słowik-Krogulec (2024) showed that task-specific flow experiences reduced anxiety and increased engagement, particularly among older adult EFL learners, suggesting broad applicability of flow-based approaches. Although focusing on a different learner group, their findings support the broader applicability of flow-based pedagogical models across age and context. Agustin (2024) found that affective barriers such as anxiety were a major obstacle to listening comprehension, indirectly supporting the importance of engagement and flow in mitigating listening-related difficulties. Moreover, Xiao (2025) demonstrated that incorporating AI-enhanced listening tools promoted learners' flow states and significantly reduced anxiety during English listening tasks.

At the same time, Chinese scholars have also begun to recognize the importance of flow experience in foreign language instruction, particularly in regulating emotional states and enhancing learning effectiveness. Li (2014) argued that flow experience helps reduce anxiety by increasing learners' attention and motivation, thus enabling optimal performance during listening tasks. Ji et al. (2020), drawing on flow theory to analyze social reading behaviors, proposed that well-designed activities can elicit flow experiences and improve learning efficiency. Li (2021) reviewed applications of flow theory in second language acquisition, concluding that creating an enjoyable and supportive learning environment can effectively alleviate anxiety and improve the quality of learning experiences. Gao et al. (2022) investigated the role of flow in foreign language reading and found a significant positive correlation between flow experience and reading performance. Their study suggests that enhancing flow can relieve reading-related anxiety and increase learners' engagement and learning outcomes, implying that the anxiety-reducing and engagement-enhancing effects of flow may also extend to listening instruction.

However, the exploration of the relationship between flow experience and English listening anxiety remains in its early stages. Existing research primarily focuses on the effects of flow on anxiety in reading or writing contexts, while its application in listening instruction has received limited attention. Therefore, this study aims to not only empirically investigating the impact of flow-based instructional approaches on high school students' listening anxiety and performance, but also clarifying the mechanisms through which flow emerges in pedagogical practice. It seeks to address the following research questions:

1. Is there a significant difference in students' listening anxiety before and after the intervention?
2. Is there a significant difference in students' listening performance before and after the intervention?
3. How does flow experience regulate English listening anxiety among high school students?

3 Empirical research design

3.1 Research participants

The participants of this study were 105 first-year high school students from two classes at a public high school in Fuzhou, Fujian Province, China. This age group (approximately 16 years old) was selected because students at this stage typically possess a foundational knowledge of English but have limited prior exposure to flow-based pedagogical interventions. Among the participants, 48 were male and 57 were female, ensuring a relatively balanced gender distribution. In terms of family background, the majority of students came from urban households, reflecting the school's catchment area, which primarily serves students from urban or suburban communities. This demographic information helps contextualize the learning environment and socio-educational factors influencing students' engagement and anxiety. In terms of academic background, students represented a mixed-ability sample: placement test results and teachers' records indicated a typical range of proficiency levels across both classes. All had received at least 6 years of formal English instruction under the national curriculum. English was primarily learned for academic purposes (e.g., Gaokao), with little daily communicative use. Students' access to extracurricular English resources (e.g., apps, private tutoring) was similar across the two classes. These contextual details help position the study within a typical urban Chinese EFL environment.

Two intact classes were selected for the study. The class teacher randomly assigned one class as the experimental group ($N = 50$) and the other as the control group ($N = 55$). Pre-test English listening scores and anxiety assessments indicated no significant differences between the two groups in terms of their baseline listening performance or anxiety levels ($p > 0.05$). Furthermore, both groups were comparable in terms of gender, age, and learning background, helping to control for confounding variables and ensuring the internal validity of the intervention results.

3.2 Research procedures

This study was approved by the Research Ethics Committee of Fuzhou Shude High School, and all procedures complied with the ethical guidelines for human subjects research. Given that participants were minors, written informed consent was obtained from both the students and their legal guardians prior to data collection. Participants were assured of their right to withdraw from the study at any time without penalty. All collected data were used solely for research purposes.

This study employed a quantitative approach and divided the experiment into two groups, an experimental group and a control group. The experiment lasted for one semester (16 weeks), during which students attended one English listening lesson per week. All students were taught by the same instructor using identical textbooks, and the teaching schedule was standardized to ensure consistency in the instructional conditions.

Prior to the experiment, the instructor received 10 h of professional training in flow-based pedagogy, which covered task

design principles (e.g., scaffolding challenges, feedback strategies, and motivational scaffolding techniques). To ensure fidelity of implementation, researchers conducted biweekly classroom observations throughout the intervention period.

The experimental group followed a flow-based teaching model, which incorporated the following procedures. Firstly, in each English listening task, the teacher paid particular attention to balancing the task's level of challenge with the students' abilities. The tasks were designed to be sufficiently challenging to stimulate students' intrinsic motivation and engagement. Secondly, during the implementation of listening tasks, the teacher utilized a range of multimodal teaching materials, including images, videos presentations, to stimulate student interest and activate prior knowledge. This helped lay the foundation for the comprehension of the listening input. Thirdly, the teacher provided timely feedback and encouragement to help students maintain a balance between the sense of challenge and their self-perceived abilities, enhancing their emotional experience and engagement. Fourthly, after the while-listening procedures, the teacher organized interactive activities, including role-playing and group discussions, to deepen students' understanding of the listening material. This approach was designed to enhance students' sense of participation, immersion, and overall learning experience.

In contrast, the control group followed a conventional textbook-based listening approach. The teacher primarily relied on prescribed audio recordings and provided explanations of key language points based on the curriculum. Instructional input was limited to auditory stimuli, and the class format followed a traditional listen-and-answer pattern, without multimodal enhancements. Feedback was delivered post-class through general reviews and summaries. This model emphasized content delivery and curriculum coverage, with fewer opportunities for interactive engagement during instructional time.

3.3 Data analysis

To ensure the reliability and validity of the data, a quantitative research method was employed, with the use of multiple measurement scales for data collection. Firstly, the study utilized the Foreign Language Listening Anxiety Scale (FLCAS), developed by Horwitz et al. (1986), which is widely used in research on foreign language anxiety. The scale was adapted based on the revised version by Zhang and Zhao (2011) to suit the context of Chinese high school students. The scale comprises 17 items, using a 5-point Likert scale to assess four dimensions, including anxiety during the listening process, anxiety related to listening outcomes, lack of listening confidence, and attitudes toward learning and motivation. A pilot study with 50 questionnaires showed a Cronbach's alpha of 0.963, well above the acceptable threshold of 0.7, indicating excellent reliability. Additionally, the KMO value was 0.934, further demonstrating the scale's strong construct validity.

Secondly, to measure students' flow experiences during listening tasks, the Flow State Scale (FSS) by Jackson and Marsh (1996) was employed. This 22-item scale, also on a 5-point Likert scale, assesses four dimensions, including challenge–skills balance, concentration and immersion, perceived control and feedback, and enjoyment and achievement. A pilot survey ($N = 50$) yielded a Cronbach's alpha of 0.992 and a KMO of 0.922, providing evidence of robust construct validity.

Thirdly, students' English listening proficiency was assessed using the listening section of the Fuzhou first-year high school end-of-term quality examination. This test was selected to align with students' existing curriculum and proficiency level. Pre- and post-tests were administered to track changes in listening performance.

All quantitative data were analyzed using SPSS 26.0. The analyses included independent-samples t-tests, paired-samples t-tests, and regression analysis to examine the moderating effect of flow experience on listening anxiety. This research design, integrating flow-based pedagogy with multimodal instruction, aimed to investigate the interrelationship between flow experience, listening anxiety, and listening performance.

4 Experimental results

4.1 Changes in learners' English listening anxiety before and after flow experience

At the pre-test stage prior to the intervention, learners' English listening anxiety was assessed using the Foreign Language Listening Anxiety Scale (FLCAS). The data were collected from all participants ($N = 105$), including both the experimental group and the control group. The FLCAS is a 17-item instrument rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), where higher scores reflect greater anxiety.

The results showed that students exhibited the highest levels of anxiety during the listening process, with a mean score of 3.91, which is considered relatively high. This anxiety was particularly evident when students encountered fast speech or complex listening materials, affecting their attentional focus and task engagement. In terms of outcome-related anxiety, the mean score was 3.82, reflecting a high level of concern about test performance and external evaluation. Many students feared that poor performance on listening tasks would negatively affect their final grades or result in negative evaluations from teachers and peers. Students also reported a mean score of 3.89 for lack of listening confidence, indicating that low perceived competence contributed significantly to their anxiety. Particularly when faced with unfamiliar vocabulary or complex sentence structures, students often felt helpless, leading to decreased confidence, frustration, and heightened anxiety. The score for listening attitude and motivation was slightly lower, at 3.43, suggesting that although students generally maintained a positive disposition, it was insufficient to offset the anxiety experienced during challenging tasks.

Prior to the intervention, a pre-test was conducted with both the experimental and control groups to measure baseline levels of listening anxiety. An independent-samples t-test showed no statistically significant difference between the two groups, which means anxiety scores were 62.40 (experimental) and 65.35 (control), $t = -1.500$, $p = 0.137$. These results indicate comparable levels of listening anxiety at the outset and establishing baseline equivalence.

Following the 16-week intervention, a post-test was administered. Results from the independent-samples *t*-test revealed a significant reduction in the experimental group's anxiety score ($M = 29.52$), while the control group's score remained high ($M = 66.02$), $t = -34.807$, $p < 0.001$. These results are summarized in Table 1.

The findings suggest that the flow-based instructional approach, which emphasized challenge-skills alignment, multimodal input, clear goal-setting, and immediate feedback, played a substantial role in alleviating learners' English listening anxiety. Through sustained engagement in such structured and emotionally supportive listening tasks, students in the experimental group demonstrated significantly lower anxiety levels after the intervention, supporting the effectiveness of flow experience as a regulatory mechanism in affective language learning contexts.

To further analyze the change in anxiety levels before and after the intervention, paired-samples *t*-tests were conducted for both the control and experimental groups. Firstly, for the control group, the mean pre-test and post-test anxiety scores were 65.35 and 66.02 respectively, showing a mean difference of 0.67, which was not statistically significant ($t = -1.219$, $p = 0.228$). The paired-sample correlation analysis between pre-test and post-test scores was strong ($r = 0.913$), suggesting a stable anxiety pattern throughout the semester under traditional instruction, as shown in Table 2.

In contrast, the experimental group showed a significant decrease in anxiety levels from pre-test ($M = 62.40$) to post-test ($M = 29.52$), with a mean difference of 32.88 ($t = 22.206$, $p < 0.001$). The paired-sample correlation analysis between the two time points was also high ($r = 0.800$, $p < 0.01$), indicating that the trend in anxiety score changes was consistent between the two tests, and the scope of the change was substantial.

In summary, the results of this study indicate that the flow experience has a significant effect in alleviating students' English listening anxiety. Under the intervention of the flow experience, the anxiety levels of students in the experimental group significantly decreased, while the anxiety levels of students in the control group showed little change. This result proves the practical application value of the flow experience in teaching. By personalizing tasks, introducing challenging learning tasks, providing timely feedback, and creating an immersive learning environment, teachers can effectively help students overcome anxiety in English listening learning, then enhancing their learning efficiency and classroom participation.

4.2 Changes in learners' English listening performances before and after the flow experience

This study explored the effect of the flow experience on the improvement of high school students' English listening scores through a pre-test and post-test comparative analysis. Prior to the experiment, an independent samples *t*-test was conducted on the listening scores of both the experimental and control groups. The results showed no significant difference in their pre-test scores. The average score of the experimental group was 59.9 ($SD = 4.225$), and that of the control group was 58.89 ($SD = 5.294$), with a *t*-value of 1.073 ($p = 0.503$). This indicates that both groups had similar starting levels. This result provides a reliable basis for comparison in subsequent interventions, ensuring that both the experimental and control groups began the experiment at similar points. Moreover, the homogeneity of variance test showed consistent variance in scores between the two groups, further verifying the fairness of the experimental design.

After the intervention, the experimental group's scores showed a significant improvement. As shown in Table 3, the post-test average score of the experimental group was 85.90 ($SD = 4.482$), an increase of 26 points from the pre-test score of 59.90 ($SD = 4.225$). In contrast, the control group's post-test score was 63.71 ($SD = 3.725$), which showed only an increase of 4.82 points from the pre-test. The independent samples *t*-test revealed a highly significant statistical difference between the experimental and control groups' scores, with a *t*-value of 27.437 ($p = 0.000$). This suggests that the flow experience significantly enhanced the English listening scores of students in the experimental group. In comparison, although the control group showed some improvement, the increase was much smaller than that of the experimental group, indicating that traditional listening teaching methods have a limited effect on improving listening scores.

Further analysis of the performance changes of students in the experimental group revealed that the paired sample

TABLE 1 Independent *T*-test of pre-and post-test of English listening anxiety.

Test	Experimental group	Control group	*t*	Sig. (2-tailed)
Pre-test	62.40	65.35	−1.5	0.137
Post-test	29.52	66.02	−34.807	0.000

TABLE 3 Independent *T*-test of pre-and post-test of English listening performance.

Test	Experimental group	Control group	*t*	Sig. (2-tailed)
Pre-test	59.9	58.89	1.073	0.503
Post-test	85.9	63.71	27,437	0.000

TABLE 2 Paired *T*-test of pre-and post-test of English listening anxiety.

Experimental group				Control group			
Pre-test	Post-test	*t*	Sig. (2-tailed)	Pre-test	Post-test	*t*	Sig. (2-tailed)
62.40	29.52	22.206	0.000	65.35	66.02	−1.219	0.228

TABLE 4 Correlation analysis between flow experience, listening anxiety, and listening performance.

Factors	Listening anxiety	Flow experience	Listening score
Listening anxiety	1.000	Correlation = −0.773 Sig. (2-tailed) = 0.000	−0.767
Flow experience	Correlation = −0.773	1.000	Correlation = 0.752 Sig. (2-tailed) = 0.000
Listening score	Correlation = −0.767 Sig. (2-tailed) = 0.000	0.752	1.000

t-test showed a mean difference of 26.00 points between the pre-test and post-test, with a *t*-value of −48.642 (p = 0.000), indicating that the flow experience had a significant positive impact on the listening scores of students in the experimental group. Not only did the experimental group show significant improvements in their listening scores, but their performance on listening tasks also became more stable, with a reduction in anxiety, and a significant enhancement in their learning engagement and self-confidence. From an emotional and psychological perspective, the flow experience helped students enter a highly focused learning state, reducing anxiety and nervousness during the learning process. In contrast, the average score difference between the pre-test and post-test of the control group was only 4.818, showing some improvement in the traditional teaching process, but no significant change in listening anxiety, further verifying the effectiveness of the flow experience in regulating student emotions and improving learning outcomes.

In summary, in a flow state, students are able to engage more fully in learning tasks, perceiving a match between the challenge of the task and their abilities, then enhancing intrinsic motivation for learning. Through this positive learning experience, students demonstrated greater initiative and autonomy in subsequent listening tasks, further promoting their learning progress.

4.3 The moderating role of flow experience between listening anxiety and listening performance

4.3.1 Correlation analysis between flow experience, listening anxiety, and listening performance

In the correlation analysis, we used the Spearman rank correlation test and found significant correlations between listening anxiety, flow experience, and listening performance, as detailed in Table 4. Firstly, the correlation coefficient between post-test English listening anxiety and post-test flow experience total score was −0.773 (p = 0.000), indicating a significant negative correlation between the two. This suggests that as the flow experience increases, students' listening anxiety decreases significantly. This result confirms that flow experience, as a positive psychological state, can effectively alleviate negative emotions during the learning process, helping students complete tasks with a more relaxed mindset. Secondly, the correlation coefficient between post-test English listening anxiety and post-test English listening performance was −0.767 (p = 0.000), showing a significant negative correlation. This means that the reduction in listening anxiety is closely related to the improvement in English listening performance. Finally, the correlation coefficient between the post-test flow experience total score and post-test English performance was 0.752 (p = 0.000), showing a significant positive correlation. This indicates that an increase in flow experience not only reduces listening anxiety but also significantly improves students' English listening performance. This is consistent with Csikszentmihalyi's (1990) flow theory, which posits that when students experience a flow state, their attention and psychological resources are more focused on the learning task, then enhancing learning outcomes.

TABLE 5 Regression analysis of flow experience on the relationship between listening anxiety and listening performance.

R	R^2	Adjusted R^2	*F*	*p*
0.990[a]	0.980	0.979	1,638.631	0.000

[a]Indicates that the correlation coefficient *R* is significant at the 0.001 level (2-tailed).

4.3.2 Regression analysis of flow experience on the relationship between listening anxiety and listening performance

To further verify the moderating effect of flow experience between anxiety and listening performance, this study conducted hierarchical regression analysis, with the specific data presented in Table 5.

Before performing the regression, relevant statistical assumptions were tested. The normality of residuals was examined using the Shapiro-Wilk test and Q-Q plots, and no significant deviations were detected. Additionally, multicollinearity was assessed using the Variance Inflation Factor (VIF), with all VIF values below 2, indicating acceptable levels of collinearity. The Durbin-Watson statistic was 1.865, suggesting no autocorrelation in residuals.

The R^2 of the regression model was 0.980, and the adjusted R^2 was 0.979, indicating that the model has a high explanatory power, accounting for 98% of the variance in the scores. The ANOVA results showed that the F-value of the regression model was 1,638.631 ($p < 0.001$), indicating that the model fits well and that the regression equation is statistically significant. The regression coefficient analysis revealed that the direct effect of flow experience on listening performance was significant, with

$\beta = 0.256$ ($p = 0.006$), suggesting that the higher the level of flow experience, the lower the student's anxiety and the better their listening performance. Additionally, the negative predictive effect of listening anxiety on listening performance was significant, with $\beta = 0.739$ ($p < 0.001$), confirming the negative impact of anxiety on academic performance. Most importantly, the interaction term, flow experience × pre-test listening anxiety, showed a significant negative moderating effect, with $\beta = -1.245$ ($p < 0.001$). This indicates that flow experience can significantly reduce the adverse effects of anxiety on listening performance, particularly among students with high levels of anxiety.

Although the model yielded robust explanatory power, several limitations should be acknowledged. Firstly, the data were drawn from a single regional context, which may limit the generalizability of the findings. Secondly, while assumptions were met statistically, future research might consider structural equation modeling to further validate the interaction pathways and latent constructs.

4.3.3 Interaction effect analysis of flow experience, listening anxiety, and listening performance

To further explore the moderating role of flow experience, an interaction analysis was conducted using a line graph (Figure 1). The results reveal a distinct interaction pattern. Among students with higher levels of listening anxiety, those who reported greater flow experience achieved noticeably higher listening scores than those with lower flow engagement. A similar trend was observed among low-anxiety students, indicating that flow experience positively influenced performance across anxiety levels. These findings emphasize the regulatory function of flow in learning environments. Rather than merely serving as a motivational construct, flow appears to buffer the adverse effects of anxiety and promote sustained cognitive focus, thereby supporting students' task performance under varying affective conditions.

In summary, through regression analysis and interaction effect analysis, this study has confirmed the significant moderating role of flow experience between listening anxiety and listening performance. The results show that flow experience not only directly affects students' listening performance but also indirectly enhances their learning outcomes by alleviating listening anxiety. Furthermore, the moderating effect of flow experience is particularly notable in students with high anxiety levels, which further supports the effectiveness of flow experience.

5 Discussion

5.1 The impact of flow experience on listening anxiety and comprehension performance

The results of this study demonstrate that flow experience exerts a dual influence in the context of English listening instruction, both in regulating learners' affective states and in enhancing their listening comprehension performance.

On the affective side, students in the experimental group showed a significant decrease in listening anxiety, especially in the dimensions of "process anxiety" and "lack of confidence." This is particularly relevant in high-pressure listening tasks, where time constraints, complex input, and low self-efficacy often induce cognitive overload. Flow experience mitigates these stressors by fostering intense concentration and emotional regulation, helping students stay focused and composed under pressure. These findings align with Dewaele and MacIntyre's (2024) claim that affective variables such as enjoyment and anxiety co-regulate language performance through their influence on learner engagement and flow states. This also echoes Csikszentmihalyi's (2008) theory that flow states suppress distractions and psychological tension, allowing learners to engage more effectively with demanding tasks.

Simultaneously, flow experience significantly improved students' listening comprehension abilities. Compared to the

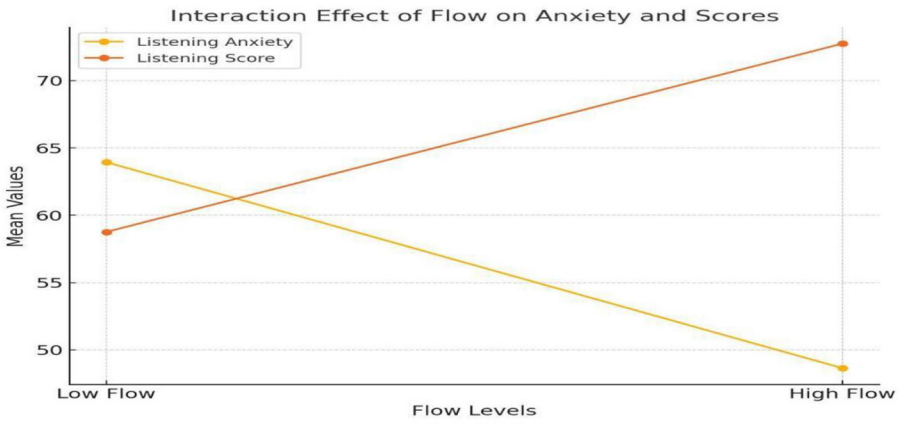

FIGURE 1
Interaction line chart of flow experience, listening anxiety and listening performance.

control group, the experimental group achieved notably higher post-test scores. This improvement can be attributed to the alignment between task difficulty and learners' skills, which triggered deeper engagement and intrinsic motivation. This supports Choi et al. (2014), who emphasized the necessity of balancing task difficulty to maintain motivation and minimize anxiety in second language instruction. When learners perceive listening tasks as challenging yet manageable, they are more likely to enter a state of optimal focus, enhancing real-time information processing, semantic inference, and retention. In this way, flow experience not only reduces affective barriers but also reinforces cognitive mechanisms central to listening development.

Overall, the study highlights that flow experience in listening instruction is not merely an emotional buffer, it functions as an integrated cognitive-affective -behavioral mechanism. It empowers learners to overcome anxiety while simultaneously promoting sustained attention, learning motivation, and skill acquisition.

While the findings of this study offer promising insights into the use of flow experience in listening instruction, several critical reflections are necessary. Firstly, although the intervention demonstrated strong effects in reducing anxiety and improving listening performance, its effectiveness may depend heavily on contextual factors such as teacher expertise, school resources, and student receptivity. Implementing flow-based pedagogy requires not only a deep understanding of the theoretical foundations but also sustained teacher training and curricular support, which may not be readily available in all educational settings. Secondly, flow experience may not be universally beneficial. For some learners, especially those with high trait anxiety or low self-regulation, the intensity of immersive engagement may lead to cognitive overload rather than enjoyment. Therefore, future research should further examine individual differences in learners' flow susceptibility and emotional profiles to better tailor interventions. Through these critical reflections, we hope to further deepen the understanding of the feasibility and complexity of "flow experience" teaching in this study, so as to provide more practical theoretical support for future teaching reform.

5.2 Pedagogical frameworks for eliciting flow experience in English listening tasks

To bridge the gap between theoretical constructs and instructional practice, this section presents a series of reusable task design frameworks based on authentic textbook scenarios. These examples illustrate how the core components of flow, namely, challenge-skills balance, goal clarity, and immediate feedback, which can be embedded into English listening instruction to reduce learners' anxiety and sustain engagement.

In practical teaching, in the "People's Education Press high school textbook English," Compulsory Second Book, Unit 2, Page 14, titled "Wildfire Protection" (Liu and Zheng, 2019a), teachers design a series of progressive listening tasks based on students' actual levels to help them gradually adapt to the speed and information load of the listening materials, thus improving their listening comprehension. As shown in Table 6, for instance, in the first step of the task, students focused on identifying key words, such as "What animals were mentioned by Prince William?" to build their confidence. In subsequent tasks, the difficulty gradually increased, requiring students to record specific data and protective measures from the listening material, such as "How many elephants are killed every day?" and "What did Prince William say about China's role in wildlife protection?" This step-by-step task design not only enhanced the task's appeal but also allowed students to experience a sense of achievement when facing challenges, thus continuously improving their listening ability (Liu and Lin, 2025).

In practical teaching, in the "People's Education Press high school textbook English," Selective Compulsory First Book, Unit 3, Page 30, titled "Fascinating Parks" (Liu and Zheng, 2019b), the teacher can organize a group competition by dividing the class into several groups to compete in the listening task, as shown in Table 7. Students predict the activities tourists may participate in before the listening, select answers during the listening, and

TABLE 6 Flow-based listening task: "wildfire protection."

Flow element	Task design examples
Challenge-skills balance	Keyword Identification: "what animals were mentioned by Prince William?"
	Detail extraction: "how many elephants are killed every day?"
	Inference and opinion: "what did Prince William say about China's role in wildlife protection?"
Immediate feedback	Group scoring: groups earn points for accurate answers.
	Teacher comments: teacher provides real-time verbal feedback: "you precisely captured the data on elephant poaching!"
Goal clarity	Distribute a goal card outlining clear objectives: animal recognition: before task, students are told to identify at least 3 animals mentioned. Protection measures: students are guided to find two specific protection measures from the listening audio.

TABLE 7 Flow-based listening task: "fascinating parks."

Flow element	Task design examples
Challenge-skills balance	Group prediction tasks: students discuss possible tourist activities (e.g., biking, camping) to activate prior knowledge.
	Information matching: during listening, students select correct information according to predicted activities.
	Route reconstruction: groups draw a complete tourist route based on listening content.
Deep participation and social interaction	Role-play activity: 1. Student A plays the tour guide and uses a map to guide Student B (a tourist) through the park. 2. The guide must retell accurate information from the listening text.
Goal clarity	Set specific and attainable micro-goals: Pre-listening goal: list at least three tourist activities mentioned. While-listening goal: identify where each activity takes place and its features. Post-listening goal: design a logical travel route and justify the sequence.

complete the touring route after the listening. The group with the highest score can receive a reward or extra points, which stimulates the students' sense of collective honor and learning motivation. Additionally, after the listening task, the teacher can arrange a role-play activity where students simulate real scenarios, such as one student acting as a tour guide and another as a tourist. The tour guide would use a map to guide the tourist through the park, imitating a real tour experience. Through role-playing, students improve their speaking skills and reinforce their understanding and memory of the listening material, while reducing anxiety through interaction and communication (Liu and Lin, 2025).

Taken together, these task frameworks demonstrate how flow theory can be operationalized in the senior high school. By aligning instructional techniques with flow principles, teachers can cultivate emotionally supportive, cognitively stimulating environments where students not only improve their listening skills but also regulate anxiety through authentic engagement. These models are adaptable across various textbook units aimed at affective-cognitive integration.

6 Conclusion

This study examined the regulatory role of flow experience in reducing English listening anxiety among high school students. The findings demonstrate that flow experience significantly alleviated anxiety by enhancing learners' concentration, engagement, and emotional stability. Specifically, students in a flow state exhibited stronger sustained attention, minimized self-distraction (e.g., intrusive thoughts), and greater immersion in listening tasks. These improvements contributed to better comprehension and more consistent performance. The alignment between moderate task difficulty and students' skill levels created an optimal learning zone, which activated intrinsic motivation and built confidence in dealing with complex input.

Importantly, flow experience emerged not merely as a cognitive phenomenon, but as a holistic state shaped by emotional and behavioral dynamics. For example, students who experienced flow were more likely to persist in challenging tasks, actively participate in discussions, and maintain focus during prolonged listening segments, indicating behavioral engagement beyond cognitive processing. These observations support the view that flow integrates affective regulation with observable task-oriented behaviors.

From a pedagocial perspective, while the present study is situated in the Chinese high school context, the pedagogical implications of flow experience are not confined to this setting. Flow is not achieved through isolated strategies, but through the coordinated implementation of core dimensions, for example, aligning task difficulty with student ability, providing clear and actionable goals, and offering immediate formative feedback, which can be readily adapted to diverse educational systems and cultural backgrounds. In particular, in other high-anxiety learning environments such as large multilingual classrooms or test-driven curricula in Asia, Latin America, or Eastern Europe, these strategies may similarly help students manage affective barriers and foster deeper engagement in language learning.

Firstly, teachers should develop a scaffolded task sequence informed by diagnostic pre-assessments of students' listening abilities. Tasks should progress from basic word recognition to complex semantic inference, ensuring that the level of challenge remains slightly above the learner's current proficiency. This task chaining strategy helps sustain engagement and prevent both boredom and overload.

Secondly, clear sub-goals should be set at each phase of the lesson, for example, "identify speaker's attitude" or "extract key points" to enhance attentional focus and goal-directed behavior. Thirdly, multimodal resources such as images, subtitles, and short video clips should be integrated to activate prior knowledge and enhance the comprehensibility of auditory input. To maintain students' emotional stability and sense of control, teachers should deliver immediate, formative feedback during tasks using verbal encouragement, modeling, and visual cues. Additionally, post-lesson reflective activities, such as metacognitive listening reflection logs, role-play extensions, listening mind maps and dubbing or voice-over tasks can effectively support learners' self-monitoring and emotional regulation.

Finally, creating a safe and inclusive classroom climate is essential. Teachers should avoid judgmental language, emphasize positive reinforcement, and reduce performance pressure, then allowing learners to enter and maintain a flow state more easily. In conclusion, these strategies transform abstract flow theory into concrete, actionable pedagogical techniques, enabling both emotional regulation and improved listening proficiency.

However, this study has several limitations. Firstly, the sample was limited to a single high school in Fuzhou, which restricts the generalizability of the findings. Future research should involve a broader range of participants from different regions, school types, and age groups to enhance external validity. Secondly, the study relied solely on quantitative instruments, such as standardized scales and test scores, without the support of qualitative methods. While these tools provide measurable indicators of anxiety and performance, they don't fully capture the nuances of students' psychological states or classroom interactions during the intervention.

To address this, future studies should incorporate qualitative methods, such as interviews with both teachers and students. These interviews can offer deeper insights into students' personal perceptions of flow and anxiety throughout the intervention. For example, future research could explore: (1) students' flow experience—when and under what conditions they occurred, and how these states influenced their listening engagement; (2) students' changes in listening anxiety—whether and why they perceived reductions in anxiety; (3) students' evaluations of the intervention strategies—what aspects they found most or least effective and why. Such qualitative data would enrich the interpretation of findings, compensate for the current study's reliance on quantitative data, and offer more deep perspectives to inform future pedagogical practices. Finally, this study lacked a longitudinal follow-up. The current results reflect only short-term effects after a 16-week intervention. It remains unclear whether the anxiety-reducing and engagement-enhancing effects of flow-based teaching are sustainable over time. Longitudinal designs with delayed post-tests would be valuable for assessing the durability of these effects.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

XL: Writing – original draft. ML: Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

References

Agustin, T. W. (2024). *EFL students' difficulties in understanding dialogue of spoken text in English listening course: A survey research at the eleventh grade students in MAN 4 Garut* (Undergraduate thesis, UIN Sunan Gunung Djati Bandung). Bandung, Indonesia: UIN Institutional Repository.

Choi, H.-H., van Merriënboer, J. J. G., and Paas, F. (2014). Effects of the physical environment on cognitive load and learning: towards a new model of cognitive load. *Educ. Psychol. Rev.* 26, 225–244. doi: 10.1007/s10648-014-9262-6

Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper & Row.

Csikszentmihalyi, M. (2008). *Flow: The Psychology of Optimal Experience*. New York: Harpercollins Publishers Inc.

Dewaele, J., and MacIntyre, P.D. (2024). "You can't start a fire without a spark": enjoyment, anxiety, and the emergence of flow in foreign language classrooms. *Appl. Ling. Rev.* 2, 403–426. doi: 10.1515/applirev-2021-0123

Egbert, J. (2003). A study of flow theory in the foreign language classroom. *Mod. Lang. J.* 87, 499–518. doi: 10.1111/1540-4781.00204

Elkhafaifi, H. (2005). Listening comprehension and anxiety in the Arabic language classroom. *Mod. Lang. J.* 89, 206–220. doi: 10.1111/j.1540-4781.2005.00275.x

Etkin, A., Egner, T., and Kalisch, R. (2011). Emotional processing in anterior cingulate and medial prefrontal cortex. *Trends Cogn Sci.* 15, 85–93. doi: 10.1016/j.tics.2010.11.004

Gao, Y., Zhang, Z., and Ni, C. (2022). The flow experience in foreign language reading and its relationship with reading performance. *Foreign Lang. World* 3, 70–78. doi: 10.16362/j.cnki.cn61-1023/h.2021.04.010

Horwitz, E., Horwitz, M., and Cope, J. (1986). Foreign language classroom anxiety. *Mod. Lang. J.* 70, 125–132. doi: 10.1111/j.1540-4781.1986.tb05256.x

Ibrahim, Z., and Al-Hoorie, A. H. (2019). Shared, sustained flow: triggering motivation with collaborative projects. *ELT J.* 73, 51–60. doi: 10.1093/elt/ccy025

Jackson, S. A., and Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: the flow state scale. *J. Sport Exercise Psychol.* 18, 17–35. doi: 10.1123/jsep.18.1.17

Ji, D., Guo, Z., and Li, W. (2020). Influencing factors of socialized reading behavior from the perspective of flow theory. *Library Forum* 40, 116–122. doi: 10.3969/j.issn.1002-1167.2020.05.016

Li, C. (2021). Research on second language acquisition from the perspective of positive psychology: a review and outlook (2012–2021). *Foreign Lang. Educ.* 42, 57–63.

Li, L. (2014). The role of flow experience in foreign language learning: the regulating effect on English listening anxiety. *J. Educ. Psychol. Res.* 19, 81–90.

Liu, D., and Zheng, W. (Eds.). (2019a). *General High School Textbook: English (Compulsory Volume 2) (1st Edn.)*. Beijing: People's Education Press.

Liu, D., and Zheng, W. (Eds.). (2019b). *General High School Textbook: English (Selective Compulsory Volume 1) (1st Edn.)*. Beijing: People's Education Press.

Liu, X., and Lin, M. (2025). The moderating effect and mechanism of flow experience on high school students' English listening anxiety. *Primary Secondary Sch. Foreign Lang. Teach.* 48, 7–12.

MacIntyre, P. D., and Gardner, R. C. (1994). The subtle effects of language anxiety on cognitive processing in the second language. *Lang. Learn.* 44, 283–305. doi: 10.1111/j.1467-1770.1994.tb01103.x

Mystkowska-Wiertelak, A., and Słowik-Krogulec, A. (2024). Task-specific flow in older adult EFL learners. *J. Psychol. Lang. Learn.* 6, 1–22. doi: 10.52598/jpll/6/2/4

Nakamura, J., and Csikszentmihalyi, M. (2002). "The concept of flow," in *Handbook of Positive Psychology*, eds. C. R. Snyder and S. J. Lopez (Oxford: Oxford University Press), 89–105. doi: 10.1093/oso/9780195135336.003.0007

Rost, M. (2002). *Teaching and Researching Listening*. London: Longman.

Xiao, Y. (2025). The impact of AI-driven speech recognition on EFL listening comprehension, flow experience, and anxiety: a randomized controlled trial. *Humanit. Soc. Sci. Commun.* 12:425. doi: 10.1057/s41599-025-04672-8

Zhang, Q. (2015). The relationship between flow experience and english listening anxiety. *Foreign Lang. Ann.* 48, 296–312.

Zhang, X., and Zhao, G. (2011). Construct validity and reliability testing of the Foreign Language Listening Anxiety Scale. *Mod. Foreign Langu. (Quart.)* 34, 162–170.