Gamified Problem-Based Learning: A Pedagogical Innovation to Enhance Self-Efficacy among Undergraduate EFL Learners in China

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Abstract

This study examines the effectiveness of Gamified Problem-Based Learning (GPBL) in enhancing learning self-efficacy among English as a Foreign Language (EFL) learners in China. An experimental pretest-posttest control-group design involving 120 first-year undergraduate students compared a GPBL intervention with current instruction over 4 weeks. The GPBL module integrated game elements (points, leaderboards, rewards) with problem-based learning activities centred on authentic real-world scenarios. Results from analysis of covariance revealed significant improvements in learning behavioural self-efficacy and learning ability self-efficacy compared to the control group. Findings demonstrate that GPBL systematically activates Bandura's four sources of self-efficacy, addressing the relatively low learning self-efficacy in Chinese College English education. The large effect sizes suggest that integrated pedagogical approaches combining game mechanics with authentic problem-solving can substantially enhance learners' learning self-efficacy in executing specific learning behaviours and in their overall English learning capacity, offering potential directions for curriculum reform in higher education.

Keywords: gamified problem-based learning, self-efficacy, adult learners, EFL education, pedagogical innovation, College English

1. Introduction

1.1 Introduce the Problem

English language proficiency has become increasingly critical for undergraduate students in China as the nation continues to integrate with the global economy. In Chinese higher education, College English is a compulsory course for non-English majors, aiming to develop the language skills necessary for academic, professional, and personal development (Committee of College Foreign Language Teaching Guidance, 2020). However, despite years of structured instruction, many students continue to struggle with language acquisition, particularly in developing confidence in their learning abilities.

Recent data indicate persistent challenges. The 2024 National College English Test (CET) results showed that fewer than 40% of students nationwide passed CET-4, the standard proficiency benchmark (CETEC, 2024). Research has consistently documented below-average learning self-efficacy among college students, with mean scores of 2.99 on a five-point scale (Li, Feng, & Shao, 2020). These challenges are particularly acute among first-year undergraduate students transitioning from exam-oriented secondary education to autonomous university learning.

Self-efficacy, defined by Bandura (1997) as individuals' beliefs in their capacity to organise and execute actions required to attain given goals, plays a central role in language learning. Students with higher self-efficacy demonstrate greater engagement, persistence, and resilience when encountering difficulties, whereas those with low self-efficacy often show reduced motivation and avoidance behaviours (Broadbent & Fuller-Tyszkiewicz, 2023).

1.2 Explore the Importance of the Problem

The problem of low learning self-efficacy in Chinese College English education warrants new research, as existing pedagogical approaches fail to address the fundamental mechanisms of self-efficacy development identified in self-efficacy theory. This represents both a theoretical gap and a practical problem with significant consequences for student

outcomes.

From a theoretical perspective, traditional College English instruction does not systematically activate the four sources of self-efficacy identified by Bandura (1997). Teacher-led pedagogy provides limited opportunities for genuine mastery experiences, as students passively receive knowledge rather than actively solving problems (Li & Deocampo, 2021; Tang et al., 2020). Vicarious learning is constrained because individual seatwork reduces observation of peer success (Tang et al., 2020). Students with low self-efficacy demonstrate avoidance behaviours, reduced persistence, and higher anxiety (Liu, 2020). Anxiety remains high due to fear of public failure and face-saving concerns (Wen, Chen, & Hao, 2022; Xu et al., 2022).

The practical consequences of this theoretical gap are substantial. Students with weak self-efficacy tend to avoid challenging tasks, give up easily when encountering difficulties, experience higher anxiety during language use, and fail to develop effective learning strategies (Liu, 2020). These patterns create a negative cycle in which low self-efficacy leads to reduced engagement and practice, resulting in slower skill development, which in turn further undermines confidence. This problem is reflected in poor learning outcomes, with fewer than 40% of students nationwide passing CET-4 in 2024 (CETEC, 2024).

The problem is particularly acute for first-year undergraduate students transitioning from exam-oriented secondary education to autonomous university learning. Before entering university, most first-year students lack substantial opportunities for autonomous English practice in their text-oriented high school classes, and this transition to higher education marks a significant shift as they encounter the dynamic student-centred environment (Wang et al., 2024). These students face a double challenge. They must develop both English proficiency and autonomous learning capabilities simultaneously. Without adequate self-efficacy, they struggle to make this transition successfully.

Addressing this problem requires pedagogical innovation that systematically activates multiple sources of self-efficacy rather than relying on traditional instruction. Problem-based learning offers a promising approach by providing mastery experiences through authentic problem-solving, yet students may struggle with the autonomy required. Gamification offers another approach by providing immediate feedback and visible progress markers, yet superficial application risks surface-level learning. Research examining integrated approaches that combine these pedagogical strategies to address self-efficacy development in Chinese EFL contexts remains limited.

Thus, the purpose of this research is to investigate whether Gamified Problem-Based Learning can enhance learning self-efficacy among Chinese EFL learners. The study examines the effects on both learning behavioural self-efficacy and learning ability self-efficacy among first-year undergraduate students. By testing a theory-driven pedagogical intervention in authentic classroom contexts, this research addresses the theoretical gap between self-efficacy theory and instructional practice whilst providing evidence for practical curriculum reform in Chinese College English education.

1.3 Describe Relevant Scholarship

Three interconnected bodies of research inform this study: self-efficacy theory in language learning, pedagogical approaches for developing learner self-efficacy, and challenges in Chinese College English education.

Bandura's (1997) self-efficacy theory provides the theoretical foundation. Self-efficacy refers to individuals' beliefs in their capacity to organise and execute the actions required to attain given goals. In educational contexts, self-efficacy consistently predicts persistence, engagement, and achievement (Ho et al., 2022; Xie et al., 2019). Research distinguishes between learning behavioural self-efficacy (confidence in executing specific actions) and learning ability self-efficacy (confidence in general capacity to master the domain), with both influencing outcomes through distinct mechanisms (Chen et al., 2024).

Central to this theory are four sources of self-efficacy development (Bandura, 1997). Mastery experiences constitute the most influential source because successful performance provides authentic evidence of capability. Vicarious experiences strengthen self-efficacy when learners observe others like themselves succeed. Verbal persuasion through encouragement strengthens confidence. Physiological and affective states, such as anxiety, also influence judgments. Understanding these sources is critical for designing interventions, yet applying them in practice remains challenging.

In particular, Chinese College English contexts present significant barriers to activating these sources. Li et al. (2020) reported relatively low self-efficacy among first-year students (mean score of 2.99 on a five-point scale). Teacher-led instruction limits mastery experiences (Li & Deocampo, 2021; Zhang, 2022), while individual seatwork constrains vicarious learning (Tang et al., 2020). Cultural factors, including face-saving concerns, create high anxiety (Wen, Chen, & Hao, 2022), and students with low learning self-efficacy demonstrate avoidance behaviours and reduced persistence (Liu, 2020). This problem intensifies for first-year undergraduates transitioning from exam-oriented secondary

education to autonomous university learning (Wang, Luo, Liao, & Zhao, 2024). Pedagogical innovation that systematically activates multiple sources of learning self-efficacy is urgently needed.

One promising pedagogical response is problem-based learning. PBL engages students in solving authentic problems through collaborative inquiry (Barrows, 1996; Savery, 2006). Importantly, this structure directly addresses challenges in the Chinese context by activating self-efficacy sources. Problem analysis provides mastery experiences. Collaborative work enables vicarious learning. Group discussions provide verbal persuasion. Authentic problems reduce anxiety. Empirical evidence supports PBL's potential: Tan and Tee (2021) found that PBL enhanced confidence among Malaysian university students, while Yin (2021) reported reduced anxiety among Chinese learners. However, despite these benefits, students accustomed to teacher-led instruction may struggle with the demands of autonomy (Tang et al., 2020). This resistance suggests PBL alone may be insufficient.

Gamification offers such motivational scaffolding. Gamification applies game elements (points, leaderboards, badges) to enhance motivation (Deterding et al., 2011). These mechanisms complement PBL by making progress visible. Li (2020) found that gamified apps increased confidence, while Yin (2021) showed that game elements reduced classroom tension. Yet implementation quality matters critically. Superficial application risks surface-level learning, in which students focus on points rather than proficiency (Chen et al., 2022). This limitation indicates game elements must integrate with substantive learning activities. The challenge is combining gamification meaningfully with authentic tasks.

Gamified Problem-Based Learning (GPBL) represents such integration. GPBL synthesises these approaches by embedding game elements within authentic problem-solving contexts. This integration addresses limitations of each approach individually, whilst amplifying their strengths. Gamification provides motivational scaffolding and visible progress. PBL ensures confidence builds upon substantive mastery. Together, these elements should systematically activate all four sources of self-efficacy. Mastery experiences emerge from successful resolutions, made tangible through gamification. Vicarious experiences occur through collaborative structures. Verbal persuasion manifests through feedback and recognition of achievement. Positive affective states develop as a playful atmosphere reduces anxiety.

Despite this theoretical promise, research on integrated GPBL approaches remains limited, particularly in language-learning contexts. Kladchuen and Srisomphan (2021) found that combining gamification with PBL improved engagement in vocational education. Nova et al. (2020) demonstrated integrated approaches enhance understanding. However, most research focuses on STEM education. Few studies examine GPBL in language learning, especially regarding self-efficacy among EFL learners in Chinese contexts, where cultural factors may distinctly shape responses. This gap is particularly significant given that Chinese first-year undergraduates face unique challenges in transitioning from exam-oriented instruction to autonomous learning. The current study addresses this gap by investigating whether GPBL can systematically enhance self-efficacy among Chinese first-year undergraduates by simultaneously activating multiple sources.

1.4 State Hypotheses and Their Correspondence to Research Design

Based on the theoretical framework and empirical evidence reviewed, this study tests the hypothesis that GPBL systematically enhances learning self-efficacy through integrated mechanisms. Self-efficacy is examined along two distinct dimensions. First, learning behavioural self-efficacy reflects confidence in executing specific learning actions. Second, self-efficacy for learning reflects broader beliefs about one's capacity to master English.

Thus, the study addresses two specific research questions:

RQ1: Does the GPBL College English module significantly improve learning behavioural self-efficacy compared to traditional instruction?

RQ2: Does the GPBL College English module significantly improve learning ability self-efficacy compared to traditional instruction?

And the research hypotheses are:

H1: Students in the GPBL group will demonstrate significantly higher learning behavioural self-efficacy at posttest compared to the control group, after controlling for pretest scores.

H2: Students in the GPBL group will demonstrate significantly higher learning ability self-efficacy at posttest compared to the control group, after controlling for pretest scores.

These hypotheses are logically connected to the theoretical framework. The GPBL intervention systematically activates mastery experiences through successful problem resolution, vicarious experiences through collaborative team

structures, verbal persuasion through achievement recognition and teacher feedback, and positive affective states through reduced anxiety in a playful atmosphere. Traditional instruction provides fewer opportunities to activate these sources. Therefore, students receiving GPBL should develop stronger self-efficacy beliefs across both dimensions.

The experimental pretest-posttest control group design permits the inferences needed to examine these hypotheses. Random assignment to experimental and control groups ensures initial equivalence, allowing attribution of posttest differences to the intervention. The pretest measure enables Analysis of covariance (ANCOVA), which controls for baseline self-efficacy levels and isolates intervention effects. The control group receives traditional College English instruction, providing a meaningful comparison with current practice. The four-week intervention balances practical constraints with sufficient duration for self-efficacy development. This design enables clear inference about whether GPBL produces greater self-efficacy gains than traditional instruction, whilst accounting for potential confounds through statistical control.

2. Method

2.1 Research Design

This study employed a pretest-posttest experimental control-group design to investigate the effectiveness of the GPBL College English module on first-year undergraduates' learning self-efficacy. Participants were randomly assigned to either an experimental group that received the GPBL intervention or a control group that received traditional College English instruction. Both groups were assessed at pretest and posttest using the same self-efficacy questionnaire. This between-subjects design was selected because it enables rigorous comparison between instructional approaches whilst maintaining ecological validity in authentic classroom environments.

2.2 Participant (Subject) Characteristics

The study population comprised 2,755 first-year non-English major undergraduate students enrolled in College English II during the second semester of 2024 at Chengdu College of UESTC. All participants were aged 18-21 years, navigating the transition from secondary to tertiary education. Eligibility criteria included enrollment as first-year non-English major undergraduates in College English II. No exclusion criteria based on demographic characteristics were applied beyond these enrollment requirements.

The final sample consisted of 120 students randomly assigned to experimental (n = 60) or control (n = 60) groups. Table 1 presents the demographic characteristics of participants. The gender distribution was relatively balanced across groups, with males comprising 48.3% of the experimental group and 56.7% of the control group. The majority of participants were 19 years old (58.3% in the experimental group, 51.7% in the control group), followed by 18-years-old (26.7% in the experimental group, 33.3% in the control group). Chi-square tests revealed no significant differences between groups in gender distribution (χ^2 = 0.53, p = 0.465) or age distribution (χ^2 = 1.69, p = 0.640), confirming successful random assignment and group equivalence on demographic variables.

Table 1. Participant Demographics

Variable	Category	Experimental Group (n = 60)	Control Group (n = 60)
Gender	Male	29 (48.3%)	34 (56.7%)
	Female	31 (51.7%)	26 (43.3%)
Age	18 years	16 (26.7%)	20 (33.3%)
	19 years	35 (58.3%)	31 (51.7%)
	20 years	5 (8.3%)	7 (11.7%)
	21 years	4 (6.7%)	2 (3.3%)

2.3 Sampling Procedures

Sample size was determined using Cochran's (1977) formula for an finite populations. The initial calculation for infinite population yielded:

$$n = Z^2 \cdot p \cdot (1-p)/e^2 \quad (1)$$

where Z = 1.96 (95% confidence level), p = 0.5 (maximum variance), and e = 0.09 (9% margin of error), resulting in n ≈ 119. Then applying the finite population correction:

$$n = n_0/(1+n_0-1/N) \quad (2)$$

where $N = 2{,}755$ yielded $n \approx 114$. The final sample was set at 120 to facilitate balanced group comparisons.

The study population comprised 2,755 first-year non-English major undergraduate students enrolled in College English II during the second semester of 2024 at Chengdu College of UESTC. This approach guaranteed that each major contributed proportionally to the overall sample whilst maintaining the target size of 120 participants. All 120 students approached agreed to participate, yielding a 100% participation rate. No participants selected themselves into the sample; all were selected through the stratified random sampling procedure.

Data were collected in regular classroom settings at Chengdu College of UESTC during scheduled College English II course sessions. No payments were made to participants. The study received ethical approval from the Research Ethics Committee of Universiti Sains Malaysia (USM) and Chengdu College of the University of Electronic Science and Technology of China (UESTC). Prior to participation, all students were informed of the study's purpose, procedures, and their right to withdraw without consequences. Informed consent was obtained from all participants in accordance with the Declaration of Helsinki. All personal identifiers were removed following data collection to ensure anonymity, and research data were securely stored with access restricted to authorised research team members.

2.4 Measures and Covariates

2.4.1 Learning Self-Efficacy Questionnaire

The primary outcome measures were learning behavioural self-efficacy and learning ability self-efficacy, assessed using a 14-item questionnaire employing a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The questionnaire was grounded in Bandura's (1997) self-efficacy theory and designed to capture students' confidence in both specific learning behaviours and general English learning ability. Initial item generation drew on established English-learning self-efficacy instruments, with items adapted from Kang et al. (2019), Ifdil et al. (2019), Yavuzalp and Bahcivan (2020), and Yiin et al. (2024). Four College English experts from Chengdu College of UESTC reviewed the initial 20-item version and recommended streamlining to 14 items (7 per dimension) to improve clarity and reduce participant burden.

Table 2. Learning Self-Efficacy Questionnaire Items

Section A: Learning Behavioural Self-Efficacy	1	2	3	4	5
1. I consistently complete College English assignments on time.					
2. I actively participate in College English class discussions.					
3. I regularly seek out additional learning resources to improve my English.					
4. I maintain a positive attitude towards learning English, even when faced with difficulties.					
5. I feel comfortable asking for help in English class when needed.					
6. I can adapt to various English teaching methods.					
7. I practise English outside of class to enhance my skills.					
Section B: Learning Ability Self-Efficacy	1	2	3	4	5
8. I have a good understanding of English grammar in reading contexts.					
9. I am confident in identifying the main ideas and key points of English texts.					
10. I can analyse the organisation and interpret the meaning of English reading materials effectively.					
11. I am confident in understanding spoken English in conversations.					
12. I can express my ideas clearly and fluently in English.					
13. I am able to pronounce English words correctly and speak with proper intonation.					
14. I am confident in applying my English reading and speaking skills to achieve academic or professional goals.					

Note. Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

A pilot study with 40 first-year undergraduates confirmed adequate internal consistency for both learning behavioural self-efficacy (Cronbach's $\alpha = 0.897$ for the pretest, 0.812 for the posttest) and learning ability self-efficacy (Cronbach's $\alpha = 0.948$ for the pretest, 0.825 for the posttest). The pilot study revealed no issues with item comprehension or

administration procedures. Table 2 presents the final questionnaire items. Section A contains 7 items measuring learning behavioural self-efficacy, reflecting confidence in executing specific learning actions such as completing assignments on time, participating in discussions, seeking additional resources, maintaining positive attitudes, asking for help, adapting to teaching methods, and practising outside class. Section B contains 7 items measuring learning ability self-efficacy, reflecting confidence in understanding grammar, identifying main ideas, analysing texts, understanding spoken English, expressing ideas fluently, pronouncing correctly, and applying skills to academic or professional goals.

2.4.2 Psychometric Properties

The reliability and validity of the questionnaire were evaluated through multiple analyses conducted at both pretest and posttest stages in the main study. Internal consistency was assessed using Cronbach's alpha coefficients. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were employed to determine the suitability of the data for factor analysis. Corrected item-total correlations (CITC) were calculated to evaluate item discrimination. Table 3 presents the instrument's psychometric properties.

Table 3. Psychometric Properties of the Learning Self-Efficacy Questionnaire

Dimension	Items	Pretest α	Posttest α	KMO (Pretest)	KMO (Posttest)
Learning Behavioural Self-Efficacy	7	0.883	0.906	0.900	0.909
Learning Ability Self-Efficacy	7	0.895	0.917	0.921	0.926

Note. All Bartlett's tests of sphericity were significant at $p < 0.001$. CITC values ranged from 0.573 to 0.783 across both dimensions and time points.

Both scales demonstrated satisfactory reliability (Cronbach's $\alpha > 0.85$) and validity (KMO > 0.85; Bartlett's test $p < 0.001$). Exploratory factor analysis confirmed the expected two-factor structure, with items loading appropriately on their intended dimensions. CITC values consistently remained above 0.50, indicating adequate item discrimination. Pretest scores on learning behavioural self-efficacy and learning ability self-efficacy served as covariates in subsequent analyses to control for baseline differences between groups.

2.5 Experimental Manipulations and Interventions

2.5.1 Intervention Overview

The GPBL College English module served as the experimental manipulation. The module was systematically developed using the ADDIE instructional design model (Analysis, Design, Development, Implementation, Evaluation). Both experimental and control groups covered the same four thematic units over four weeks, with 90 minutes of classroom instruction per week. Both groups used the same textbook (*21st Century College English II*) and online learning platform (Chaoxing Learning APP) for pre-class preparation. Table 4 presents the instructional content covered across the four-week intervention.

Table 4. Instructional Content Across Four Weeks

Week	Unit Theme	Main Text (Text A)	Author	Learning Focus
1	Animals	"Loving Memory: Elephant Reunion"	Caitlin O'Connell	Animal intelligence; emotional bonds; wildlife conservation; human-animal relationships
2	Sportsmanship	"My Greatest Olympic Prize"	Jesse Owens	Fair play; respect in competition; Olympic values; personal integrity
3	Advertisement	"The Effects of TV Advertising on Children"	Dafna Lemish	Media influence; consumer behaviour; advertising ethics; critical media literacy
4	Health	"The Search for the Perfect Body"	Sarah Grogan	Body image; health vs. appearance; social pressures; wellness concepts

Both groups studied the same content but through different pedagogical approaches. The experimental group received the GPBL intervention integrating problem-based learning with gamification elements, whilst the control group followed traditional interactive task-based instruction. Table 5 presents a detailed comparison of the experimental and

control group interventions.

Table 5. Comparison of Experimental and Control Group Interventions

Feature	Experimental Group (GPBL)	Control Group (Traditional)
Duration	4 weeks, 90 min/week	4 weeks, 90 min/week
Content Source	*21st Century College English II*	*21st Century College English II*
Pre-class Preparation	Chaoxing online learning platform	Chaoxing online learning platform
Classroom Structure	7-step PBL process with gamification	5-phase traditional structure
Teaching Approach	PBL with gamification	Interactive task-based instruction
Primary Activity	Authentic problem-solving requiring research, discussion, presentations	Vocabulary study, text analysis, grammar exercises, guided discussions
Teacher Role	Learning facilitator and guide	Knowledge transmitter and activity organizer
Student Role	Problem solver and autonomous researcher	Knowledge receiver and guided practitioner

2.5.2 GPBL Intervention (Experimental Group)

The GPBL intervention followed a structured seven-step classroom process designed to systematically activate multiple sources of self-efficacy. Each 90-minute session progressed through sequential stages, integrating problem-based learning with gamification elements that supported mastery experiences, vicarious learning, verbal persuasion, and positive affective states. Table 6 details the seven-step classroom process, including time allocation, activities, and corresponding gamification elements.

Table 6. GPBL Seven-Step Classroom Process

Step	Duration	Activities	Gamification Elements
1. Sharing Pre-Class Learning	5 min	Students present key points from online preparation to groups	Challenge
2. Problem Introduction & Role Assignment	10 min	Teacher presents authentic scenarios; students assigned specific roles (e.g., Wildlife Specialist, Ethical Advisor)	Role-playing system; Challenge framing
3. Group Brainstorming	10 min	Teams generate initial solution ideas and identify information needs	Challenge (mission completion); Cooperation
4. Independent Research	10 min	Students investigate their assigned role areas using textbooks and resources	Challenge (mission completion)
5. Solution Refinement	10 min	Groups integrate research findings and develop comprehensive solutions	Challenge (mission completion); Cooperation
6. Group Presentations	30 min	Teams present solutions using creative formats (PowerPoint, role-plays, etc.)	Team competition; Peer voting
7. Evaluation & Awards	15 min	Teacher feedback, peer voting for best solutions, bonus points awarded	Immediate feedback; Points and rewards; Leaderboards

The process integrated core PBL elements, including authentic problem scenarios (e.g., endangered species protection with roles such as Wildlife Specialist and Ethical Advisor), self-directed research, collaborative team structures, and a teacher as facilitator. Gamification elements provided motivational scaffolding through challenge framing, role-playing systems, team cooperation and competition, peer voting, points and rewards, classroom leaderboards tracking cumulative scores across four weeks, and immediate feedback from both teacher and peers.

2.5.3 Traditional 5-step Instruction (Control Group)

The control group followed a five-phase, sequential structure that represented current College English teaching practice at the institution. Table 7 presents the control group's instructional process, including time allocation, activities, and

teaching methods.

Table 7. Traditional Five-Phase Classroom Process (Control Group)

Phase	Duration	Activities	Methods
1. Lead-in (Starter)	10–15 min	Introduce background knowledge and preview vocabulary; activate prior knowledge of unit theme	Multimedia input (videos, images); brainstorming; prediction tasks
2. Text Engagement (First Pass)	15–20 min	Skim the text for main ideas; highlight new vocabulary; peer discussion	Skimming/scanning; guided questions; collaborative reading
3. Close Reading & Language Focus	25–30 min	Detailed reading; paragraph analysis; vocabulary and grammar in context	Guided reading; contextualized grammar annotation; strategy-based practice
4. Text-Based Speaking (Production)	15–20 min	Answer comprehension and opinion questions; pair/group discussion; role-play based on text themes	Text-based discussion; think-pair-share; role-play tasks
5. Conclusion & Reflection	5–10 min	Summarize key ideas; clarify difficulties; short reflective oral tasks	Teacher-guided synthesis; reflective questioning; self-evaluation

This interactive task-based structure moved systematically from receptive to productive skills through five phases. The lead-in activated background knowledge. Text engagement guided comprehension through skimming and analysis. Close reading provided explicit vocabulary and grammar instruction. The speaking phase applied learned language through discussions and role-plays. The final phase consolidated learning through teacher-led review and self-evaluation.

2.6 Procedure

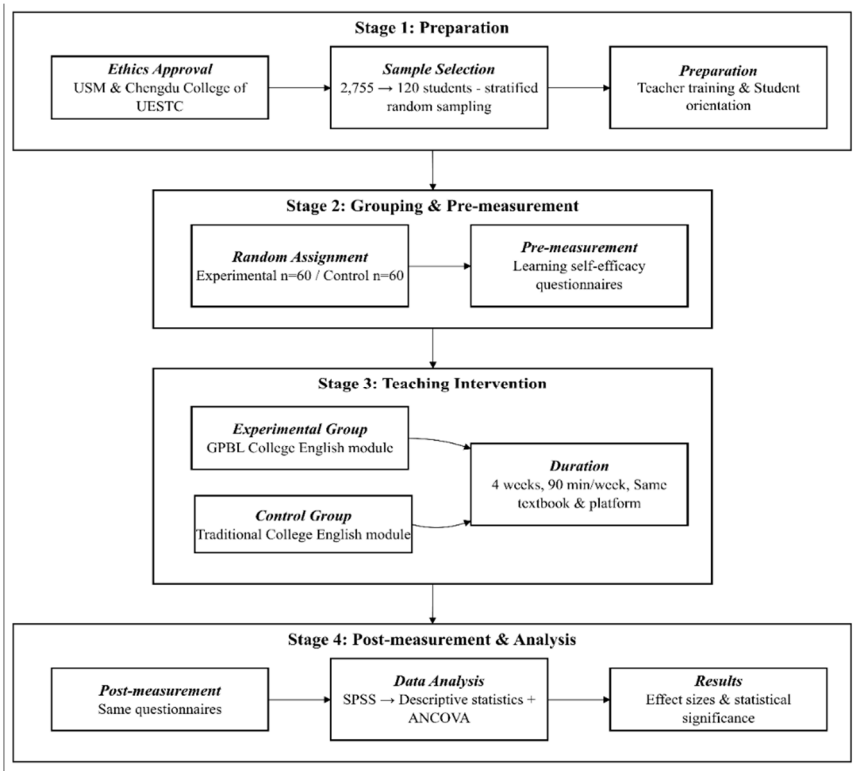

Figure 1. Research Procedures

The research procedures are illustrated in Figure 1. The study was conducted across four stages: preparation, grouping and pretesting, intervention, and posttesting and data analysis. Notably, to control for teacher effects, each group of 60

students was divided into two classes of 30 each, with the same two instructors teaching both the experimental and the control classes.

2.7 Data Analysis

Data were analysed using SPSS Version 27.0. Descriptive statistics (means, standard deviations, minimum and maximum values) characterised sample distributions at pretest and posttest. Independent samples t-tests examined baseline equivalence between groups on demographic variables and pretest self-efficacy scores. ANCOVA was conducted to examine group differences on learning behavioural self-efficacy and learning ability self-efficacy at posttest, controlling for pretest scores as covariates. This approach isolated intervention effects whilst accounting for baseline differences. Prior to ANCOVA, all statistical assumptions were verified. Tests of regression slope homogeneity confirmed parallel regression slopes between groups. Levene's test confirmed homogeneity of variance. Shapiro-Wilk tests confirmed that the residuals were normally distributed. Variance inflation factors confirmed the absence of multicollinearity (VIF < 10). And effect sizes were calculated using Cohen's *d* to assess practical significance, with interpretive guidelines of 0.2 (small), 0.5 (medium), and 0.8 (large) (Cohen, 1988). Partial eta-squared (η^2) was reported for ANCOVA results, with interpretive guidelines of 0.01 (small), 0.06 (medium), and 0.14 (large). Statistical significance was determined at $\alpha = 0.05$ for all analyses.

3. Results

3.1 Participant Flow

All 120 participants who were recruited and randomly assigned completed the study. The experimental group ($n = 60$) received the GPBL intervention, and the control group ($n = 60$) received traditional instruction. No participants withdrew from the study or crossed over to other conditions. All 120 participants completed both pretest and posttest assessments and were included in the final analyses. The study was conducted from December 2024 through February 2025, with recruitment occurring in Week 1, intervention delivery from Weeks 2-5, and posttest administration in Week 6.

3.2 Baseline Data

Demographics are presented in Table 1(see Method section). Independent-samples t-tests revealed no significant baseline differences between groups on either self-efficacy dimension. Table 8 presents the baseline equivalence results. For learning behavioural self-efficacy, t (118) = -0.614, $p = 0.540$. For learning ability self-efficacy, t (118) = -0.324, $p = 0.746$. The mean differences between groups were minimal, ranging from -0.05 to -0.08 points. These non-significant results confirmed successful randomisation and that the two groups were statistically equivalent prior to the intervention.

Table 8. Baseline Equivalence Between Groups

Variable	Control *M* (*SD*)	Experimental *M* (*SD*)	*t*	*df*	*p*	Mean Difference	95% *CI*
Learning Behavioural Self-Efficacy	2.57 (0.77)	2.65 (0.72)	-0.614	118	0.540	-0.08	[-0.34, 0.18]
Learning Ability Self-Efficacy	2.46 (0.74)	2.51 (0.79)	-0.324	118	0.746	-0.05	[-0.36, 0.26]

Note. CI = confidence interval. All p-values are two-tailed.

3.3 Descriptive Statistics

Table 9 presents descriptive statistics for both groups at pretest and posttest. Both groups demonstrated similar baseline levels, with mean scores ranging from 2.46 to 2.65, indicating moderate-to-low initial self-efficacy. The experimental group showed substantial improvements from pretest to posttest. Learning behavioural self-efficacy increased by 0.75 points (28.3%), while learning ability self-efficacy increased by 0.84 points (33.5%). The control group showed minimal changes, with increases of 0.11 points (4.3%) and 0.02 points (0.8%) respectively.

Table 9. Descriptive Statistics for Learning Self-Efficacy by Group and Time

Variable	Group	Time	*n*	*M*	*SD*	Min	Max
Learning Behavioural Self-Efficacy	Experimental	Pretest	60	2.65	0.72	1.43	4.14
		Posttest	60	3.40	0.73	1.86	5.00
	Control	Pretest	60	2.57	0.77	1.00	4.14
		Posttest	60	2.68	0.83	1.14	5.00
Learning Ability Self-Efficacy	Experimental	Pretest	60	2.51	0.79	1.00	4.71
		Posttest	60	3.35	0.68	1.71	5.00
	Control	Pretest	60	2.46	0.74	1.00	4.86
		Posttest	60	2.48	0.78	1.00	4.43

3.4 Primary Analyses

ANCOVA was conducted to examine the intervention's effectiveness on learning self-efficacy, with pretest scores controlled as covariates. All participants assigned to conditions were included in the data analysis regardless of attendance patterns, following an intent-to-treat approach. Prior to ANCOVA, all statistical assumptions were verified. Tests of regression slope homogeneity revealed no significant interactions between group and covariates (all $ps > 0.05$), confirming parallel regression slopes. Levene's test indicated homogeneity of variance for learning behavioural self-efficacy (F (1, 118) = 0.356, p = 0.552) and learning ability self-efficacy (F (1, 118) = 0.021, p = 0.886). The Shapiro-Wilk test confirmed that the residuals were normally distributed for both variables (all ps > 0.05). Table 10 presents the ANCOVA results.

Table 10. ANCOVA Results for Learning Self-Efficacy Outcomes

Dependent Variables	Type III Sum of Squares	Mean Square	*F*	*p*	Partial η^2
Learning Behavioural Self-Efficacy	12.934	12.934	22.069	< 0.001	0.165
Learning Ability Self-Efficacy	18.314	18.314	40.109	< 0.001	0.264

Note. df = 1, 112 for all F-tests.

The ANCOVA revealed significant group differences on both self-efficacy dimensions. For learning behavioural self-efficacy, the experimental group significantly outperformed the control group, F (1, 112) = 22.069, $p < 0.001$, partial $\eta^2 = 0.165$, accounting for 16.5% of the variance in posttest scores after controlling for baseline levels. For learning ability self-efficacy, the experimental group also demonstrated significantly higher scores than the control group, F (1, 112) = 40.109, $p < 0.001$, partial $\eta^2 = 0.264$, accounting for 26.4% of the variance. Both partial η^2 values represent large effect sizes according to Cohen's (1988) guidelines, indicating substantial and educationally meaningful improvements in the experimental group's learning self-efficacy.

Table 11 presents the adjusted means and effect size for learning behavioural self-efficacy. The experimental group achieved an adjusted mean of 3.373 compared to the control group's adjusted mean of 2.708, representing an increase of 0.665 points on the five-point scale. Cohen's d was 0.869, substantially exceeding the 0.8 threshold for a large effect (Cohen, 1988).

Table 11. Adjusted Means and Effect Size for Learning Behavioural Self-Efficacy

Group	*M*	*SE*	95% *CI*	Cohen's *d*
Control	2.708	0.100	[2.510, 2.905]	
Experimental	3.373	0.100	[3.176, 3.571]	0.869

Note. Adjusted means control for pretest learning behavioural self-efficacy.

The magnitude of this effect is particularly noteworthy given the four-week intervention period. Students in the experimental group moved from below-average confidence (M = 2.65 at pretest) to above-average confidence (M = 3.40 at posttest), crossing the midpoint of the scale and approaching the upper range. This substantial shift suggests that GPBL systematically enhanced students' beliefs in their capacity to engage productively in English learning behaviours during the four-week intervention period.

Table 12 presents the adjusted means and effect size for learning ability self-efficacy. The experimental group's adjusted mean was 3.312 compared to the control group's adjusted mean of 2.519. Cohen's *d* was 1.173, substantially exceeding the 0.8 threshold for a large effect.

Table 12. Adjusted Means and Effect Size for Learning Ability Self-Efficacy

Group	*M*	*SE*	95% *CI*	Cohen's *d*
Control	2.519	0.088	[2.345, 2.693]	
Experimental	3.312	0.088	[3.138, 3.486]	1.173

Note. Adjusted means control for pretest learning ability self-efficacy.

Learning ability self-efficacy showed the stronger intervention effect, with an effect size of Cohen's $d = 1.173$, compared to behavioural self-efficacy, which had an effect size of Cohen's $d = 0.869$. This differential effect suggests that GPBL particularly influenced students' fundamental beliefs about their learning capacity beyond merely boosting confidence in specific actions in the immediate term. The experimental group demonstrated a remarkable improvement, moving from below-average ability confidence ($M = 2.51$ at pretest) to well above-average confidence ($M = 3.35$ at posttest), representing a 0.84-point shift on the five-point scale.

3.5 Intervention Fidelity

The GPBL intervention was delivered as intended across all four weeks. Both experimental and control groups maintained 100% attendance throughout the study. The same two instructors taught both the experimental and control conditions, with each instructor teaching one class of 30 students in each condition. Classroom observations conducted during Weeks 1 and 4 confirmed adherence to the designated instructional protocols, with experimental groups consistently following the seven-step GPBL process and control groups following the five-phase traditional structure. Both groups used the same textbook and online platform, covered the same four thematic units, and maintained equivalent time allocation (90 minutes per week), with no deviations from planned procedures.

3.6 Summary

The GPBL intervention produced large-to-very large positive effects on both dimensions of learning self-efficacy. Learning behavioural self-efficacy improved with a large effect size (Cohen's $d = 0.869$), and learning ability self-efficacy showed an even greater improvement with a very large effect size (Cohen's $d = 1.173$). The partial η^2 values (0.165 and 0.264, respectively) indicate that 16.5% and 26.4% of variance in posttest scores was attributable to the intervention after controlling for baseline levels. These results provide strong evidence that GPBL substantially enhances multiple dimensions of EFL learners' self-efficacy.

4. Discussion

4.1 Support for Hypotheses

The results provide strong support for both research hypotheses. Hypothesis 1 predicted that students in the GPBL group would demonstrate significantly higher learning behavioural self-efficacy at posttest than the control group, after controlling for pretest scores. This hypothesis was supported, $F(1, 112) = 22.069$, $p < 0.001$, partial $\eta^2 = 0.165$, with a large effect size (Cohen's $d = 0.869$). Hypothesis 2 predicted that students in the GPBL group would demonstrate significantly higher learning ability self-efficacy at posttest than the control group, after controlling for pretest scores. This hypothesis was also supported, $F(1, 112) = 40.109$, $p < 0.001$, partial $\eta^2 = 0.264$, with a very large effect size (Cohen's $d = 1.173$). Both hypotheses received robust empirical support, demonstrating that the GPBL intervention successfully enhanced EFL learners' learning self-efficacy.

4.2 Interpretation of Findings

The substantial gains in both learning self-efficacy dimensions demonstrate that GPBL effectively addresses the persistent self-efficacy deficits in Chinese College English contexts. The effect sizes (Cohen's $d = 0.869$ and 1.173) substantially exceed Hattie's (2009) average effect size of 0.40 across educational interventions. These results can be attributed to four mechanisms deliberately incorporated into the GPBL intervention, corresponding to Bandura's (1997) four sources of self-efficacy.

The first mechanism involved providing mastery experiences through scaffolded problem-solving. The seven-step PBL process enabled students to progress from simple information sharing to complex problem-solving, with each

completed problem providing concrete evidence of their capabilities. Unlike traditional instruction, where students passively receive knowledge, GPBL requires active problem-solving with visible outcomes. Gamification elements amplified these effects by making success tangible through accumulated points, leaderboards, and rewards. This supports Bandura's (1997) assertion that mastery experiences constitute the most powerful source of self-efficacy.

Beyond individual mastery, the collaborative structure facilitated vicarious learning as the second mechanism. Observing peers complete tasks successfully enabled students to believe they could succeed as well, consistent with sociocultural perspectives emphasising peer modelling (Vygotsky, 1978). The leaderboard displayed all teams' achievements, showing that multiple teams could succeed through different approaches, providing further evidence that success was achievable.

The third mechanism involved verbal persuasion through concrete feedback. Gamification elements provided feedback that reinforced effort and progress. Points, leaderboards, and rewards transformed abstract progress into tangible recognition (Sailer & Homner, 2020). Teachers provided encouraging feedback during problem-solving processes, recognising effort rather than solely evaluating final products. This persuasion was grounded in observable performance, likely enhancing its impact compared to generic encouragement.

The fourth mechanism addressed affective states through a supportive classroom climate. Traditional English classrooms often foster fear of judgment and a tendency to avoid error (Horwitz, 2020; Xu et al., 2022). In contrast, GPBL normalised mistakes as natural elements of problem-solving. The collaborative structure diffused individual anxiety by distributing responsibility across teams, while gamification fostered a playful atmosphere in which mistakes became learning opportunities. These elements reduced anxiety and fostered positive emotional states conducive to the development of self-efficacy.

Finally, the differential effects on the two self-efficacy dimensions require explanation. The larger effect size for learning ability self-efficacy (Cohen's $d = 1.173$) compared with learning behavioural self-efficacy (Cohen's $d = 0.869$) warrants particular attention. Learning behavioural self-efficacy reflects beliefs in performing specific tasks. Learning ability self-efficacy reflects broader beliefs in one's general capacity to learn College English. The integrated nature of GPBL tasks (requiring speaking, planning, collaboration, and problem-solving) likely contributed to students viewing themselves as capable language learners rather than merely competent task performers. This suggests that authentic, integrated activities may be particularly effective for developing domain-general confidence at least in the short term, though longitudinal research is needed to confirm sustained effects.

4.3 Comparison with Previous Research

These findings are consistent with and extend previous research on PBL and gamification in language education contexts. Previous research on PBL in Chinese College English contexts has documented positive effects on language proficiency and autonomy (Luo et al., 2021; Xie, 2022), but has rarely directly measured self-efficacy. The current study demonstrates that PBL's benefits include substantial increases in self-efficacy. Similarly, whilst gamification research in Chinese contexts has shown motivational benefits (Li, 2020; Yin, 2021), few studies have specifically examined self-efficacy. The current findings demonstrate that gamification's motivational effects include powerful self-efficacy development when integrated with substantive learning activities.

The integrated approach addressed self-efficacy through multiple simultaneous mechanisms rather than relying on a single pathway. The integration of gamification and PBL appears to produce synergistic effects that exceed those of either approach alone, particularly for learners navigating the transition to university-level autonomous learning. This is consistent with Kladchuen and Srisomphan (2021), who found that combining gamification with PBL improved engagement and problem-solving competence, though their study focused on vocational education rather than language learning.

The findings also help address cultural barriers to the development of confidence in Chinese EFL contexts. Students frequently experience high evaluative pressure and reluctance to speak, out of fear of losing face (Wen, Chen, & Hao, 2022). The collaborative, game-supported environment provided a psychologically safe space where effort was visible, improvement was rewarded, and peer support mitigated embarrassment. By reframing errors as learning opportunities within a game structure and distributing responsibility across team members, the module reduced individual performance anxiety. The reduction in anxiety is particularly significant in Chinese educational contexts where face-saving concerns strongly influence behaviour (Liu, 2020). Students who fear embarrassment avoid participation, which prevents the mastery experiences necessary for efficacy development.

4.4 Limitations and Threats to Validity

Several limitations must be considered when interpreting these results. Several design features enhanced internal

validity. Random assignment minimised selection bias and established group equivalence. ANCOVA controlled for baseline differences by using pretest scores as covariates. Both groups received identical instructional time (90 minutes per week for 4 weeks) and materials. The same two instructors taught both conditions to control for instructor effects. Classroom observations confirmed adherence to designated protocols. Nonetheless, some threats persist. Testing effects are possible, although the four-week interval between measurements reduces this likelihood. And students in different groups may have discussed the study informally outside class.

External validity is limited by three primary constraints. First, the study was conducted at a single private university in southwestern China, so results may not be generalised to all universities, other regions, senior students, or English majors. Second, the four-week intervention demonstrates only immediate effects, as learning self-efficacy was measured immediately after the intervention without follow-up. The persistence of these gains over time is therefore unknown. Third, the sample comprised only first-year non-English majors. Multi-site studies with more diverse student populations are needed.

The measurement approach also shows limitations. The study relied exclusively on self-report questionnaires, which demonstrated strong reliability (Cronbach's $\alpha > 0.88$) and validity (KMO > 0.90). However, self-reports are susceptible to social desirability bias, as students may overstate their confidence to align with perceived expectations. Future research should incorporate behavioural measures, such as task selection (challenging versus easy), persistence when facing difficulties, frequency of volunteering, and actual use of learning strategies. These objective indicators would provide a valuable complement to self-reported confidence.

The construct coverage in this study is limited, as only learning self-efficacy was measured. Other relevant outcomes, such as actual motivation levels, practice frequency outside class, and improvements in language proficiency, were not examined. According to Bandura's (1997) theory, learning self-efficacy influences behaviour and achievement, but this pathway was not assessed in the present study. Future research should measure language proficiency (for example, CET-4 scores), document practice behaviours, and track persistence over time to determine whether learning self-efficacy gains translate into academic success. Despite these limitations, the study offers strong evidence that GPBL enhances learning self-efficacy. The experimental design, probability-based sampling, and large effect sizes support this conclusion. However, questions regarding long-term effects and broader generalizability remain for future research.

4.5 Practical Implications

This study suggests four important practical implications. First, educational leaders should recognise that student success encompasses more than test scores. Institutions should incorporate self-efficacy development as an explicit instructional goal alongside traditional performance metrics. Second, curriculum designers should move beyond teacher-led instruction toward approaches that systematically activate multiple sources of self-efficacy. The GPBL model demonstrates that integrating problem-based learning with gamification can yield substantial gains in confidence. Third, teacher training programs should equip instructors with skills to implement student-centred approaches effectively. Professional development should emphasise how to scaffold authentic problems, structure collaborative learning, and appropriately balance competitive elements. Fourth, implementation in Chinese contexts requires attention to cultural factors. Face-saving concerns may create initial resistance. Educators should deliberately create psychologically safe environments where mistakes are normalised as learning opportunities rather than performance failures.

4.6 Theoretical Significance

This study contributes to self-efficacy theory and language learning research in four important ways. First, it provides empirical support for Bandura's (1997) self-efficacy theory in Chinese EFL contexts, demonstrating that self-efficacy is responsive to instructional innovation. By systematically activating all four sources of self-efficacy, GPBL produced substantial gains within four weeks. Second, the differential effects on learning behavioural versus learning ability self-efficacy dimensions suggest these constructs respond differently to instructional interventions. The stronger effect on learning ability self-efficacy indicates that integrated, authentic tasks particularly influence broader self-perceptions about learning capacity. This extends understanding of how different self-efficacy dimensions develop. Third, the combined effects of gamification and PBL show that these two approaches complement each other by addressing each other's limitations. Gamification provides motivation support that helps students engage with challenging PBL tasks, while PBL ensures that confidence builds on real learning achievements rather than superficial rewards.

4.7 Future Research Directions

Several important questions remain for future research. First, longitudinal studies should examine whether self-efficacy gains translate into sustained behavioural changes and improvements in achievement over time. Future research should

incorporate objective behavioural measures to complement self-report data. Examples include task persistence (time spent on challenging assignments), participation frequency (documented classroom contributions), autonomous learning behaviours (self-initiated practice outside class), and standardised language proficiency assessments such as CET-4 scores. These objective indicators would provide converging evidence beyond self-reported confidence and help determine whether learning self-efficacy gains lead to actual performance improvements.

Second, research should investigate whether GPBL effects generalise across different educational levels, subject areas, and cultural contexts. Multi-site studies across public and private universities, different geographic regions, and diverse student populations would clarify the intervention's broader applicability. Third, studies should examine moderating variables, such as prior achievement, initial learning self-efficacy, and individual differences in response to gamification. Understanding which students benefit most from GPBL would enable adaptive approaches tailored to diverse learner needs. Fourth, cost-benefit analyses considering development time, teacher training requirements, and resource allocation would inform practical implementation decisions.

5. Conclusion

This study provides robust evidence that GPBL substantially enhances both learning behavioural and learning ability self-efficacy among undergraduate EFL learners in China. The large effect sizes, strong support for the hypothesis, and alignment with theoretical predictions demonstrate the effectiveness of this approach. Integrated pedagogical approaches combining game mechanics with authentic problem-solving can address persistent self-efficacy challenges in Chinese College English education. The findings have important implications for curriculum reform. Traditional teacher-led instruction should evolve toward approaches that systematically cultivate learner confidence through multiple mechanisms. When educators thoughtfully integrate these elements, they may enhance students' immediate self-efficacy in learning. If these gains persist, this may ultimately support students' academic success and professional advancement, though longitudinal studies are needed to confirm long-term effects.

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Authors contributions

Liang Zhuxin was responsible for study design, data collection, and data analysis. Dr. Siti Zuraidah Binti Md Osman provided guidance on research design and methodology. Liang Zhuxin drafted the manuscript. Dr. Siti Zuraidah Binti Md Osman revised the manuscript. All authors read and approved the final manuscript.

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No additional data are available.