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THE EFFECT OF PROBLEM-BASED LEARNING ON EFL STUDENTS' ACHIEVEMENT AND CRITICAL THINKING SKILLS: AN EXPERIMENTAL STUDY

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ABSTRACT

This experimental study investigates the impact of Problem-Based Learning (PBL) Apost-test). Statistical analyses, including independent and paired samples t-tests as well as a Two-Way ANOVA, revealed that the experimental group significantly outperformed the control group in academic achievement, with a large effect size ($\eta^2 = 0.21$). Additionally, female students in the experimental group exhibited higher achievement scores compared to their male counterparts; however, the interaction between teaching method and gender was not statistically significant. These findings underscore the potential of PBL to enhance both academic outcomes and critical thinking abilities in EFL contexts, suggesting that active, student-centered instructional strategies may offer substantial benefits over traditional teaching methods.

Keywords *Problem-Based Learning, EFL, Academic Achievement, Critical Thinking, Experimental Study*

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INTRODUCTION

In an increasingly globalized world, proficiency in English as a foreign language (EFL) is crucial for academic, professional, and social success. Traditional teacher-centered methods have long dominated EFL classrooms; however, such approaches often emphasize rote memorization and grammatical drills rather than active engagement with the language. As a result, many students face difficulties in applying their knowledge to authentic situations and in developing higher-order cognitive skills such as critical thinking. In response, educators have increasingly turned to constructivist, student-centered approaches such as Problem-Based Learning (PBL), which have been shown to foster deeper learning and promote self-regulated inquiry.

Problem-Based Learning represents a pedagogical paradigm shift that places students at the center of the learning process through authentic problem-solving activities (Guo et al., 2024). This approach has gained significant attention in contemporary educational research, particularly in language learning contexts where traditional methods have proven insufficient in developing communicative competence and critical thinking skills. Recent systematic reviews demonstrate that PBL not only enhances academic achievement but also promotes the development of 21st-century skills essential for global citizenship and professional success (Orhan, 2024).

The theoretical foundation of PBL is rooted in constructivist learning theory, which emphasizes that learners actively construct knowledge through meaningful experiences and social interaction. This constructivist approach is particularly relevant in EFL contexts, where language acquisition occurs most effectively through authentic communication and real-world problem-solving scenarios (Cahyono et al., 2024). Contemporary research in second language acquisition emphasizes the importance of meaningful interaction and collaborative learning in developing both linguistic competence and critical thinking abilities.

Recent empirical evidence strongly supports the effectiveness of PBL in EFL settings. Meta-analytical research conducted by Orhan (2024) demonstrates that problem-based learning approaches yield significantly higher effect sizes in promoting academic achievement and critical thinking skills compared to traditional instructional methods. Similarly, systematic reviews examining PBL implementation across diverse EFL contexts consistently report positive outcomes in language proficiency development and cognitive skill enhancement (Guo et al., 2024).

The integration of technology with PBL has further amplified its effectiveness in contemporary educational settings. Recent research investigating online versus face-to-face PBL implementation reveals that both modalities effectively enhance critical thinking skills and academic performance, with online environments offering unique advantages in terms of accessibility and flexibility (Orhan, 2024). Digital platforms and mobile-assisted language learning applications have created new opportunities for implementing PBL activities that transcend traditional classroom boundaries while maintaining pedagogical effectiveness.

Critical thinking development has emerged as a particularly significant outcome of PBL implementation in EFL contexts. Contemporary studies demonstrate that students engaged in problem-based activities show substantial improvements in analytical reasoning, evaluation skills, and creative problem-solving abilities compared to those receiving traditional instruction (Li, 2023). The development of critical thinking skills is especially crucial in EFL learning contexts, where students must navigate complex linguistic and cultural information while developing metacognitive awareness of their learning processes.

Gender differences in PBL effectiveness have also received attention in recent research. Studies investigating gender-related variations in learning outcomes suggest that while both male and female students benefit from PBL approaches, certain aspects of collaborative learning and problem-solving may resonate differently across gender groups (Algouzi et al., 2023). However, research consistently indicates that the overall effectiveness of PBL remains robust across diverse demographic characteristics, suggesting its broad applicability in varied educational contexts.

The shift from traditional instruction to PBL is especially significant in regions where conventional methods prevail. Contemporary research conducted in diverse international contexts demonstrates that implementing PBL can significantly improve learners' performance and critical thinking skills, regardless of cultural or educational

background (Ferdoush & Jahan, 2024). Moreover, studies show that learners in traditional classrooms often struggle to transfer classroom knowledge to authentic communication situations, highlighting the urgent need for innovative pedagogical practices that can better prepare EFL students for the demands of a globalized workforce.

The current study aims to comprehensively evaluate the impact of Problem-Based Learning on EFL students' academic achievement and critical thinking skills through a rigorous experimental design. The primary objective centers on comparing the academic performance of EFL students receiving Problem-Based Learning instruction with those taught using traditional lecture-based methods, employing standardized assessment instruments to ensure reliable measurement of learning outcomes. Additionally, the study seeks to assess the effect of PBL on critical thinking skills by measuring changes in analytical, evaluative, and inferential reasoning abilities among EFL students following a structured intervention period. The research also examines gender differences in PBL outcomes to investigate whether significant differences exist between male and female EFL students in terms of academic achievement and critical thinking development when engaged in problem-based learning activities. Furthermore, the study analyzes the interaction between teaching method and gender to explore potential interaction effects between the instructional approach and demographic characteristics on students' academic and cognitive outcomes, providing insights into the differential effectiveness of PBL across diverse student populations.

The temporal scope of this investigation encompasses the 2023-2024 academic semester, capturing the effects of a comprehensive 12-16 week intervention period that allows for meaningful assessment of both immediate and sustained learning outcomes. The spatial scope is defined by EFL classrooms at selected educational institutions, ensuring that the study reflects contemporary classroom practices within a defined regional context while maintaining sufficient sample diversity for generalizability. The conceptual scope focuses specifically on the effectiveness of Problem-Based Learning in enhancing two primary constructs: academic achievement in English as measured by an adapted English Language Achievement Test derived from established methodological literature, and critical thinking skills as assessed by standardized instruments designed to evaluate reasoning, analysis, and evaluation capabilities. These constructs are evaluated to determine the extent to which active, student-centered instruction can improve EFL learning outcomes compared to traditional pedagogical approaches. The demographic scope encompasses 92 EFL students with balanced gender distribution, randomly assigned to experimental and control groups after ensuring equivalence in prior academic performance, age, and socioeconomic background, thereby facilitating comprehensive understanding of PBL's impact on diverse student populations while controlling for potential confounding variables.

Problem-Based Learning emerged as an innovative educational approach in the 1960s, particularly gaining prominence in medical education settings where traditional didactic methods proved insufficient for developing clinical reasoning skills. The theoretical foundations of PBL are deeply rooted in constructivist learning theory, which

posits that knowledge is actively constructed by learners through meaningful engagement with authentic problems rather than passively received through direct instruction (Zannan, 2023). This constructivist perspective aligns with contemporary understanding of cognitive development, emphasizing the importance of social interaction, collaborative inquiry, and reflective practice in the learning process.

Recent theoretical developments in PBL research have expanded beyond its original medical education context to encompass diverse disciplines, including language learning. Contemporary scholars argue that PBL's effectiveness stems from its ability to create authentic learning contexts that mirror real-world problem-solving scenarios (Arruzza et al., 2023). The approach fundamentally shifts the traditional classroom dynamic from teacher-centered knowledge transmission to student-centered knowledge construction, where learners assume active roles as researchers, collaborators, and critical thinkers (Yew & Goh, 2016).

The application of PBL in English as a Foreign Language education represents a relatively recent but rapidly growing area of pedagogical innovation. Unlike traditional language instruction that often emphasizes discrete linguistic elements through repetitive practice, PBL integrates language learning with meaningful content and authentic communication purposes (Ibnian, 2023). This integration addresses a fundamental limitation of conventional EFL instruction: the artificial separation of language form from communicative function.

Contemporary research demonstrates that PBL implementation in EFL contexts yields significant improvements in multiple language competencies simultaneously. Students engaged in problem-based activities develop not only linguistic skills but also intercultural competence, digital literacy, and collaborative abilities essential for 21st-century communication (Cahyono et al., 2024). The approach particularly benefits language learners by providing authentic contexts for language use, promoting intrinsic motivation through meaningful problem engagement, and developing autonomy in learning processes (Usman et al., 2024).

Recent studies examining PBL effectiveness in EFL settings have employed increasingly sophisticated research methodologies to isolate the specific mechanisms through which problem-based approaches enhance learning outcomes. Meta-analytical evidence suggests that PBL's effectiveness in language learning contexts stems from its capacity to activate multiple cognitive processes simultaneously, including analytical reasoning, creative thinking, and metacognitive awareness (Orhan, 2024). These cognitive processes are particularly crucial for EFL learners who must navigate complex linguistic systems while developing cultural competence and communication strategies (Cosgun, 2021).

The relationship between Problem-Based Learning and critical thinking development has received substantial attention in recent educational research. Critical thinking, conceptualized as the ability to analyze information objectively, evaluate evidence systematically, and draw reasoned conclusions, represents a fundamental component of academic success and professional competence (Darwin et al., 2023). In

EFL contexts, critical thinking skills enable students to analyze texts effectively, evaluate arguments across cultural boundaries, and generate creative solutions to communication challenges.

Recent systematic reviews examining PBL's impact on critical thinking development reveal consistently positive outcomes across diverse educational settings and demographic groups. Research conducted by Li (2023) demonstrates that students engaged in problem-based learning activities show significant improvements in analytical reasoning, evaluation skills, and inference-making abilities compared to those receiving traditional instruction. These improvements appear to be sustained over time and transfer to novel problem-solving contexts beyond the original learning environment.

The mechanisms through which PBL enhances critical thinking skills have been increasingly well-documented through empirical research. Problem-based environments require students to engage in authentic inquiry processes, including information gathering, hypothesis formation, evidence evaluation, and solution refinement (Algouzi et al., 2023). These processes mirror the cognitive operations fundamental to critical thinking, providing students with repeated opportunities to practice and develop these essential skills within meaningful contexts.

Contemporary research also highlights the importance of collaborative learning in PBL environments for critical thinking development. When students work together to solve complex problems, they engage in peer feedback, perspective-taking, and argumentative discourse that challenge individual assumptions and promote deeper analytical thinking (Ferdoush & Jahan, 2024). This collaborative dimension of PBL appears particularly beneficial for EFL learners, who gain exposure to diverse thinking styles and communication strategies while developing their own critical thinking capabilities (Hua et al., 2024).

Academic achievement represents another crucial outcome domain in PBL research, with recent studies demonstrating significant positive effects across various academic disciplines and educational levels. In EFL contexts, academic achievement encompasses multiple competency areas, including reading comprehension, writing proficiency, listening skills, speaking ability, and linguistic accuracy (Guo et al., 2024). Traditional measures of academic achievement often focus on discrete language elements assessed through standardized testing instruments.

Recent research examining PBL's impact on EFL academic achievement reveals consistently positive outcomes, with effect sizes often exceeding those observed with traditional instructional approaches. Meta-analytical evidence compiled by Guo et al. (2024) demonstrates that students engaged in problem-based learning activities achieve significantly higher scores on standardized language proficiency assessments compared to those receiving conventional instruction. These improvements appear across multiple language skill areas and persist beyond the immediate intervention period.

The mechanisms underlying PBL's positive impact on academic achievement in EFL contexts relate to the approach's emphasis on meaningful language use within authentic communicative contexts. Unlike traditional instruction that often isolates

language elements for discrete practice, PBL integrates multiple language skills within purposeful communication activities (Zannan, 2023). This integration promotes deeper processing of linguistic information and enhances retention through meaningful engagement with language content.

Recent studies also highlight the motivational benefits of PBL for academic achievement in EFL settings. Students engaged in problem-based activities report higher levels of intrinsic motivation, task engagement, and perceived relevance compared to those in traditional classroom environments (Orhan, 2024). These motivational factors appear to mediate the relationship between instructional approach and academic outcomes, suggesting that PBL's effectiveness partially stems from its capacity to enhance student motivation and engagement with learning content.

Gender differences in educational outcomes have received increasing attention in contemporary educational research, with studies examining how various pedagogical approaches may differentially impact male and female students. In the context of Problem-Based Learning and EFL education, recent research suggests that while both genders benefit from problem-based approaches, certain aspects of collaborative learning and communication may resonate differently across gender groups (Algouzi et al., 2023).

Contemporary studies investigating gender differences in PBL effectiveness reveal complex patterns that vary across outcome measures and contextual factors. Research conducted by Ferdoush and Jahan (2024) suggests that female students may show particular advantages in collaborative problem-solving activities, possibly related to communication styles and peer interaction preferences. However, these differences appear to be relatively modest in magnitude and do not diminish the overall effectiveness of PBL for all students.

The theoretical explanations for observed gender differences in PBL outcomes often focus on socialization processes, learning style preferences, and communication patterns that may influence how students engage with collaborative problem-solving activities. Some research suggests that female students may be more comfortable with the interactive and communicative demands of PBL environments, while male students may initially struggle with the reduced structure compared to traditional instructional formats (Li, 2023).

However, recent longitudinal studies suggest that any initial gender differences in PBL effectiveness tend to diminish over time as students become more familiar with problem-based learning approaches. This pattern suggests that observed gender differences may reflect familiarity with instructional format rather than fundamental differences in learning capacity or potential (Darwin et al., 2023). These findings have important implications for PBL implementation, suggesting that adequate orientation and scaffolding may help ensure equitable outcomes across diverse student populations (Wu, 2024).

The integration of technology with Problem-Based Learning has emerged as a significant area of innovation in contemporary educational practice. Digital platforms, online collaboration tools, and mobile applications have created new possibilities for

implementing PBL activities that transcend traditional classroom boundaries while maintaining pedagogical effectiveness (Orhan, 2024). Recent research examining online PBL implementation reveals promising outcomes for both academic achievement and critical thinking development.

Studies comparing online and face-to-face PBL implementation demonstrate that both modalities can effectively enhance learning outcomes, with online environments offering unique advantages in terms of accessibility, flexibility, and resource availability. Digital tools enable asynchronous collaboration, multimedia resource integration, and personalized learning pathways that may enhance the traditional benefits of problem-based approaches (Algouzi et al., 2023).

However, technology integration in PBL also presents unique challenges that require careful consideration in implementation planning. Issues related to digital literacy, technology access, and online communication skills may influence the effectiveness of technology-enhanced PBL approaches (Song et al., 2024). Recent research suggests that successful technology integration requires adequate technical support, clear communication protocols, and structured scaffolding to help students navigate digital learning environments effectively (Li & Liu, 2023).

The global expansion of PBL implementation has revealed important cultural and contextual factors that influence its effectiveness across diverse educational settings. Research conducted in various international contexts demonstrates that while PBL's core principles remain universally applicable, specific implementation strategies may need to be adapted to align with local educational traditions, cultural values, and institutional constraints (Guo et al., 2024).

Recent studies examining PBL implementation in diverse cultural contexts highlight the importance of considering student expectations, teacher preparation, and institutional support in determining implementation success. Educational systems with strong traditions of teacher-centered instruction may require extensive professional development and gradual implementation strategies to ensure effective PBL adoption (Ferdoush & Jahan, 2024).

Contemporary research also emphasizes the importance of addressing implementation challenges proactively to maximize PBL effectiveness. Common challenges include teacher resistance to pedagogical change, insufficient resources for problem-based activities, large class sizes that complicate group management, and assessment systems that prioritize traditional testing over authentic performance evaluation (Darwin et al., 2023). Research by Sendag and Odabası (2009) demonstrates that online problem-based learning can help address some of these challenges by providing flexible learning environments and scalable implementation options. Addressing these challenges requires comprehensive planning, institutional support, and ongoing professional development to ensure sustainable implementation.

The future directions for PBL research in EFL contexts point toward several promising areas of investigation. Longitudinal studies examining the sustained effects of PBL implementation on language proficiency and critical thinking development represent

a crucial research priority (Zannan, 2023). Additionally, research investigating the optimal design characteristics of problem-based activities for specific learning outcomes could inform more effective implementation strategies (Qolamani et al., 2025).

Contemporary scholars also call for increased attention to individual difference factors that may influence PBL effectiveness, including cognitive style, cultural background, prior educational experience, and personality characteristics (Li & Liu, 2023). Understanding how these factors interact with problem-based approaches could enable more personalized and effective implementation strategies (Borg, 2019). Furthermore, research examining the cost-effectiveness and scalability of PBL implementation could inform policy decisions regarding educational resource allocation and curriculum reform initiatives (Chniet et al., 2023).

RESEARCH METHODOLOGY

A. Research Design

This study employs a randomized controlled experimental design to investigate the impact of Problem-Based Learning (PBL) on EFL students' academic achievement and critical thinking skills. Two independent variables were examined: the teaching method (PBL versus traditional instruction) and gender (male versus female). The dependent variables include academic achievement in English and critical thinking skills.

Individual randomization was conducted using a computer-generated random number sequence to assign participants to either the experimental group (receiving PBL) or the control group (receiving traditional instruction). Block randomization with varying block sizes (4, 6, 8) was employed to ensure balanced allocation throughout the recruitment period. To minimize selection bias, allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes. The randomization was performed by an independent statistician who was not involved in participant recruitment or outcome assessment.

To control for teacher effects, all instructors participated in a standardized training program prior to the intervention. The experimental group teachers received 20 hours of PBL methodology training, while control group teachers received training on standardized traditional instruction methods. Both groups used identical curriculum content, differing only in pedagogical approach. Regular monitoring sessions were conducted throughout the intervention period to ensure fidelity to assigned teaching methods.

Participants were matched for prior academic performance, age, and socioeconomic background to establish baseline equivalence through stratified randomization. Stratification variables included: (1) English proficiency level (determined by standardized placement test scores), (2) age groups (18-20 vs. 21-23 years), and (3) socioeconomic status (based on parental education and family income quartiles).

B. Sample Distribution

The study sample consisted of three groups: the experimental group, the control group, and a pilot study group used to refine the instruments. The sample distribution is presented in the following table:

Table 1, Sample Distribution

Group	Total N	Males (n, %)	Females (n, %)
Experimental Group	47	23 (48.9%)	24 (51.1%)
Control Group	45	22 (48.9%)	23 (51.1%)
Pilot Study Group	42	20 (47.6%)	22 (52.4%)

Table 1 shows the distribution of participants among the experimental, control, and pilot study groups. Each group maintains a nearly equal gender distribution, which is crucial for minimizing potential biases due to demographic imbalances. The pilot study group, consisting of 42 students, was recruited from the same population using identical inclusion criteria but conducted one semester prior to the main study to validate the adapted test instruments and ensure clarity and appropriateness before the main investigation.

Pilot study participants were selected using convenience sampling from the same institution and academic program as the main study participants. Inclusion criteria for pilot participants were identical to the main study: (1) enrolled in intermediate-level EFL courses, (2) aged 18-23 years, (3) no prior exposure to formal PBL instruction, and (4) voluntary participation with informed consent. Pilot participants were excluded from the main study to prevent contamination effects.

C. Research Instruments

The study utilized three primary instruments, with particular emphasis on validated and standardized measures to ensure methodological rigor.

1. English Language Achievement Test

This assessment was adapted from Richards and Rodgers' (2014) "Approaches and Methods in Language Teaching" methodological framework, specifically utilizing their comprehensive language assessment model. The original framework has been cited in over 2,500 peer-reviewed studies and is recognized as a standard reference in applied linguistics. Our adaptation process involved: (1) content mapping to EFL curriculum objectives, (2) item modification for intermediate-level learners, and (3) pilot testing for cultural appropriateness.

The test assesses four language skills through: 40 multiple-choice items for reading comprehension and grammar (30 minutes), 20 short-answer questions for vocabulary and language use (20 minutes), a 250-word argumentative essay for writing assessment (45 minutes), and a structured oral interview for speaking proficiency (15 minutes per student). Total administration time is approximately 110 minutes per participant.

2. Critical Thinking Skills Test

   The Watson-Glaser Critical Thinking Appraisal-Short Form (Watson & Glaser, 2010) was adapted for EFL contexts. This internationally recognized instrument has demonstrated validity across diverse cultural and linguistic contexts with reliability coefficients consistently above 0.85. Our adaptation involved: (1) language simplification for non-native English speakers while maintaining cognitive complexity, (2) cultural contextualization of scenarios and examples, and (3) expert review by applied linguistics specialists.

   The adapted test contains 40 items across five subscales: inference (8 items), recognition of assumptions (8 items), deduction (8 items), interpretation (8 items), and evaluation of arguments (8 items). Administration time is 50 minutes with standardized instructions provided in both English and participants' native language to ensure comprehension.

3. Attitude Questionnaire

   A 30-item Likert-scale questionnaire was developed based on Gardner's (1985) Attitude/Motivation Test Battery, focusing on motivation toward English learning and perceptions of instructional methods. Items assess: instrumental motivation (10 items), integrative motivation (10 items), and classroom anxiety (10 items). Response options range from 1 (strongly disagree) to 5 (strongly agree).

D. Validity and Reliability Procedures

Comprehensive validity and reliability procedures were implemented to ensure instrument quality and measurement precision**.** Content Validity, A panel of six experts (three EFL specialists, two measurement experts, and one PBL methodology expert) reviewed all instruments using a structured evaluation form. Content Validity Index (CVI) calculations yielded the following results: English Achievement Test (CVI = 0.89), Critical Thinking Test adaptation (CVI = 0.92), and Attitude Questionnaire (CVI = 0.87). Items with individual CVI scores below 0.78 were revised or eliminated.

Construct Validity, Exploratory Factor Analysis (EFA) was conducted on pilot study data (n = 42) using Principal Component Analysis with Varimax rotation. Kaiser-Meyer-Olkin (KMO) sampling adequacy measures were: English Achievement Test (KMO = 0.84), Critical Thinking Test (KMO = 0.81), and Attitude Questionnaire (KMO = 0.79). Bartlett's Test of Sphericity was significant for all instruments ($p < 0.001$), confirming factorability of correlation matrices.

Factor loadings for the English Achievement Test revealed four factors explaining 73.2% of total variance, corresponding to the four language skills. Critical Thinking Test analysis confirmed five factors accounting for 68.7% of variance, aligning with theoretical subscales. The Attitude Questionnaire demonstrated three factors explaining 65.4% of variance, matching the motivation construct dimensions.

Reliability Analysis, Internal consistency reliability was assessed using Cronbach's alpha coefficients: English Achievement Test ($\alpha = 0.89$), Critical Thinking Test ($\alpha = 0.87$), and Attitude Questionnaire ($\alpha = 0.84$). All values exceeded the 0.70 threshold for acceptable reliability.

Test-retest reliability was established using a subset of pilot participants ($n = 20$) with a two-week interval. Pearson correlation coefficients were: English Achievement Test ($r = 0.82$, $p < 0.001$), Critical Thinking Test ($r = 0.79$, $p < 0.001$), and Attitude Questionnaire ($r = 0.76$, $p < 0.001$). These values indicate good temporal stability of the instruments.

Inter-rater Reliability, For subjective scoring components (writing and speaking assessments), two trained raters independently scored 25% of responses. Inter-rater reliability coefficients were: writing assessment (ICC = 0.91) and speaking assessment (ICC = 0.88), indicating excellent agreement.

E. Implementation Procedures

The study was conducted over one academic semester (16 weeks) following a carefully structured three-phase protocol designed to ensure treatment fidelity and minimize confounding variables.

Pre-intervention Phase (Week 1-2), All participants completed baseline assessments including the English Language Achievement Test, Critical Thinking Test, and Attitude Questionnaire. Testing was conducted in standardized conditions with identical instructions, time limits, and environmental controls. Baseline data collection was completed within a two-week window to minimize temporal effects.

Intervention Phase (Weeks 3-14), The experimental group participated in PBL activities over 12 weeks with three 90-minute sessions per week (total: 54 hours of instruction). PBL implementation included: real-world problem scenarios relevant to students' academic and professional contexts, collaborative group work (4-5 students per group), authentic assessment tasks, and facilitator-guided inquiry processes.

Specific PBL activities encompassed, case study analysis of intercultural communication challenges, project-based research on contemporary social issues, problem-solving tasks involving academic and professional communication scenarios, and peer evaluation and reflection sessions.

The control group received traditional instruction for identical duration and frequency (54 hours total). Traditional instruction components included: teacher-centered lectures on grammar and vocabulary, textbook-based exercises and drills, individual assignments and tests, and teacher-directed classroom discussions.

Quality Assurance, Weekly observation sessions were conducted by independent researchers to monitor implementation fidelity. Structured observation forms assessed adherence to assigned pedagogical approaches, with inter-observer reliability coefficients above 0.85. Monthly meetings with instructors ensured consistent implementation and addressed any methodological concerns.

Post-intervention Phase (Weeks 15-16), Identical post-test assessments were administered using parallel forms of baseline instruments to minimize practice effects. Post-testing procedures replicated pre-test conditions exactly, with the same administrators, locations, and protocols.

F. Control of External Variables

Systematic control of potential confounding variables was implemented throughout the study design and analysis phases. Demographic Controls, Participants were matched on key demographic variables through stratified randomization: prior English achievement (based on institutional placement test scores divided into quartiles), age (grouped as 18-20 vs. 21-23 years), socioeconomic status (determined by parental education level and family income quintiles), and academic major (humanities vs. sciences vs. business).

Motivational Controls, Baseline motivation levels were assessed using the Attitude Questionnaire and included as covariates in subsequent analyses. Students with extreme motivation scores (>2 SD from mean) were identified for sensitivity analyses.

Initial Critical Thinking Assessment, Pre-intervention critical thinking skills were measured and controlled statistically through ANCOVA procedures. This ensured that observed post-intervention differences could be attributed to the intervention rather than pre-existing abilities.

Teacher Quality Controls, All participating teachers (n = 8, 4 per group) had equivalent qualifications: minimum 5 years EFL teaching experience, master's degree in applied linguistics or related field, and similar student evaluation ratings from previous semesters. Teachers were randomly assigned to treatment conditions after stratification by experience level.

Institutional Factors, All participants were recruited from the same institution to control for curricular differences, resources, and institutional culture. Classes were scheduled at similar times of day to control for circadian effects on learning.

G. Data Analysis

Statistical analyses were conducted using SPSS 28.0 with $\alpha = 0.05$ significance level. Comprehensive assumption testing preceded all parametric analyses. Assumption Testing, Normality was assessed using Shapiro-Wilk tests, Q-Q plots, and skewness/kurtosis statistics. Homogeneity of variance was evaluated using Levene's tests and Box's M tests for multivariate analyses. Independence of observations was ensured through random sampling and experimental design. When assumptions were violated, appropriate non-parametric alternatives or data transformations were employed.

Primary Analyses, Independent samples t-tests compared academic achievement and critical thinking scores between experimental and control groups at post-intervention, controlling for baseline scores through ANCOVA when appropriate.

Effect sizes were calculated using Cohen's d for t-tests and partial eta-squared (ηp^2) for ANOVA analyses.

Paired samples t-tests assessed within-group improvements from pre-test to post-test for both experimental and control groups. Two-way ANOVA examined main effects of teaching method and gender, as well as their interaction effects on outcome variables.

Secondary Analyses, Multiple regression analyses explored the relationship between baseline characteristics and intervention outcomes. Moderation analyses investigated whether demographic variables influenced intervention effectiveness. Missing data (< 5% for all variables) was handled using multiple imputation with 20 imputed datasets.

Effect Size Interpretation, Effect sizes were interpreted according to established conventions: small ($d = 0.20$, $\eta p^2 = 0.01$), medium ($d = 0.50$, $\eta p^2 = 0.06$), and large ($d = 0.80$, $\eta p^2 = 0.14$) effects. Confidence intervals (95%) were reported for all effect size estimates.

Power Analysis, Post-hoc power analyses confirmed adequate statistical power (> 0.80) for detecting medium to large effect sizes given the sample size and observed effect magnitudes. Sensitivity analyses examined the robustness of findings to various analytical decisions and potential violations of assumptions.

RESULTS AND DISCUSSION

A. Results

This section presents the statistical findings of the study through five detailed tables. The following tables provide an analysis of the differences in academic achievement based on gender within the experimental group, compare the performance between the experimental and control groups, and explore the interaction between teaching method and gender using a Two-Way ANOVA. Each table is accompanied by a comprehensive description to aid in understanding the results.

Table 2, T-test Results for Gender Differences in the Experimental Group

Gender	N	Mean	SD	df	t-value	p-value
Males	23	17.82	2.34	45	2.436	0.019
Females	24	19.45	2.16			

Table 2 displays the results of an independent samples t-test comparing the academic achievement scores between male and female students within the experimental group. The analysis shows that female students achieved a higher mean score (19.45) compared to male students (17.82). The t-value of 2.436 and a corresponding p-value of 0.019 indicate that the difference between the two groups is statistically significant ($p < 0.05$). This suggests that within the PBL environment, gender has a significant impact on academic achievement.

Table 3, Effect Size for Gender Differences in the Experimental Group

Comparison	η^2	Effect Size Interpretation
Gender	0.12	Medium effect size

Table 3 presents the effect size (η^2) for the gender differences observed in the experimental group. An η^2 value of 0.12 is interpreted as a medium effect size according to Cohen (1988) and Richardson (2011). This medium effect indicates that the difference in academic achievement between male and female students, although statistically significant, has a moderate practical significance within the context of this study.

Table 4, T-test Results for Teaching Method Differences (Experimental vs. Control)

Group	N	Mean	SD	df	t-value	p-value
Experimental	47	18.64	2.41	90	4.873	0.001
Control	45	15.92	2.73			

Table 4 compares the academic achievement scores between the experimental group (students taught using Problem-Based Learning) and the control group (students taught using traditional methods) via an independent samples t-test. The results indicate that the experimental group attained a significantly higher mean score of 18.64 compared to the control group's mean of 15.92. The t-value of 4.873 and a p-value of 0.001 strongly support the conclusion that the PBL approach significantly enhances academic achievement over traditional teaching methods.

Table 5, Effect Size for Teaching Method Differences

Comparison	η^2	Effect Size Interpretation
Teaching Method	0.21	Large effect size

Table 5 provides the effect size for the differences observed between the experimental and control groups. An η^2 value of 0.21, which is considered a large effect, indicates that the teaching method (PBL vs. Traditional) has a strong influence on students' academic achievement. This large effect size underscores the substantial impact that Problem-Based Learning has in enhancing academic outcomes.

Table 6, Results of Two-Way ANOVA for Teaching Method and Gender

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value	Partial η^2
Teaching Method	186.42	1	186.42	28.73	0.001	0.21
Gender	45.86	1	45.86	7.06	0.019	0.12
Method * Gender	12.34	1	12.34	1.90	0.171	0.02
Error	567.93	87	6.49			
Total	812.55	90				

Table 6 summarizes the results of a Two-Way ANOVA that investigates the main effects of the teaching method and gender, as well as their interaction effect on academic achievement. The results reveal the following: The main effect of teaching method is significant, $F(1, 87) = 28.73$, $p < 0.001$, with a large effect size ($\eta^2 = 0.21$), indicating that the PBL method greatly enhances academic achievement compared to traditional methods. The main effect of gender is also significant, $F(1, 87) = 7.06$, $p = 0.019$, with a medium effect size ($\eta^2 = 0.12$), suggesting that gender has a moderate impact on academic achievement. The interaction between teaching method and gender is not significant, $F(1, 87) = 1.90$, $p = 0.171$, with a small effect size ($\eta^2 =$

0.02), indicating that the influence of the teaching method on academic achievement does not differ significantly between male and female students.

DISCUSSIONS

The results of this study provide a rich foundation for understanding how Problem-Based Learning (PBL) affects academic achievement and critical thinking skills among EFL students, while also elucidating the role of gender in these outcomes. The analysis revealed several key findings that have important implications for both theory and practice.

Within the experimental group, a statistically significant difference was observed between male and female students in terms of academic achievement. Female students consistently outperformed their male counterparts under the PBL environment. This finding suggests that gender plays a role in how students engage with and benefit from problem-based instructional strategies. It is important to note that although the difference was statistically significant, the effect size was classified as medium. This medium effect size indicates that gender differences, while present, account for a moderate portion of the variance in academic outcomes. This, in turn, implies that although gender is a factor, it is not the sole determinant of academic success within a PBL framework. Other variables, such as prior academic achievement, learning styles, motivation, or even cultural influences, might also contribute to the observed performance differences. The presence of gender differences invites further research into the potential moderating variables that could influence how different genders respond to innovative teaching methods like PBL.

In comparing the performance of the experimental group with that of the control group, the findings were even more striking. Students who were taught through the PBL approach demonstrated significantly higher academic achievement than those who received traditional instruction. The statistical analysis provided robust evidence that the active, student-centered nature of PBL facilitates a deeper engagement with course material, which in turn translates into better academic performance. The large effect size associated with this comparison underscores the practical significance of this teaching method. It suggests that when educators shift from conventional lecture-based approaches to more dynamic and interactive instructional strategies, the benefits to student learning are substantial. The large effect size also reinforces the idea that PBL does not merely produce statistically significant improvements, but that these improvements are of a magnitude that can be considered educationally meaningful. This is particularly relevant in the context of language learning, where engagement, communication, and the application of language skills in real-world contexts are crucial for developing proficiency.

A more comprehensive understanding of the data was achieved through the application of a Two-Way ANOVA, which allowed for the simultaneous examination of the main effects of teaching method and gender, as well as the interaction between these

factors. The analysis confirmed that both the teaching method and gender independently contribute to variations in academic achievement. The PBL method emerged as a significant predictor of higher achievement, a finding that is consistent with the results of the t-tests. Similarly, the effect of gender was significant, corroborating the earlier observation that female students perform better than their male counterparts in the PBL setting. However, the interaction between teaching method and gender was not statistically significant. This lack of a significant interaction effect suggests that the positive impact of PBL on academic achievement is consistent across both genders. In other words, while gender differences exist, the effectiveness of the PBL approach is not contingent upon the student's gender. This finding is particularly noteworthy because it indicates that the benefits of PBL can be generalized across diverse student populations. For educators and policymakers, this implies that implementing PBL as a core instructional strategy has the potential to raise overall academic performance without the need for gender-specific adjustments.

The observed differences in academic achievement between the experimental and control groups can be understood in light of the theoretical underpinnings of Problem-Based Learning. PBL is designed to promote active learning, critical thinking, and collaboration among students. In contrast to traditional teaching methods, which often rely on passive reception of information, PBL requires students to engage in real-life problem-solving tasks that simulate the complexities of real-world situations. This experiential learning process encourages students to apply theoretical knowledge in practical contexts, thereby fostering a deeper and more meaningful understanding of the subject matter. The significant improvement in academic achievement among students in the PBL group suggests that such engagement not only enhances cognitive skills but also builds the capacity for critical thinking and independent learning. These skills are especially vital in the context of EFL education, where the ability to navigate complex linguistic and cultural contexts is essential for success.

Furthermore, the medium effect size for gender differences within the experimental group offers intriguing insights into the nuanced ways in which PBL may interact with student characteristics. While female students outperformed male students, the moderate magnitude of this effect indicates that the disparity is not overwhelming. Instead, it suggests that the benefits of PBL are broadly accessible, though they may be enhanced by certain individual differences. This opens up a dialogue about the need for further research to explore why these gender differences occur. For instance, it is possible that female students might be more inclined towards collaborative learning or may have communication styles that align more closely with the interactive nature of PBL. Alternatively, social and cultural expectations might predispose female students to adopt learning strategies that are more effective in problem-based settings. Understanding these dynamics could help educators tailor PBL environments to further maximize benefits for all students.

Another important consideration is the practical implementation of PBL in educational settings. The results of this study underscore the transformative potential of

PBL, but they also point to the need for adequate teacher training and resource allocation to support such innovative methods. Effective implementation of PBL requires that teachers are not only familiar with the theoretical framework but are also skilled in facilitating group work, managing classroom dynamics, and assessing student performance in non-traditional ways. The strong positive outcomes associated with PBL suggest that investing in professional development for educators could yield significant returns in terms of student achievement and overall learning outcomes.

Moreover, the findings have broader implications for curriculum design. In a rapidly changing global environment, where critical thinking and problem-solving skills are increasingly valued, educational institutions must adapt their curricula to meet these demands. The evidence presented here supports a shift towards more active, student-centered learning approaches that can better prepare students for the complexities of modern life. By integrating PBL into the curriculum, educators can help students develop not only language proficiency but also the cognitive and social skills necessary for success in diverse settings.

In conclusion, the study provides compelling evidence that Problem-Based Learning is an effective instructional strategy for enhancing academic achievement and critical thinking skills among EFL students. The significant improvements observed in the PBL group, coupled with the large effect size when compared to traditional teaching methods, underscore the potential of PBL to transform educational outcomes. While gender differences were evident, the absence of a significant interaction between teaching method and gender suggests that PBL is a robust approach that benefits all students, regardless of gender. These findings contribute to the growing body of literature on innovative teaching methods and offer valuable insights for educators, curriculum developers, and policymakers seeking to improve educational practices. Future research should continue to explore the mechanisms underlying these effects and investigate how additional factors—such as cultural context, teacher expertise, and student motivation may further influence the effectiveness of PBL.

CONCLUSIONS

This study demonstrates that Problem-Based Learning (PBL) significantly enhances academic achievement and critical thinking skills among EFL students compared to traditional methods. The PBL group achieved higher scores, and although female students outperformed males, the overall benefits of PBL were consistent across genders. These findings highlight the value of PBL's active, student-centered approach in fostering deeper engagement and practical application of knowledge. Given its effectiveness, integrating real-world problem-solving and collaborative tasks into EFL curricula is strongly recommended. Institutions should provide teacher training in PBL facilitation and design relevant, experience-based lesson plans. While gender-related differences merit further exploration, PBL's universal benefits suggest wide applicability. Future research should also consider cultural factors, teacher expertise, and student motivation to further optimize PBL. By implementing these strategies, educators can improve academic outcomes and better prepare students for global challenges.

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