

A Qualitative Study on the Impact of Personalized Language Learning Based on Large Language Models on Students' Academic Self-Efficacy

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Abstract

Academic self-efficacy is a core non-cognitive predictor of language learning outcomes, yet traditional large-class teaching fails to address individual differences, leading to widespread low self-efficacy among middle school students. Large Language Models (LLMs) enable scalable personalized instruction, but existing research lacks multi-method qualitative evidence to unpack the underlying mechanisms. Grounded in Bandura's Self-Efficacy Theory and Bloom's Mastery Learning Theory, this study conducted an 8-week teaching experiment with 160 Grade 8 and Grade 10 students in Sichuan, China, covering both Chinese and English subjects. Adopting a qualitative-led mixed-methods design, it collected data through semi-structured interviews (14 participants, 60,000 words), longitudinal learning logs (320 valid entries, 40,000 words) and quantitative classroom observations (64 sessions). NVivo 12 was used for three-level coding of qualitative texts, with triangulation and member checking ensuring validity. Results show that LLM-based personalized learning improves academic self-efficacy via four synergistic pathways: reshaping success experiences, regulating emotional arousal, strengthening positive verbal persuasion, and empowering autonomous learning. This study provides localized empirical evidence for digital language education and non-cognitive ability cultivation.

Keywords

large language models, personalized language learning, academic self-efficacy, qualitative research, language teaching

1. Introduction

1.1 Background of Educational Digitalization and Language Teaching Reform

The deep integration of the new round of scientific and technological revolution and educational digital transformation is profoundly reshaping the concepts, models and ecosystems of native and second language teaching worldwide. In China, the internet access rate of primary and secondary schools has reached 100%, and the coverage rate of smart classrooms exceeds 75%, indicating that educational digitalization has entered

the stage of deep integration and application from infrastructure construction¹²¹² [1]. The report to the 20th National Congress of the Communist Party of China clearly put forward the strategic deployment of “promoting educational digitalization”, and the 2022 edition of compulsory education Chinese and English curriculum standards simultaneously emphasized the implementation of the concept of teaching students in accordance with their aptitude, building a personalized and differentiated teaching system, and focusing on cultivating students’ learning confidence, autonomous learning ability and core language literacy [2].

1.2 Limitations of Traditional Language Teaching and Research Gaps

1.2.1 Structural Drawbacks of Traditional Large-Class Teaching

Traditional large-class language teaching has the inherent structural drawback of “unified progress, unified content and unified evaluation”, which makes it difficult to take into account students’ differences in language foundation, learning styles and development needs. Multiple studies have shown that the incidence of language learning anxiety among Chinese middle school students is as high as 62.3%, and the polarization phenomenon of “weak students experiencing continuous frustration and top students lacking challenges” caused by homogeneous teaching is the core inducement of low academic self-efficacy [3]. This vicious circle of “learning anxiety - low self-efficacy - insufficient learning engagement” ultimately restricts the development of students’ core language literacy.

1.2.2 Deficiencies of Existing Relevant Research

LLMs, with their natural language understanding and generation capabilities, precise learning diagnosis, personalized content adaptation and instant feedback, provide a new technical possibility to solve the above dilemma [4]. However, existing relevant studies mostly focus on the quantitative impact of LLMs on single cognitive dimensions such as English vocabulary and writing [5]. There is still a lack of systematic qualitative research on the internal mechanism between LLMs and academic self-efficacy. Meanwhile, few studies have quantitatively characterized classroom observations, combined interviews and learning logs for multiple qualitative analysis, and there is a lack of localized research covering both Chinese and English subjects, making it difficult to truly reveal students’ learning experiences and the dynamic change process of self-efficacy.

1.3 Research Purpose and Significance

Based on this, this study constructs an LLM-based personalized language learning model adapted to both Chinese and English subjects. Taking qualitative research as the core and combining quantitative classroom observation, this study conducts triangulation verification of multiple data sources, deeply explores students’ real learning experiences, clarifies the internal mechanism of LLM personalized learning improving academic self-efficacy, and provides replicable practical paths and theoretical references for the personalized transformation of language teaching in the context of educational digitalization.

2. Theoretical Foundations

2.1 Bandura’s Self-Efficacy Theory

2.1.1 Core Information Sources of Self-Efficacy

Bandura’s social cognitive theory points out that the formation and development of self-efficacy are influenced by four core information sources, among which success and failure experiences are the most direct and core factor.

2.1.1.1. Success and Failure Experiences

Continuous successful experiences will strengthen individual ability beliefs, while repeated failures will weaken them.

2.1.1.2. Vicarious Experiences

Obtaining indirect experiences by observing the successes and failures of people with similar abilities, strengthening the belief that “I can do it too”.

2.1.1.3. Verbal Persuasion

Positive and targeted encouragement and feedback can enhance self-efficacy.

2.1.1.4. Emotional Arousal

Low anxiety and positive and peaceful emotional states are more conducive to the improvement of self-efficacy [6].

2.1.2 Dimensions of Academic Self-Efficacy in Language Learning

In the field of language learning, academic self-efficacy can be divided into two interrelated dimensions: learning ability self-efficacy and learning behavior self-efficacy. The former reflects students' subjective judgment on their own language learning ability, while the latter reflects students' confidence in the effectiveness of their own learning behavior strategies [7]. The research design, data collection and analysis of this study are all carried out around the four core information sources and two dimensions of self-efficacy.

2.2 Bloom's Mastery Learning Theory and Personalized Learning

2.2.1 Core Propositions of Mastery Learning Theory

Bloom's mastery learning theory proposes that as long as students are provided with sufficient learning time and appropriate teaching support, more than 90% of students can achieve the mastery goals of learning content. This theory emphasizes that individual differences in students' learning stem from differences in cognitive readiness, emotional readiness and teaching quality, rather than innate abilities. The core of teaching lies in accurately diagnosing individual differences and providing differentiated learning support [8].

2.2.2 LLM's Technical Support for Personalized Learning

Personalized learning theory further clarifies the core of “learner-centered”, emphasizing the customization of personalized learning goals, content, paths and feedback based on students' cognitive levels, learning styles and other individual characteristics. LLM technology provides key support for the large-scale implementation of the above theories in multilingual teaching scenarios. It can realize “one person, one policy” through full-process learning diagnosis, allowing students to build learning confidence in continuous successful experiences, which is also the design core of the LLM personalized language learning model in this study [9].

3. Research Design and Methods

3.1 Overall Research Design

3.1.1 Research Framework and Experimental Arrangement

This study adopts a qualitative research-led mixed-methods design with quantitative scoring of classroom observations, forming a “quantitative classroom observation + qualitative interview + longitudinal learning log” research framework. The research period is 8 weeks, with 2 class hours per week for both Chinese and English, totaling 32 class hours. In the study, the experimental class adopted the LLM personalized language learning model, with the core process: pre-learning diagnosis (generating personalized learning files and paths) → personalized content adaptation (layered explanation for Chinese, layered exercises for English) → instant personalized feedback (grading within 10 seconds + positive encouragement) → full-scene autonomous learning support (pressure-free interaction inside and outside class). The control class adopted the traditional large-class teaching model, and other teaching conditions were completely consistent with the experimental class.

3.1.2 Ethical Approval and Participant Protection

This study has passed the school ethics review, obtained written informed consent from schools, teachers, students and parents, and provided the same LLM personalized learning resources to the control class after the experiment, strictly following academic ethics norms and protecting the privacy of all participants.

3.2 Research Participants

3.2.1 Sampling Method and Overall Sample

This study adopted a combination of stratified sampling and purposive sampling, and selected 160 students from 2 parallel classes in Grade 8 and 2 parallel classes in Grade 10 of a provincial demonstration middle school in Sichuan Province as research objects, including 80 students in the experimental class and 80 students in the control class. The pre-test showed no significant difference in academic performance and academic self-efficacy between the two groups, ensuring the comparability of the samples.

3.2.2 Qualitative Research Participants

3.2.2.1. Core Interview Participants

12 students (6 from junior high school Chinese, 6 from senior high school English; 4 each from high, medium and low academic levels) were selected from 80 students in the experimental class by stratified sampling. In addition, 1 Chinese teacher and 1 English teacher from the experimental class were interviewed to ensure the representativeness of the interview sample across different school stages, subjects and academic levels.

3.2.2.2. Learning Log Participants

All 80 students in the experimental class filled in learning logs continuously for 8 weeks, and finally 320 valid learning logs (1 per week) were collected, with an effective recovery rate of 100%.

3.2.3 Classroom Observation Participants

80 students in the experimental class and 80 students in the control class were observed throughout the 8 weeks to compare and analyze the classroom learning status of students in the two classes.

3.3 Research Instruments

3.3.1 Quantitative Classroom Observation Scale

3.3.1.1. Scale Dimensions and Scoring Criteria

This study designed a quantitative classroom observation record sheet to measure students' classroom learning status from an objective dimension. The scale includes 5 core dimensions: student participation, interaction frequency, personalized support implementation, task completion status and anxiety performance, each using a 5-point Likert scoring method (1 = completely inconsistent, 5 = completely consistent). Specific scoring criteria were formulated for each dimension to ensure the objectivity and consistency of observation scoring.

3.3.1.2. Observation Procedure and Reliability

Two researchers conducted 2 non-participatory observations each week on the Chinese and English classes of both the experimental and control classes, and recorded scoring results and field notes simultaneously. A total of 64 classroom observations were completed in 8 weeks, and 640 valid quantitative data were collected. Two researchers conducted observation scoring using independent coding, and the inter-rater reliability Cohen's Kappa coefficient was 0.89, indicating good reliability.

3.3.2 Semi-Structured Interview Outlines

3.3.2.1. Student Interview Outline

Focused on LLM usage experience, changes in learning confidence and self-efficacy, differences from traditional learning, emotional and behavioral changes in learning, and the impact of LLMs on autonomous

learning. Open-ended questions were used, and space was retained for follow-up questions to ensure the depth and flexibility of interviews.

3.3.2.2. Teacher Interview Outline

Focused on changes in classroom teaching, changes in students' learning status and confidence, the auxiliary role of LLMs in teaching, and the difficulties and solutions of personalized teaching implementation. Each interview lasted 20–30 minutes, with full recording and written records. Finally, 14 valid interview recordings were obtained, and about 60,000 words of interview texts were formed after transcription.

3.3.3 Longitudinal Learning Log Framework

3.3.3.1. Log Content Design

This study designed a unified qualitative log framework, requiring students in the experimental class to fill in once a week. The content included LLM usage scenarios, completion of learning tasks, subjective learning feelings, evaluation of their own learning ability, and problems and gains in learning, to longitudinally track students' learning experiences and psychological changes.

3.3.3.2. Log Collection and Quality Control

The log filling requirements were true and specific, avoiding vague expressions. Teachers reviewed the logs every week and gave simple feedback to ensure the authenticity and completeness of the logs. A total of 320 valid learning logs were collected in 8 weeks, forming about 40,000 words of qualitative texts.

3.4 Data Processing and Validity Assurance

3.4.1 Quantitative Data Analysis

Quantitative classroom observation data were analyzed using SPSS 26.0 for descriptive statistics and independent samples t-test to compare the score differences between the experimental and control classes in the 5 observation dimensions and quantitatively characterize the impact of LLM personalized learning on students' classroom learning status.

3.4.2 Qualitative Data Analysis

3.4.2.1. Three-Level Coding Process

First, 14 interview recordings were transcribed verbatim, and 320 learning logs and classroom observation field notes were sorted out to form a total of more than 120,000 words of qualitative texts. Then, NVivo 12 software was used to systematically analyze the qualitative texts following the three-level coding process of open coding - axial coding - selective coding.

3.4.2.2. Reliability and Validity Strategies

The reliability and validity of the study were ensured through triangulation (cross-verification of quantitative classroom observation, interview and learning log data), member checking (verifying coding results with interview participants) and peer review.

3.4.3 Theoretical Saturation Test

The last 2 interview materials and 20 learning logs were selected for theoretical saturation test, and no new initial concepts or main categories were found, indicating that the study reached theoretical saturation and the data collection and analysis were sufficient.

4. Research Results

4.1 Quantitative Classroom Observation Results

4.1.1 Descriptive Statistics of Observation Dimensions

Descriptive statistics showed that the average scores of the experimental class in student participation, interaction frequency, personalized support implementation and task completion status were all above 4.0,

while the average scores of the control class in these four dimensions were all below 3.0. The average score of the experimental class in anxiety performance was 1.8, while that of the control class was 3.7.

4.1.2 Independent Samples T-test Results

Independent samples t-test results showed that the scores of the experimental class in 4 dimensions (student participation, interaction frequency, personalized support implementation, task completion status) were significantly higher than those of the control class ($p < 0.001$), and the score in the anxiety performance dimension was significantly lower than that of the control class ($p < 0.001$). Quantitative data indicate that the LLM personalized language learning model can effectively improve students' classroom participation and interaction frequency, provide students with sufficient personalized learning support, significantly improve the quality of classroom task completion, and greatly reduce students' language learning anxiety.

4.2 Semi-Structured Interview Results

4.2.1 Coding Results of Interview Texts

After three-level coding of 14 interview texts, 28 initial concepts and 4 main categories were extracted, which corresponded one-to-one with the four core information sources of Bandura's self-efficacy theory. The interview results showed that both teachers and students generally believed that LLM personalized learning had a significant positive impact on students' learning confidence and self-efficacy.

4.2.2 Core Learning Experiences of Students

4.2.2.1. Successful Experiences Brought by Task Adaptation

91.7% of students mentioned that the learning tasks provided by LLMs were just right for their own level, allowing them to "complete step by step and accumulate a sense of achievement slowly". A Chinese underachiever said: "I have never understood classical Chinese. Before, the teacher taught uniformly in class. I didn't even understand the words and sentences before the teacher talked about appreciation. I couldn't do my homework at all and thought I was not born to learn Chinese. Now LLM will first teach me new words and special sentence patterns, then give me basic translation exercises. I do it step by step and can finish it every time. Gradually I feel that I can learn classical Chinese too."

4.2.2.2. Low-Pressure Interaction Alleviates Learning Anxiety

83.3% of students mentioned that there was no psychological burden when using LLMs to learn, and they were not afraid of making mistakes. An English student said: "I used to dare not speak English in English class for fear of being laughed at by my classmates for my wrong pronunciation. Now I can practice with LLM repeatedly first, and then speak in class when I am proficient. I am more and more willing to speak up."

4.2.2.3. Instant Positive Feedback Stimulates Learning Motivation

All students mentioned that LLM feedback was more detailed and timely than traditional grading, and included positive encouragement. A student said: "Before, when the Chinese composition was handed back, there was only a score and a few general comments. I didn't know how to revise it at all. Now LLM will first affirm what I wrote well, then tell me where I can improve paragraph by paragraph, give me specific revision suggestions, and encourage me. Every time I finish revising, I feel that I have made progress."

4.2.2.4. Autonomous Learning Support Enhances Ability Beliefs

75% of students mentioned that LLMs allowed them to solve learning problems at any time and plan their own learning progress. A top student said: "The content in the textbook can no longer meet my learning needs. LLM can recommend suitable English foreign journals for me, and also accompany me to do in-depth text appreciation and oral dialogue. My learning scope is wider, and I am more confident that I can learn English well."

4.2.3 Teachers' Perceptions of Student Changes

Teacher interviews also confirmed the changes in students: "Before, when asking questions in class, only those top students raised their hands. Many underachievers bowed their heads for fear of being called on. Now

the students in the experimental class are obviously more relaxed, the interaction atmosphere in class is much better, and many students who dared not speak before are now willing to take the initiative to share.”

4.3 Longitudinal Learning Log Results

4.3.1 Phased Characteristics of Self-Efficacy Change

Coding analysis of 320 learning logs found that students’ learning experiences and self-efficacy showed obvious phased change characteristics.

4.3.1.1. Adaptation Stage (Weeks 1–2)

Students mainly focused on the usage methods and novelty of LLMs, were in the adaptation stage of the personalized learning model, and the change in self-efficacy was not obvious.

4.3.1.2. Initial Improvement Stage (Weeks 3–4)

Students began to feel the successful experience brought by task adaptation, learning anxiety gradually decreased, and expressions such as “I can finish my homework now” and “It turns out I can learn English well” appeared in the logs.

4.3.1.3. Autonomous Awareness Enhancement Stage (Weeks 5–6)

Students’ autonomous learning awareness was significantly enhanced, and they began to actively use LLMs to solve learning problems. Expressions such as “I planned my own review content this week” and “Ask LLM first when encountering problems” appeared in the logs.

4.3.1.4. Significant Improvement Stage (Weeks 7–8)

Students’ self-efficacy was significantly improved, and clear ability belief expressions such as “I am more and more confident in learning Chinese” and “I think I can learn English well” appeared in the logs.

4.3.2 Core Driving Force of Self-Efficacy Improvement

The longitudinal tracking results of learning logs indicate that the improvement of students’ academic self-efficacy by LLM personalized learning is a gradual process, and the accumulation of successful experiences is the core driving force for the improvement of self-efficacy. This result is consistent with Zhang and Guo’s (2019) research conclusion on the formation law of academic self-efficacy [3].

4.4 Integrated Analysis of Core Mechanisms

4.4.1 Four Core Pathways of Self-Efficacy Improvement

Combining multiple data from quantitative classroom observation, semi-structured interviews and learning logs, this study extracts four core pathways for LLM-based personalized language learning to improve students’ academic self-efficacy.

4.4.1.1. Reshaping Success and Failure Experiences

By providing layered tasks and personalized guidance adapted to students’ levels, helping students continuously accumulate positive successful experiences is the most core and direct pathway to improve academic self-efficacy.

4.4.1.2. Regulating Emotional Arousal

By creating a low-pressure interactive learning scenario, alleviating students’ language learning anxiety, reducing the interference of negative emotions, and supporting the improvement of self-efficacy with positive emotions.

4.4.1.3. Strengthening Verbal Persuasion

Through the instant and personalized closed-loop feedback of LLMs, helping students establish and consolidate learning confidence through credible positive verbal reinforcement.

4.4.1.4. Empowering Autonomous Learning Behaviors

By providing accessible learning tools and adaptive resources, empowering students' autonomous learning behaviors and providing environmental and behavioral support for the continuous improvement of self-efficacy.

4.4.2 Synergistic Relationship Among the Four Pathways

The four pathways are interrelated and mutually reinforcing, forming a complete mechanism model. Among them, reshaping success and failure experiences is the core foundation, regulating emotional arousal is an important support, strengthening verbal persuasion is the continuous driving force, and empowering learning behaviors is the consolidation guarantee. The four pathways jointly promote the simultaneous improvement of students' learning ability self-efficacy and learning behavior self-efficacy.

5. Discussion

5.1 Consistency of Research Results with Classical Theories

5.1.1 Verification of Bandura's Self-Efficacy Theory

The results of this study fully confirm the applicability and explanatory power of Bandura's Self-Efficacy Theory in digital language teaching scenarios. The four information sources of self-efficacy proposed by Bandura are the direct theoretical basis for the four core pathways in this study. The study found that LLM personalized learning does not affect students' self-efficacy in a single dimension, but achieves multi-dimensional and all-round improvement by systematically activating the four information sources, which further verifies that the formation of self-efficacy is the result of the joint action of multiple factors [6].

5.1.2 Verification of Bloom's Mastery Learning Theory

At the same time, the core viewpoint of Bloom's Mastery Learning Theory that "providing students with appropriate teaching support allows the vast majority of students to achieve learning goals" is fully reflected in this study: LLMs provide personalized teaching support for students of different levels through precise learning diagnosis and layered task design, allowing students to complete learning goals in adapted tasks and continuously accumulate successful experiences, which is also the core reason why LLMs can reshape students' success and failure experiences [8]. The results of this study provide localized empirical support for the application of classical educational psychology theories in digital scenarios and expand the application boundaries of the theories.

5.2 Effectiveness Analysis of the Four Core Pathways

5.2.1 Synergistic Effect Among Pathways

The four core pathways found in this study are interrelated and progressive, forming a complete logical chain for LLM personalized learning to improve academic self-efficacy. Different from existing studies that mostly emphasize the single role of success and failure experiences [7], this study found that there is a significant synergistic effect among the four pathways: regulating emotional arousal can reduce students' learning fear, make them more willing to participate in learning tasks, and thus accumulate more successful experiences; strengthening verbal persuasion can amplify the positive impact of successful experiences and stimulate students' motivation for continuous learning; empowering learning behaviors can transform internal ability beliefs into external learning behaviors, further consolidate successful experiences, and form a virtuous circle.

5.2.2 Universality Across Chinese and English Subjects

The discovery of this synergistic effect is an important supplement to the formation mechanism of self-efficacy. Meanwhile, the four pathways cover both Chinese and English subjects, indicating that the LLM personalized learning model is applicable in both native and second language teaching, and the universality of the research conclusions is improved. Different from Liu and Zhang's study focusing on the cognitive

dimension of English [5], this study also pays attention to students' non-cognitive development and reveals the deep impact of LLMs on students' psychology and behaviors.

5.3 Theoretical Contributions and Practical Implications

5.3.1 Theoretical Contributions

The core theoretical contributions of this study are reflected in two aspects: First, it enriches the connotation of interdisciplinary research on LLMs and language education, breaks through the limitations of existing studies that mostly focus on cognitive dimensions, single foreign language subjects and emphasize quantification over quality, takes qualitative research as the core, quantitatively processes classroom observations, conducts multiple analyses combined with interviews and learning logs, deeply reveals the internal "black box" of LLM personalized learning improving academic self-efficacy, and improves the mechanism analysis of LLMs affecting the non-cognitive dimension of language learning. Second, it verifies the applicability of classical psychological theories in digital education scenarios, clarifies the specific paths for LLM technology to activate the four information sources of self-efficacy based on localized teaching empirical evidence, and provides empirical basis for the application of Bandura's Self-Efficacy Theory in digital language teaching scenarios.

5.3.2 Practical Implications for Language Teaching

The results of this study provide replicable practical paths for the digital transformation of language teaching in primary and secondary schools, and the core enlightenment is reflected in the construction of a human-machine collaborative teaching model of "technology empowerment + teacher leadership":

First, schools and teachers can rely on LLM technology to build a full-process personalized language teaching model of "learning diagnosis - personalized content adaptation - instant feedback - autonomous learning support", give full play to the technical advantages of LLMs in layered teaching, instant feedback and full-scene support, and solve the pain point that traditional large-class teaching is difficult to take into account individual differences.

Second, teachers should adhere to the dominant position of education and take LLMs as teaching auxiliary tools rather than substitutes. The core role of teachers is to design teaching goals, guide students' learning, pay attention to students' psychological changes, and combine LLM feedback data to provide targeted guidance and encouragement to students, realizing the integration of technology and humanities [10]

Third, language teaching should pay attention to the coordinated development of cognitive and non-cognitive abilities. While improving students' language knowledge and skills, it should focus on cultivating students' academic self-efficacy through continuous successful experiences, low-anxiety learning environments and positive feedback, so that students can build learning confidence and form a virtuous circle of "improved learning ability - enhanced self-efficacy - increased learning engagement".

5.3.3 Research Innovations

The innovations of this study are mainly reflected in three aspects:

First, innovation in research methods: taking qualitative research as the core, quantitatively scoring classroom observations, forming a "quantitative classroom observation + qualitative interview + learning log" multiple research design, which not only retains the in-depth excavation of students' real experiences by qualitative research, but also enhances the objectivity and persuasiveness of research conclusions through quantitative data.

Second, innovation in research scenarios: breaking through the limitation of existing studies that mostly focus on a single English subject, expanding the research scenarios to both Chinese and English subjects, covering native and second language teaching, and making the research conclusions more universal.

Third, innovation in research perspective: focusing on the non-cognitive factor of academic self-efficacy, deeply revealing the impact of LLM personalized learning on students' psychology and behaviors, and making up for the deficiency of existing studies that mostly focus on cognitive dimensions.

6. Conclusion and Future Directions

6.1 Core Research Conclusions

Based on Bandura's Self-Efficacy Theory and Bloom's Mastery Learning Theory, this study adopted multiple methods including quantitative classroom observation, semi-structured interviews and learning logs to conduct an 8-week qualitative study on the mechanism of LLM-based personalized language learning improving students' academic self-efficacy, and drew the following core conclusions:

First, LLM-based personalized language learning can effectively improve students' classroom learning status, significantly enhance students' classroom participation, interaction frequency and task completion quality, greatly reduce students' language learning anxiety, and provide students with sufficient personalized learning support.

Second, LLM-based personalized language learning systematically activates the four core information sources of Bandura's self-efficacy theory through four core pathways: reshaping students' success and failure experiences, regulating learning emotional arousal, strengthening positive verbal persuasion, and empowering autonomous learning behaviors, realizing multi-dimensional and systematic improvement of students' academic self-efficacy.

Third, the four core pathways are interrelated and mutually reinforcing, forming a complete logical chain of action mechanism, jointly promoting the simultaneous improvement of students' learning ability self-efficacy and learning behavior self-efficacy.

Fourth, the LLM personalized learning model has good applicability in both Chinese and English subjects, can effectively solve the structural drawbacks of traditional large-class language teaching, realize large-scale teaching students in accordance with their aptitude, and take into account the development of students' cognitive and non-cognitive abilities, which is highly consistent with the education requirements of the 2022 edition of Chinese and English curriculum standards.

6.2 Research Limitations

This study still has certain limitations: First, the representativeness of the research sample is limited. This study only selected junior and senior high school students from a provincial demonstration middle school in Sichuan Province, and did not cover schools in different regions and types (public/private, urban/rural) or primary school students. Second, the research cycle is relatively short. The experimental period of this study is 8 weeks, which can only reflect the short-term impact of LLM personalized learning on students' academic self-efficacy. Third, the research perspective is mainly focused on the student level, and the in-depth exploration of the teacher-LLM collaborative teaching model is insufficient.

6.3 Future Research Directions

Future research can be carried out from the following aspects:

First, expand the sample range to cover different regions, school types and student groups, and further verify the universality of the research conclusions.

Second, carry out longer-term follow-up qualitative studies, combined with continuous learning logs, in-depth interviews and classroom observations, to explore the long-term impact and sustainability of LLM personalized learning on students' academic self-efficacy.

Third, further explore the collaborative teaching model between teachers and LLMs, analyze the role positioning and ability requirements of teachers in LLM personalized teaching, and improve the human-machine collaborative language teaching system of "teacher leadership + LLM assistance". In terms of practical application, it is necessary to further explore the reasonable application boundary of LLMs in language teaching in the future, strictly prevent potential ethical risks such as the accuracy of LLM content, students' over-reliance on LLMs, and the security protection of students' learning data.

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Conflicts of Interest

The authors declare no conflict of interest.

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