



Inquiry-Based Learning in Phonetics and Phonology: Promotion of Critical Thinking Skills in an EFL Higher Education Context

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This study investigates the effectiveness of Inquiry-Based Learning (IBL) strategies in enhancing Critical Thinking (CT) skills and academic performance in the study of English Phonetics and Phonology among students at a Spanish Higher Education Institution. A total of 54 students from a Bachelor's Degree in Primary Education were divided into control and experimental groups to compare traditional teaching methods with IBL methodologies. Results indicated that students in the IBL group showed significant improvements in academic performance, critical thinking skills, and long-term retention of complex subject matter compared to those in the control group. Furthermore, the study highlights that the IBL approach not only facilitates the immediate educational outcomes but also equips students with essential cognitive tools for real-world problem-solving. This research underscores the pedagogical value of learner-centered models in the study of English Phonetics and Phonology, promoting active engagement and systematic thinking. The findings contribute to the growing body of literature advocating for the integration of active learning strategies across various disciplines and educational contexts.

Keywords: inquiry-based learning (IBL), critical thinking, English language teaching (ELT), long-term retention, learner-centered models, EFL

INTRODUCTION

Understanding a knowledge of phonetics and phonology in a second language has become a fundamental aspect in the education of professionals involved in foreign language instruction. Proficiency in these two sciences allows L2 teachers to develop practical models derived from theoretical insights, facilitating the enhancement of oral communication and pronunciation—essential skills in language teaching (Bauer, 2024). However, an examination of the future language classroom reveals that phonetic and phonological subjects present significant challenges for aspiring educators. Unlike more tangible subjects, these fields are filled with abstract concepts, increasing the likelihood of misinterpretation and differing understandings among students (Henderson et al., 2012). To concretize such abstract topics, it is imperative to employ methods that foster active student engagement, contextualize theoretical concepts within everyday

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scenarios, and enable students to undertake pseudo-investigative experiences related to the subject matter.

In the 21st-century educational landscape, students must cultivate various competencies, among which critical thinking stands out as crucial. Vital for problem-solving in everyday contexts, critical thinking demands early cultivation in the educational journey (Dwyer et al., 2014). Nurturing students' critical thinking skills requires innovative, creative, and stimulating pedagogical approaches, alongside educators' adeptness in selecting strategies aligned with the traits of contemporary learners. However, existing evidence indicates a gap between students' critical thinking proficiency and educational expectations, underscoring inconsistencies in instructional methodologies and learning outcomes (Halpern, 1999; Kuhn, 1999).

Despite recent reflections on the subject, students' critical thinking skills are not being attentively addressed, particularly in higher education. This discrepancy is evident in the planning, execution, and assessment of specialized courses, which have not sufficiently prioritized the enhancement of students' critical thinking abilities (Liyanage et al., 2021). The teaching of critical thinking skills in higher education systems, such as the Spanish one, faces several obstacles, including teacher-centered learning and limited opportunities for students to engage in high-order thinking (Cáceres et al., 2020). Additionally, two factors hinder students in the critical thinking process: teachers' focus on completing curriculum material due to broad material objectives and learning activities that predominantly consist of teacher-led verbal dissemination, leading to decreased student motivation and passive participation (Choy et al., 2009). This aligns with Gregory et al.'s (2013) assertion that students' cognitive limitations in the classroom stem not solely from their abilities but also from pedagogical strategies. Overcoming these challenges necessitates the development of effective strategies to optimize learning outcomes.

One potential solution lies in the integration of Inquiry-based Learning (IBL) strategies into the educational framework. This approach not only shifts the educational focus from teacher-centeredness to learner-centeredness but also enhances student engagement and autonomy. IBL requires students to actively engage in systematic, critical, logical, and analytical thinking to explore and resolve diverse problems independently (Asy'ari et al., 2019; Wiemer, 2019). The depth of student involvement in IBL activities directly influences their learning experiences, thereby shaping their cognitive processes and motivating their learning endeavors. Consequently, embracing an IBL framework holds promise for nurturing critical thinking skills essential for navigating 21st-century challenges and demands (Duran & Dökme, 2016; Sasanti et al., 2024).

Given the potential impact of IBL strategies on fostering critical thinking, this study aims to analyze this relationship using a pseudo-research training program that focused on the subject of English Phonetics and Phonology. The program targets English teacher trainees within a Spanish Higher Education Institution, aiming to illuminate the efficacy of IBL in enhancing critical thinking in this complex domain.

Literature Review

The landscape of English Language Teaching (ELT) is currently undergoing a significant transformation, wherein critical thinking skills are increasingly acknowledged as essential for the comprehensive development of English as a Foreign Language (EFL) learners, particularly within Higher Education settings. This evolution is driven by the recognition that critical thinking equips learners with a range of skills vital for both academic success and life beyond the classroom. As tertiary education continues to evolve, there is a growing emphasis not only on imparting linguistic knowledge but also on fostering the application of such knowledge in addressing complex issues (Huber & Kuncel, 2016). Within the realm of ELT, the consistent utilization of critical thinking skills empowers learners to become discerning decision-makers, adept problem-solvers, and independent scholars (Andrews, 2015; Warsah et al., 2021). Jannah (2021) further asserts that the integration of real-life events into learning significantly promotes the development of critical thinking skills, playing a pivotal role in preparing students to navigate the challenges of the modern world. Wijaya (2023) highlights that critical thinking skills not only enable EFL learners to achieve more fruitful language learning outcomes but also transform them into lifelong knowledge seekers, capable of adapting to various academic and real-life situations.

Critical thinking, initially conceptualized by Lewis and Smith (1993) and expanded upon by Paul and Elder (2001), encompasses intellectual discipline involving the analysis, synthesis, and evaluation of information within a dialogic framework characterized by interaction and internalization (Kuhn, 2019). Paul et al. (1990) classified critical thinking into three main categories: affective strategies, cognitive strategies (macro skills), and cognitive strategies (micro skills), delineating thirty-five distinct critical thinking skills and elucidating the principles underlying each strategy. While affective strategies aim to foster independent thinking, macro skills involve organizing various basic skills into an extended chain of thought required for effective thinking. Micro skills encompass the ability to identify constituent parts without disregarding the whole and to interpret expressions within the broader context. In the context of higher education, which aims to cultivate independent thinkers and proficient researchers, the intersection of critical thinking and scholarly-oriented abilities assumes particular significance (Ennis, 2018).

The cultivation of critical thinking skills among students is a primary objective of higher education, as evidenced by numerous studies investigating interventions designed to enhance these skills within university curricula (DeWaele, 2015). Critical engagement with content, a hallmark of critical thinking, extends beyond mere mastery of disciplinary knowledge to its application in inquiry-based scenarios. This sentiment is echoed by the findings of Arum and Roksa (2010), who underscore the gains in critical thinking skills among college students, indicating a need for more targeted educational strategies to fortify these capabilities.

Furthermore, the interplay between critical thinking and problem-solving skills holds particular relevance for graduate-level EFL learners, who must apply these competencies in their academic and future professional pursuits. Yang and Gamble

(2013) discovered that learners exposed to critical thinking exercises outperformed peers engaged in teacher-centric methods. Kabeel and Eisa (2016) propose seven principles for fostering critical thinking in ELT practices, including analyticity, open-mindedness, and maturity, emphasizing their role in shaping lifelong learners with a profound appreciation for diverse perspectives. The capacity to question, evaluate, and devise solutions to language-related challenges is integral to their success as future scholars and professionals (Yang & Gamble, 2013).

The correlation between critical thinking and language proficiency, coupled with the interaction of problem-solving strategies, is substantiated by studies exploring the nexus within this framework. Elevated levels of critical thinking have been associated with advanced competencies in reading and writing, suggesting that the evaluative component of critical thinking facilitates language comprehension and production (Din, 2020; Liaw, 2007).

Despite its significance, the definition and pedagogical integration of critical thinking remain subjects of contention. Although it is acknowledged that problem-oriented techniques are effective in nurturing the ability to pose and address critical questions (Browne & Keeley, 2007), translating this conceptual understanding into teaching practices remains challenging, with no consensus on the optimal approach. Ennis (2018) and others (Heidari, 2020; Larsson, 2017) have made concerted efforts to integrate critical thinking into education and ELT; however, the literature does not identify any single approach as universally effective in academic settings (Cáceres et al., 2020; Kennedy et al., 1991). Factors such as the affective component are equally crucial, necessitating dispositions such as open-mindedness and a willingness to seek information (Ennis, 2018; Moghadam et al., 2021). Additionally, research indicates a reciprocal relationship between critical thinking and language proficiency, suggesting that critical thinking and second language learning may develop synergistically (Din, 2020). Apart from that, in spite of the extensive research on phonetics and phonology, IBL, and critical thinking strategies, there is a scarcity of studies examining the intersection of these fields. The potential benefits of integrating IBL and critical thinking strategies into phonetics and phonology instruction remain largely unexplored.

In conclusion, the literature suggests that critical thinking, a multifaceted construct influenced by cognitive and affective dimensions, may be fundamental to the integration of second language teaching and related sciences in higher education curricula. The incorporation of critical thinking and inquiry-based techniques into tertiary education has shown promise in preparing students to meet the demands of the 21st century. Effective pedagogical strategies, a supportive learning environment, and a reorientation of traditional language instruction towards fostering critical thinking are seen as crucial for cultivating proficient language learners who are also critical thinkers (Abrami et al., 2015).

METHOD

Research Questions

The problem statement of the study can be articulated as follows:

What are the effects of traditional teaching methods and the Inquiry-based Learning approach on the critical thinking skills, academic performance, and long-term retention levels of students studying English Phonetics and Phonology in Higher Education?

The research sub-problems are outlined as follows:

1. Is there a significant disparity in academic performance between students in the control group and those in the experimental group studying English Phonetics and Phonology?
2. Is there a significant contrast in the critical thinking skills of students between the control group and the experimental group concerning the subject of English Phonetics and Phonology?
3. Are there notable differences in the long-term retention levels of academic performance between students in the control group and those in the experimental group?
4. Is there a substantial variation in the long-term retention levels of critical thinking skills between students in the control group and the experimental group regarding the subject of English Phonetics and Phonology?

Research Assumptions

1. It is assumed that during the research, students in both the experimental and control groups provided truthful responses to the data collection instruments.
2. It is assumed that the effects of uncontrolled variables in both the experimental and control groups were equivalent.
3. It is assumed that efforts were made to minimize interaction between students in the experimental and control groups regarding the research topic.
4. It is assumed that the experimental application was administered consistently by the researcher to both the experimental and control groups.
5. It is assumed that the activities conducted in the experimental group were not replicated in the control group by the researcher.

Research Model

This study employed the unequaled control group model, a quasi-experimental research model. A distinctive feature of this model is that subjects are not allocated to groups through random assignment; however, efforts are made to ensure that participants are as comparable as possible (Fowler, 2002). It was ensured that the cognitive levels of students in the experimental and control groups were approximately equivalent. Before and after the experimental intervention, the difference between the two groups was assessed by administering the Application of Basic Theoretical Phonetics and Phonology (ABTFPP) performance test and the Critical Thinking Skills Assessment (CTSA) measurement tool to both groups. Additionally, 24 weeks after the conclusion of the intervention, students underwent a retention test using the ABTFPP test and the CTSA measurement tool.

Independent Variables

The independent variables in this study are the teaching methods utilized, namely the Inquiry-Based Learning (IBL) program and traditional teaching methods.

Study Group

The study comprised 54 students enrolled in the English Phonetics and Phonology course within the Bachelor's Degree in Primary Education (English as a Foreign Language major) at the Faculty of Education of a university in Salamanca (Spain) during the autumn semester of the academic year 2022-23. The participants included 19 males and 35 females, all aged between 21 and 29 years. These students possessed an upper-intermediate level of English proficiency, having completed various courses in English grammar and linguistics prior to participating in this study. The experimental and control groups were formed based on students' grades in the English Language I and English Morphosyntax courses, with efforts made to ensure comparable average performance levels between groups. Before the implementation commenced, students in the experimental group were divided into three subgroups of eight students each, taking into account their performance levels and ensuring heterogeneity among the subgroups.

Data Collection Instruments

Application of the Basic Theoretical Foundations of Phonetics and Phonology (ABTFPP) Achievement Test

The ABTFPP performance test was developed by the researcher to assess students' academic performance in relation to the units "Application of Phonetic Theory," "Foundations of English Phonology," and "Didactics of Pronunciation in the Primary Education Classroom." The test comprised 40 multiple-choice questions crafted in alignment with the course aims and objectives, addressing topics students typically found challenging in the syllabus. To ensure content validity, two subject specialist teachers reviewed the test and suggested corrections to the questions based on their expertise. A pilot study of the test was conducted with 80 students in the 2nd year of the Bachelor's Degree in English Studies at the Faculty of Philology. An item analysis was performed on the responses of 69 students, revealing a low discrimination index for five questions (≤ 0.20). These questions were subsequently excluded, and the reliability of the remaining 35-question test (KR-35) was calculated to be 0.74. The distribution of the questions according to Bloom's taxonomy is presented in Table 1, indicating that five questions correspond to the knowledge and comprehension level, seven to the analytical level, thirteen to the application level, four to the evaluative level, and six to the creative level.

Table 1
ABTFPP questions distributed according to Bloom's Taxonomy

	Understanding	Analyzing	Applying	Evaluating	Creating
Application of phonetic theory	Q1, Q2	Q3	Q4, Q6, Q9	Q5	Q7, Q8
Foundations of English phonology	Q10, Q12	Q11, Q13, Q14	Q15, Q16, Q17, Q18	Q20	Q19
Didactics of pronunciation in the Primary Education classroom	Q24	Q21, Q22, Q30	Q25, Q26, Q27, Q28, Q31, Q34	Q32, Q33	Q23, Q29, Q35

Evaluation of the Critical Thinking Skills Assessment (CTSA) tool

During the development of the critical thinking skills assessment tool, 22 skills were chosen from the 35 critical thinking skills outlined by Paul et al. (1990), aligning with the learning objectives of the units “Application of Phonetic Theory”, “Foundations of Applied English Phonology”, and “Didactics of Pronunciation in the Primary Classroom”. A total of 30 questions were formulated to assess these skills. The distribution of questions within the measurement tool, categorized by critical thinking skills, is detailed in Table 2. This instrument was administered both before and after the experimental intervention to evaluate students’ critical thinking abilities related to the subject matter.

Table 2

CTSA questions classified according to the critical thinking skills of Paul et al. (1990)

Critical Thinking Skills	CTSA question #
S-1. Thinking independently	Q1
S-9. Developing confidence in reason	Q6
S-10. Refining generalizations and avoiding oversimplifications	Q7
S-11. Comparing analogous situations: transferring insights to new contexts	Q2, Q27
S-12. Developing one’s perspective: creating or exploring beliefs, arguments, or theories	Q11, Q26
S-13. Clarifying issues, conclusions, or beliefs	Q15
S-14. Clarifying and analyzing the meanings of words or phrases	Q3
S-17. Questioning deeply: raising and pursuing root or significant questions	Q19, Q24
S-18. Analyzing or evaluating arguments, interpretations, beliefs or theories	Q9
S-19. Generating or assessing solutions	Q14, Q28
S-20. Analyzing or evaluating actions or policies	Q12
S-21. Reading critically: clarifying or critiquing texts	Q8
S-23. Making interdisciplinary connections	Q18
S-25. Reasoning dialogically: comparing perspectives, interpretations, or theories	Q4
S-26. Reasoning dialectically: evaluating perspectives, interpretations, or theories	Q20, Q25
S-27. Comparing and contrasting ideals with actual practice	Q10, Q23
S-29. Noting significant similarities and differences	Q17
S-30. Examining or evaluating assumptions	Q22
S-31. Distinguishing relevant from irrelevant facts	Q5
S-32. Making plausible inferences, predictions, or interpretations	Q13, Q29
S-33. Evaluating evidence and alleged facts	Q21
S-35. Exploring implications and consequences	Q16, Q30

To ensure the content validity of the CTSA, input from two trainers was sought, and adjustments to the questions were made based on their recommendations. Subsequently, to assess the clarity and difficulty level of the questions, the CTSA was administered to 60 3rd-year students pursuing a Bachelor’s Degree in Primary Education. Among them, responses from 57 students were evaluated for the measurement tool’s reliability using the *Split-half test reliability* method. By considering the correlation between the two halves of the measurement tool, its reliability was computed as 0.77 using the Spearman Brown formula.

Experimental Procedures

Pilot Study of the Inquiry-based Learning Approach

The pilot study of the worksheets designed for teaching the applied foundations of Phonetics and Phonology with an Inquiry-based Learning (IBL) program was conducted with students enrolled in the Bachelor's Degree in English Studies at the Faculty of Philology. Learning outcomes and subject duration were predetermined, and scenarios meeting the basic requirements of IBL were prepared. These scenarios, serving as guiding tools, incorporated real-life events. Before the implementation, students were briefed on the IBL program. Forty-eight students were selected and divided into four groups of 12, ensuring an even distribution of successful, unsuccessful, and moderately successful students from their previous curriculum. Students were provided with worksheets to analyze the problem, propose solutions, and conduct research if needed. Information gathered was shared, discussed, and evaluated within the group, culminating in problem resolution. This process lasted 8 teaching hours per group, forming the basis for the four IBL didactic units implemented in the experimental group.

Procedures Conducted in the Pilot Group

Based on the findings from the pilot study, necessary adjustments were made to the worksheets and implementation process. The actual implementation followed the same procedure as the pilot study, comprising 10 sessions of 2 teaching hours each, along with pretesting, post testing, and briefing sessions, totaling 24 teaching hours.

Procedures Conducted in the Experimental Group

The intervention for the experimental group was designed using Inquiry-Based Learning (IBL) principles, focusing on engaging students in active exploration and problem-solving activities related to English Phonetics and Phonology. The program consisted of ten sessions, each lasting two teaching hours, over the course of the semester. Each session began with a brief introduction to the topic, followed by group-based activities where students were presented with real-world problems and scenarios requiring the application of phonetic and phonological concepts. Students were encouraged to formulate hypotheses, conduct analyses, and present their findings to the class. The instructor facilitated the sessions by guiding discussions, providing feedback, and encouraging critical reflection on the learning process. Additionally, students had access to supplementary materials and resources to support their inquiry and research.

Procedures Conducted in the Control Group

Teaching in the control group focused on lectures, question-answer sessions, and problem-solving activities, representing traditional teaching methods. Lectures, predominantly teacher-centered, were employed, while the question-answer method facilitated student engagement and feedback. The application in the control group spanned 24 teaching hours, including 20 hours of traditional teaching methods and pre- and posttest administrations.

Data Analysis of the Critical Thinking Skills Assessment (CTSA) Tool Evaluation

For evaluating the CTSA tool, a graded scoring key was devised to assess various responses, as depicted in Table 3.

Table 3
CTSA tool graded scoring key

Score	Response
0 marks	Leaving the question blank or answering incorrectly
1 mark	Inadequate response to the question
2 marks	Answering the question partially correctly
3 marks	Partially correct answer to the question with explanation
4 marks	Complete answer to the question

After completing the evaluation of the measurement instruments, the researcher re-evaluated the tests after a specific period, yielding a Pearson correlation coefficient of 0.962 between the two evaluations. This high correlation indicated internal consistency in scoring. Additionally, to ensure analysis validity, interviews were conducted with 16 randomly selected students, equally distributed between the experimental and control groups.

Analysis of the Data Obtained During the Implementation Process

Normal distribution of the obtained data was assessed using the Shapiro-Wilk test. For comparing two unrelated samples, the Mann-Whitney U-test was utilized if the data did not exhibit normal distribution, whereas the *t*-test for unrelated samples was applied if normal distribution was observed. Furthermore, an analysis of covariance (ANCOVA) was conducted, a technique combining ANOVA and regression, under the assumption of meeting both approaches' assumptions, including equality of regression slopes within groups, a linear relationship between the dependent variable and the covariate, normal distribution, homogeneity of group variances, and independence of compared groups. To determine the independent variable's effectiveness on the dependent variable, η^2 was employed, with values interpreted as small for 0.01, medium for 0.06, and large for 0.14 (Stevens, 1992).

FINDINGS

Findings Regarding the Application of the Basic Theoretical Foundations of Phonetics and Phonology (ABTFPP) Achievement Test

The ABTFPP, designed to assess the academic achievement of students in the control group (using traditional teaching methods) and the experimental group (utilizing IBL strategies), was administered as a pretest before the experimental application, as a posttest after the application, and as a long-term retention test 24 weeks post-application. Mean scores of the pretest, posttest, and retention test for both control and experimental groups are depicted in Figure 1.

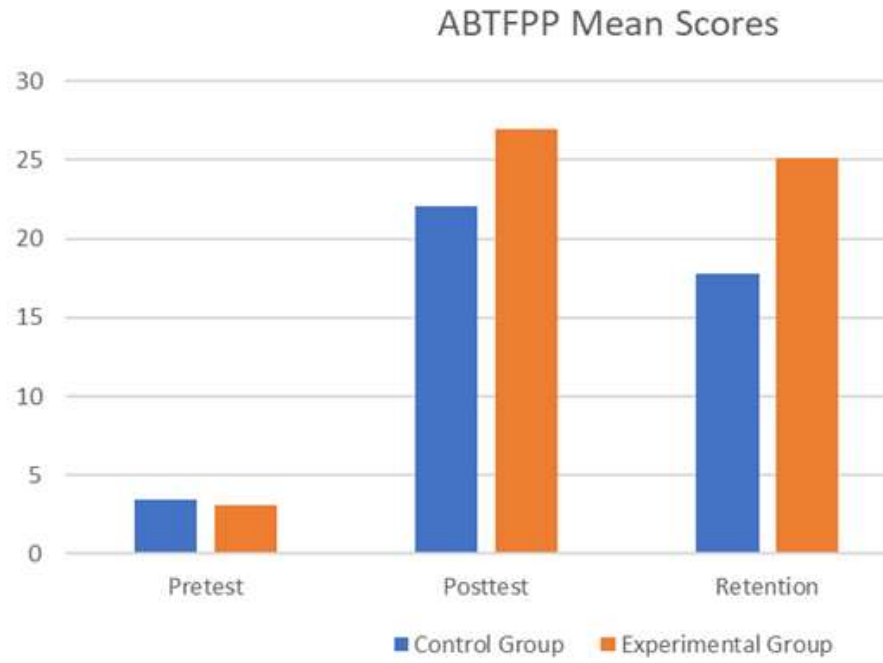


Figure 1
Pretest, posttest and retention test ABTFPP mean scores

Findings Related to the Evaluation of Critical Thinking Skills (CTSA) Tool

The CTSA, crafted to assess the critical thinking skills of students in both the experimental and control groups, was administered as a pretest before the experimental application, a posttest after the application, and a long-term retention test 24 weeks following the application. Figure 2 illustrates the averages of the pretest, posttest, and retention test scores for both the control and experimental groups.

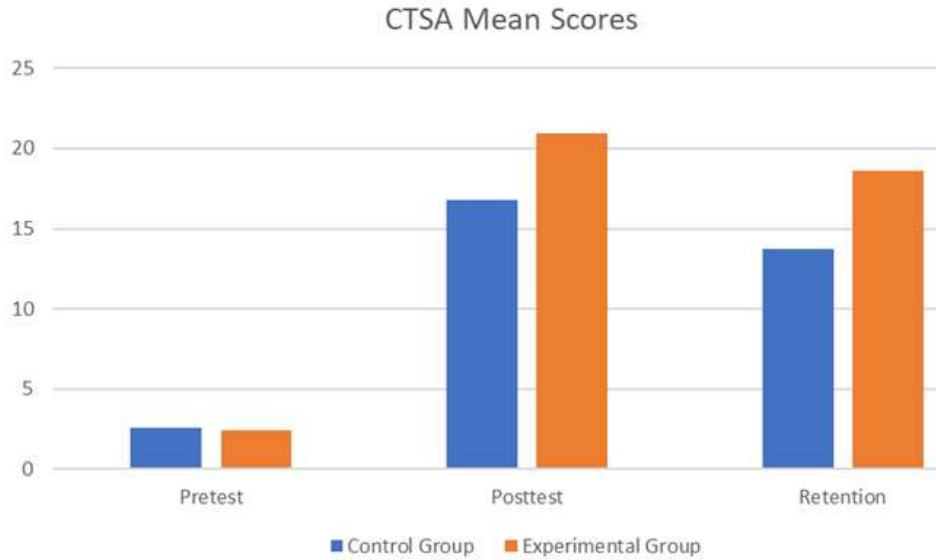


Figure 2
Pretest, posttest and retention test CTSA mean scores

Findings Related to the First Sub-problem

The first sub-problem of the study examines whether there exists a significant difference between the academic performance of learners in the control group and the experimental group regarding the application of phonetic and phonological bases of a second language. Initially, the Mann-Whitney U-test was employed to discern any disparity between the scores of learners in both groups. Table 4 displays the data obtained from this analysis. Notably, the pretest scores of the experimental group exhibited a normal distribution ($p=0.773$).

Table 4
Mann-Whitney U-test results of control and experimental group students' ABTFPP pretest scores

Group	n	Mean Rank	Sum of Ranks	U	p
Control	27	26.91	726,50	348,50	0.773
Experimental	27	28.09	758,50		

According to Table 4, the discrepancy between the pretest performance scores of students in the control group and the experimental group did not reach statistical significance [$U=348.505$, $p>0.05$]. Subsequently, an analysis of covariance (ANCOVA) was conducted to ascertain any variance between the posttest scores of both groups. The ANCOVA assumptions, including normal distribution within groups (experimental group $p=0.068$; control group $p=0.375$), homogeneity of variance ($F=0.081$, $p>0.05$), and equality of regression slopes ($F=0.182$, $p>0.05$), were verified, confirming adherence to ANCOVA prerequisites. Furthermore, significant associations between

posttest and pretest scores were observed in both the experimental ($r=0.038$, $p>0.05$) and control ($r=0.166$, $p>0.05$) groups, satisfying another ANCOVA assumption (Rutherford, 2001).

To control for the treatment effect of the pretest variable on the posttest, the ABTFPP pretest averages were held constant in the analysis. Table 5 presents the adjusted posttest mean scores of the control and experimental groups based on the pretest scores, while Table 6 outlines the results of the ANCOVA for the ABTFPP.

Table 5

Control and experimental group ABTFPP pretest, posttest and corrected posttest mean scores

Test	Group	Mean
Pretest	Control	3.48
	Experimental	3.04
Posttest	Control	21.78
	Experimental	26.81
Corrected Posttest	Control	18.30
	Experimental	23.78

Table 6

ANCOVA results related to ABTFPP tests

Variation	Sum of Squares	df	Mean Square	F	p
Group	295.940	1	295.940	11.870	0.001
Pretest	5.322	1	5.322	0.213	0.646
Error	1271.493	51	24.931		

Based on the ANCOVA analysis of covariance, a notable discrepancy was observed between the posttest scores of students in the control group and those in the experimental group regarding the achievement test on phonetic and phonological basics ($F=11.870$; $p<0.05$). Consequently, it was established that the experimental group exhibited enhanced achievement in the application of the theoretical bases of phonetics and phonology compared to the control group throughout the implementation process.

Findings Related to the Second Sub-problem

Moving to the second sub-problem, which addresses the variance in critical thinking skills between learners in the control and experimental groups concerning the application of phonetic and phonological foundations of a second language, an initial Mann Whitney U-test was conducted to evaluate any differences in pretest scores between the groups. The results indicated a normal distribution ($p=0.577$), signifying similar levels of critical thinking skills in both groups before the implementation process.

Subsequently, an ANCOVA analysis was carried out to ascertain differences in posttest scores between the control and experimental groups. Examination of ANCOVA assumptions, including normal distribution within groups (experimental group $p=0.295$; control group $p=0.085$), homogeneity of variance ($F=3.083$, $p>0.05$), and equality of regression slopes ($F=3.56$, $p>0.05$), confirmed adherence to ANCOVA requirements.

Additionally, a non-significant correlation was found between CTSA posttest scores and CTSA pretest scores in both the experimental ($r=0.371$, $p>0.05$) and control ($r=0.112$, $p>0.05$) groups.

To assess differences in posttest scores between the control and experimental groups, an ANCOVA analysis was performed, controlling for CTSA pretest means. Table 7 displays the adjusted mean posttest scores of both groups based on CTSA pretest scores, while Table 8 presents the results of the ANCOVA for the CTSA.

Table 7

Control and experimental group CTSA pretest, posttest and corrected posttest mean scores

Test	Group	Mean
Pretest	Control	2.55
	Experimental	2.42
Posttest	Control	16.77
	Experimental	20.96
Corrected Posttest	Control	15.42
	Experimental	18.46

Table 8

ANCOVA results related to CTSA tests

Variation	Sum of Ranks	df	Mean square	F	p
Group	14.983	1	14.983	1.119	0.295
Pretest	41.273	1	41.273	3.083	0.085
Error	682.653	51			

According to the ANCOVA analysis, a significant disparity exists between the scores attained by students in the control group and those in the experimental group in the CTSA (Critical Thinking Skills Assessment) posttest ($F=1.119$; $p<0.05$). The implementation of the IBL program demonstrates a substantial effect on this distinction ($\eta^2= 0.203$). This suggests that approximately 20% of the variance observed in the CTSA posttest scores can be ascribed to the adoption of the IBL approach.

Moreover, a subset of students from both the experimental and control groups underwent interviews regarding their responses to the ABTFPP questions, following which their scores were re-evaluated. The methodology proposed by Miles and Huberman (1994) was employed to ascertain the agreement percentage between the initially assigned scores and those post-interviews. With the total number of agreements divided by the total number of assessments, a compatibility rate of 98.6% was determined.

Findings Related to the Third Sub-problem

The third sub-problem of the study sought to investigate whether a significant difference exists between the long-term retention levels of academic achievement among learners in the control group compared to those in the experimental group, particularly concerning the application of phonetic and phonological theoretical bases in a second language. Twenty-four weeks subsequent to the conclusion of the

experimental application, the ABTFPP was readministered to both control and experimental groups to gauge their levels of academic achievement retention. A Mann Whitney U-test analysis was conducted to discern if there was a substantial discrepancy between the mean scores of academic achievement retention levels among students in the control and experimental groups. The results, as depicted in Table 9, revealed that while the scores of the experimental group exhibited a normal distribution ($p=0.143$), the Mann Whitney U-test was employed due to the abnormal distribution of scores within the control group ($p=0.037$).

Table 9

Mann Whitney U-test results of academic achievement long-term retention scores of control and experimental groups

Group	n	Mean Rank	Sum of Ranks	U	p
Control	27	18.89	510.00	132.000	0.001
Experimental	27	36.11	975.00		

According to Table 9, there is no statistically significant difference observed between the scores representing the retention levels of academic performance among students in the control group versus those in the experimental group [$U=132.000$, $p<0.05$]. This suggests that the application of the IBL approach does not significantly impact students' retention of academic performance when compared to the traditional teaching method.

Findings Related to the Fourth Sub-problem

The fourth sub-problem of the study aimed to explore whether there exists a significant disparity between the retention levels of critical thinking skills among learners in the control group versus those in the experimental group, particularly concerning the application of phonetic and phonological fundamentals in a second language. Twenty-four weeks following the conclusion of the experimental application, both the control and experimental groups underwent a retesting session with the CTSA to evaluate their retention levels of critical thinking skills. To ascertain if there was a notable difference between the mean scores representing the retention level of critical thinking skills in the control and experimental groups, a *t*-test analysis for unrelated measures was conducted. The outcomes are outlined in Table 10. Given that the scores of both the experimental ($p=0.214$) and control ($p=0.239$) groups exhibited a normal distribution, the *t*-test was deemed appropriate for analysis.

Table 10

t-test results between means of CT skills long-term retention scores of control and experimental groups

Group	n	Mean Rank	ss	sd	t	p	η^2
Control	27	15.81	16.62	4.00	2.712	0.787	0.124
Experimental	27	18.59	12.74	3.51			

As per Table 10, a statistically significant difference is evident between the mean scores representing the retention levels of critical thinking skills among students in the control group and those in the experimental group [$t=2.712$, $p<0.05$]. The implementation of an IBL program notably contributes to this disparity ($\eta^2=0.124$), indicating that over 10%

of the variance in the retention level scores of critical thinking skills can be attributed to the utilization of IBL teaching methodologies.

DISCUSSION

The application of an Inquiry-based Learning program in teaching English phonetics and phonology at a Spanish Higher Education Institution yielded promising results, indicating its effectiveness in enhancing both student achievement and critical thinking skills. Our study revealed significant improvements in academic performance among students engaged in an IBL approach compared to those exposed to traditional teaching methods. The adoption of IBL strategies facilitated a deeper understanding of abstract concepts, as evidenced by the notable increase in posttest scores, with approximately 20% of the variance attributable to the IBL approach.

These findings are consistent with prior research across various subject areas, demonstrating the efficacy of IBL in promoting learning outcomes and critical thinking skills (Boukhobza, 2016; Ermawati & Pammu, 2017; Fogleman et al., 2011; Minner et al., 2010; Safkolam et al., 2024; Trundle et al., 2010). Hsiao et al. (2017) conducted a study with 123 students over five weeks, showing that the IBL model improved learning outcomes and was effective across different levels of student knowledge for science education. According to the study, IBL not only helps students develop a deeper understanding of scientific concepts and knowledge but also fosters critical thinking skills by encouraging students to predict outcomes, observe events, and explain their observations.

However, there are also studies in the literature, and more precisely in the field of second language teaching, in which the effects of traditional teaching methods and IBL techniques on academic performance are similar and no significant impacts are found (Prince & Vigeant, 2006; Wilder, 2015). These variations can be attributed to several factors, including the implementation fidelity of IBL, the specific subject matter, the instructional context, and the individual differences among students. For instance, if IBL is not well-integrated into the curriculum or if students are not adequately prepared for the self-directed nature of IBL, the expected benefits may not materialize.

On the other part, the results of the Critical Thinking Skills Assessment (CTSA) tool indicate a significant enhancement in critical thinking skills among students exposed to the IBL methodology. The statistical analysis revealed a substantial difference in posttest scores ($t=2.712$, $p<0.05$), with an effect size of $\eta^2=0.203$, suggesting that more than 20% of the variance in critical thinking skills retention can be attributed to IBL methodologies. This finding aligns with existing literature emphasizing the role of IBL in fostering higher-order thinking skills (Lu et al., 2021; Miri et al., 2007). Similar studies, including those in the domain of second language teaching, such as Wale & Bishaw (2020), corroborate these findings, indicating that inquiry-based techniques positively impact students' critical thinking abilities, including interpretation, analysis, evaluation, inference, explanation, and self-regulation skills.

The observed improvement in critical thinking skills can be attributed to several factors inherent in the IBL approach. Firstly, the active engagement required by IBL

encourages students to take ownership of their learning process, promoting deeper cognitive processing and a more meaningful understanding of the subject matter. Additionally, the collaborative nature of IBL allows students to engage in discussions and debates, further enhancing their critical thinking through the exchange of diverse perspectives and the need to justify their reasoning. This is consistent with the findings of Duran and Dökme (2016), who noted that students participating in IBL activities demonstrated significant gains in critical thinking due to the continuous practice of analytical and evaluative skills.

The long-term retention of learning, a crucial measure of educational efficacy, was assessed through posttests conducted 24 weeks after the intervention. While the retention of academic performance and critical thinking skills did not exhibit statistically significant differences ($p=0.001$ for academic retention; $p<0.05$ for critical thinking retention), the nuanced effect of IBL on long-term educational outcomes suggests the need for cautious interpretation. These findings raise questions about the enduring benefits of IBL compared to traditional teaching methods.

However, our study revealed a significant difference in retention level scores between the control and experimental groups on the CTSA test, indicating that the IBL approach notably impacts the retention of critical thinking abilities, surpassing its effect on students' academic performance. While few studies have explored the long-term impact of this methodology, our results are consistent with previous research, such as that of Kogan & Laursen (2013), which demonstrated persistent benefits in the acquisition of critical thinking skills across diverse academic courses.

The differential impact on long-term retention of critical thinking skills versus academic performance may be attributed to the nature of IBL itself. IBL encourages continuous engagement and cognitive challenge, which are essential for the deep processing required to develop and retain complex skills such as critical thinking. This is supported by theories of cognitive psychology that suggest active learning strategies, like those employed in IBL, facilitate better long-term retention by promoting deeper understanding and personal connection to the material (Bransford et al., 2000). Moreover, the interactive and student-centered nature of IBL could lead to higher intrinsic motivation and engagement, factors known to enhance retention (Deci & Ryan, 2000). Students in IBL settings are often more invested in their learning because they perceive it as relevant and meaningful, which can lead to sustained interest and effort even beyond the formal educational setting. This intrinsic motivation might explain why critical thinking skills, which require active engagement and reflection, show greater retention than rote academic knowledge.

It is important to acknowledge certain restraints of our study. One limitation pertains to the assessment tool used to measure academic performance, namely the ABTFPP performance test, which comprised multiple-choice questions. Unlike open-ended questions, where points can be awarded for each stage of the solution, multiple-choice questions offer limited scope for partial credit. Consequently, students cannot earn points if they answer incorrectly. Research by Şendağ and Odabaşı (2009) suggests that the IBL approach may not significantly impact tests assessing cognitive levels of

knowledge, understanding, and application compared to other methods. Therefore, utilizing data collection tools that include synthesis, analysis, and evaluation steps, which engage higher-level skills, would be more appropriate for assessing the effectiveness of IBL methodologies. In our study, the performance test for the application of the theoretical bases of English phonetics and phonology was integrated into the continuous assessment process of the subject of English Phonetics and Phonology and comprised knowledge, comprehension, application, and analysis questions, aligning with the evaluation criteria of other units. However, it's plausible that the choice of assessment methodology could have influenced the observed effect of the IBL program on academic performance. Therefore, future research should consider employing assessment tools that better capture the nuanced impacts of IBL on student learning outcomes.

CONCLUSION

The exploration conducted in this study regarding the effectiveness of Inquiry-Based Learning strategies in the realm of English Phonetics and Phonology education within a Spanish Higher Education institution has yielded compelling evidence of its impact. The substantial improvement in both academic performance and critical thinking skills among students exposed to IBL, in comparison to their counterparts subjected to traditional teaching methodologies, highlights the pedagogical merit of IBL approaches. The findings of the study underscore the value of a learner-centered model, which fosters active engagement, systematic thinking, and the practical application of knowledge, ultimately leading to enhanced academic achievement and skill retention.

Furthermore, the observed long-term retention of critical thinking skills suggests that the benefits of IBL extend beyond immediate educational outcomes, potentially equipping students with the cognitive tools necessary to effectively navigate real-world scenarios. These findings are in line with and contribute to the expanding body of literature advocating for the integration of active learning strategies to better prepare students for the challenges of the 21st century.

LIMITATIONS

Certain limitations, related to sample size constraints and subject matter scope can be mentioned:

1. The research was confined to a sample size of 54 students enrolled in the English Phonetics and Phonology course within the Degree in Primary Education (English as a Foreign Language major) at the Faculty of Education of a university in Salamanca (Spain).
2. The scope of the study was limited to the content covered in the units "Application of Phonetic Theory," "Foundations of English Phonology," and "Didactics of Pronunciation in the Primary Education Classroom" within the subject.
3. The study was constrained to a total of 24 teaching hours allocated to the English Phonetics and Phonology course, with a weekly allocation of 6 teaching hours.

4. The study relied on one educational facilitator guiding both the experimental and control groups in the learning process, utilizing Inquiry-based techniques exclusively in the experimental group.
5. The performance test utilized in the research was limited to questions assessing knowledge, comprehension, application, and analysis, based on Bloom's Taxonomy.
6. The measurement tool used to assess critical thinking skills was confined to 22 skills deemed relevant to the acquisition of knowledge covered in the units "Application of Phonetic Theory," "Foundations of English Phonology," and "Didactics of Pronunciation in the Primary Education Classroom," out of the 35 critical thinking skills suggested by Paul et al. (1990).

Despite these limitations, the results serve as a robust foundation for advocating the reorientation of pedagogical strategies in higher education towards more interactive and student-centered models. Future research endeavors may build upon these findings by exploring the application of IBL across diverse disciplines and educational contexts, further validating the approach's relevance and adaptability to various learning environments.

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