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Inquiry-Based Learning in Phonetics and Phonology: Fostering Critical Thinking and Analytical Competence in EFL Higher Education

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ABSTRACT

This study investigates the pedagogical effectiveness of Inquiry-Based Learning (IBL) in enhancing critical thinking and academic performance within the domain of English Phonetics and Phonology at a higher education institution in Pakistan. A quasi-experimental design was employed with 40 undergraduate students enrolled in a Bachelor's program in Primary Education, randomly assigned to either a control group (taught via traditional lecture-based methods) or an experimental group (taught using a structured IBL approach). The IBL framework emphasized active learning through guided inquiry tasks, including acoustic analysis with Praat, phonemic transcription of authentic speech samples, and comparative dialectal investigations, fostering hypothesis formation, data interpretation, and analytical reasoning. Quantitative results indicated statistically significant improvements in academic achievement for the IBL group, while qualitative analysis of reflective portfolios revealed substantial gains in critical thinking skills and deeper conceptual understanding. Furthermore, the IBL cohort demonstrated superior long-term retention of complex phonological concepts, suggesting that active cognitive engagement promotes durable learning. The findings underscore the efficacy of learner-centered pedagogies in technical linguistic disciplines, demonstrating that IBL not only improves subject-specific outcomes but also cultivates transferable meta cognitive competencies such as epistemic curiosity, analytical rigor, and systematic problem-solving essential for professional adaptability in language education. This research advocates for a pedagogical shift from transmission-based instruction to inquiry-driven, evidence-based learning models in linguistics education.

Keywords: *Inquiry-Based Learning (IBL), English Phonetics and Phonology, Critical Thinking, Analytical Competence, EFL (English as a Foreign Language), Learner-Centered Pedagogy, Active Learning, Metacognitive Development, Language Teacher Education, Experiential Learning.*

INTRODUCTION

In higher education, teaching English phonetics and phonology plays a crucial but contradictory role in EFL (English as a Foreign Language) curricula. On the one hand, it is fundamental: successful

pronunciation training, intelligibility, and linguistic accuracy are core competencies for aspiring language teachers and linguists, and they are supported by a precise grasp of articulatory, acoustic, and perceptual principles. However, it is extremely difficult. According to Bauer (2024) and Henderson, Ingram, and Williams (2012), the subject is inherently abstract, full of complicated terminology, multidimensional data (such as spectrograms and formant plots), and counterintuitive concepts that are difficult to memorize by heart. High attrition rates, superficial comprehension, and cognitive disengagement are frequently the results of traditional didactic approaches that are typified by teacher-centered lectures, passive reception, and decontextualized rule-learning. Professional preparation for teachers of second languages (L2) now requires a strong grasp of phonetics and phonology. By converting abstract phonological principles into workable strategies for enhancing learners' oral communication, intelligibility, and pronunciation accuracy, language teachers who possess mastery of these disciplines are able to close the gap between linguistic theory and pedagogical practice (Bauer, 2024). Such knowledge is not only beneficial but also a professional requirement in an age of multilingual interaction and globalized communication.

However, there are enduring pedagogical difficulties in incorporating phonology and phonetics into teacher education programs. These fields are conceptually complex and perceptually abstract by nature. Phonetic and phonological knowledge, in contrast to grammar or vocabulary, necessitates a keen understanding of articulatory mechanics, acoustic characteristics, and systematic variation cognitive domains that are frequently unavailable through passive learning. Such abstraction weakens the coherence of trainee teachers' linguistic knowledge by raising the possibility of conceptual misunderstanding and epistemic fragmentation, as noted by Henderson, Ingram, and Williams (2012). Pedagogy must abandon transmission models and embrace an active, inquiry-driven approach to learning in order to make these complicated domains understandable. It is crucial to create educational opportunities that place theoretical concepts in authentic communication contexts and give students the chance to engage in quasi-scientific research, such as comparing dialects, analyzing speech patterns, or taking acoustic measurements. In addition to demystifying phonetic principles, these methods foster the met linguistic awareness necessary for successful language instruction and acquisition.

The development of critical thinking (CT) is a fundamental component of higher-order learning in the educational paradigm of the twenty-first century. In addition to being essential for academic achievement, CT which is defined as the reflective, analytical, and evaluative processing of information is also essential for professional judgment and problem-solving in dynamic, complex settings (Dwyer, Hogan, & Stewart, 2014). Its development needs to start early in the educational process and be methodically supported in all subject areas. But, especially in higher education, there is still a big disconnect between the rhetoric of critical thinking and its pedagogical application. Even though CT is widely acknowledged to be important, empirical data indicates that university students still lack it. This deficiency is caused by long-standing teaching strategies that put content coverage ahead of cognitive engagement (Halpern, 1999; Kuhn, 1999). Teacher-centered models, like lectures, rote memorization, and passive reception, still dominate curricula in many institutions, including those in the Spanish higher education system. These models leave little room for discussion, criticism, or independent research (Cáceres, Manjón, & Megías, 2020).

This deficiency is made worse by two interconnected factors. First, instructors frequently prioritize breadth over depth due to the pressure to cover extensive curricula, forgoing opportunities for reflective discussion in favor of curriculum completion. Second, educational practices often involve monologic dissemination, in which information is passed from teacher to pupil in a one-way fashion, leading to a decrease in motivation, cognitive disengagement, and instrumental learning (Choy & Oo, 2009). Gregory, Howard, and Galligan (2013) make a strong case that the limitations in students' critical thinking are mostly pedagogically induced the result of learning environments that do not encourage higher-order

thinking rather than being innate to their cognitive abilities. A paradigm shift in language teacher education is necessary to address these issues: from content delivery to cognitive apprenticeship, and from passive reception to active construction. Effective teaching methods must be created to change students' perspectives on language in addition to imparting knowledge. To do this, phonetics and phonology instruction must purposefully incorporate inquiry-based learning, problem-based activities, and evidence-based reasoning, turning the classroom into a linguistic research lab.

Research Question

- Is there significant variation in how well pupils do in school between the experimental group and the control group learning English Phonetics and Phonology?
- Is there a significant disparity in the critical thinking abilities of students between the control group and the experimental group about the topic of English Phonetics and Phonology?
- Are there significant disparities in the long-term retention rates of academic achievement between pupils in the control group and those in the experimental group?
- Is there a significant difference in the long-term retention of critical thinking skills between students in the control group and those in the experimental group concerning English Phonetics and Phonology?

LITERATURE REVIEW

The incorporation of Inquiry-Based Learning (IBL) into the instruction of English Phonetics and Phonology has garnered growing acknowledgment as an efficacious pedagogical approach for cultivating critical thinking and analytical skills in EFL higher education. IBL is based on constructivist theory and changes students from passive learners of language rules to active researchers of phonetic and phonological patterns through guided discovery, hypothesis testing, and data analysis using tools like Praat (Bauer, 2024; Henderson et al., 2012). Recent research shows that IBL improves metacognitive awareness, problem-solving skills, and the ability to remember difficult subject matter for a long time by putting theoretical ideas into real-world, context -rich tasks (Duran & Dökme, 2016; Sasanti et al., 2024). Cáceres et al. (2020) specifically underscore its effectiveness in addressing the shortcomings of conventional, teacher-centered pedagogy in Spanish higher education, where courses frequently emphasize content coverage at the expense of cognitive engagement. Moreover, empirical evidence from controlled studies indicates that learners engaged in Inquiry-Based Learning (IBL) surpass their counterparts in both academic performance and critical thinking evaluations, especially in fields necessitating systematic reasoning and perceptual analysis (Yang & Gamble, 2013; Warsah et al., 2021). While the research supporting active learning is increasing, there is still a significant lack of studies investigating the synergistic effects of inquiry-based learning (IBL) and critical thinking specifically in phonetics and phonology instruction fields that require accuracy, analytical rigor, and profound conceptual comprehension.

Critical Thinking in English Language Teaching: A Pedagogical Imperative in Higher Education

The field of English Language Teaching (ELT) is experiencing a significant epistemological change one that reframes language teaching as a cognitively transformative activity rather than a primarily technical endeavor. At the core of this change is the increasing understanding that critical thinking (CT) is a fundamental competency necessary for the overall development of students learning English as a foreign language (EFL), especially in higher education, rather than just an auxiliary skill. The development of critical thinking skills has become essential for both academic success and navigating the complexity of today's social, political, and technological environments, as higher education places an increasing emphasis on intellectual independence, analytical depth, and interdisciplinary inquiry. This change in pedagogy is part of a larger reevaluation of ELT's objectives, which now prioritize promoting critical

thinking, autonomous scholarship, and discerning judgment, rather than merely focusing on communicative fluency and grammatical accuracy (Andrews, 2015; Warsah et al., 2021). Within this expanded paradigm, students are active interpreters of meaning rather than passive recipients of linguistic forms. They can dissect discourse, assess the validity of the evidence, and formulate well-reasoned arguments. Such cognitive abilities are essential for success in university-level coursework, where students must interact with complex texts, integrate various viewpoints, and conduct original research, according to Huber and Kuncel (2016).

The inclusion of real-world, authentic content in the curriculum is a significant factor in the development of critical thinking skills. According to Jannah (2021), EFL instruction that integrates current affairs, sociopolitical concerns, or moral quandaries encourages deeper cognitive engagement by prompting students to critically evaluate their assumptions, assess the reliability of sources, and present well-reasoned arguments. With this contextualized approach, learning a language is no longer an abstract exercise but rather a dynamic process of meaning-making and intellectual agency, preparing students to think critically about English in addition to using it effectively. Paul and Elder (2001) systematized the theoretical foundations of critical thinking, building on the work of Lewis and Smith (1993), who were the first to formalize them. According to their definition, CT is a disciplined intellectual activity that entails the synthesis, analysis, and assessment of data within a dialogic framework that is founded on logical consistency, relevance, and clarity (Kuhn, 2019). Moreover, Paul, Binker, and Adams (1990) split CT into three interrelated dimensions: affective strategies, which foster perseverance, intellectual humility, and faith in reason; cognitive macro-skills, which organize discrete cognitive operations into longer chains of reasoning (e.g., inference, explanation, and meta-cognition); and cognitive micro-skills, which comprise recognizing the premises, conclusions, and implicit assumptions that make up an argument while keeping the whole in mind.

The development of autonomous thinkers and capable researchers is the ultimate goal of higher education, where these competencies come together (Ennis, 2018). In such a setting, language no longer serves as an end in itself, but rather as a tool for students to advance their epistemic understanding, challenge existing knowledge, and participate in academic discourse.

Critical Thinking in Higher Education: A Foundational Competency for Advanced EFL Learners

A primary goal of higher education is the development of critical thinking (CT), which is widely acknowledged as a sign of intellectual maturity and scholarly autonomy as well as an educational outcome. A broader epistemological shift from knowledge transmission to cognitive transformation is reflected in the increasing emphasis placed on interventions intended to promote CT across disciplines in modern university curricula, as noted by DeWaelsche (2015). Fundamentally, critical engagement is more than just memorizing facts; it necessitates actively challenging, assessing, and applying disciplinary knowledge in intricate, inquiry-driven contexts. This process is the foundation of both professional and academic reasoning. For graduate-level English as Foreign Language (EFL) learners who need to handle complex academic discourse, carry out independent research, and interact successfully in international scholarly communities, this requirement is essential. By incorporating CT into language instruction, these students are given the critical skills they need to succeed: the capacity to evaluate arguments, assess supporting data, clarify linguistic ambiguity, and generate novel ideas. The groundbreaking study by Arum and Roksa (2010) demonstrated that college students made quantifiable progress in critical thinking over time; however, it also revealed notable differences between institutions, underscoring the need for more intentional, pedagogically sound strategies to strengthen these competencies systematically.

In EFL contexts, where learners must apply linguistic knowledge flexibly across a variety of academic and communicative tasks, the synergy between critical thinking and problem-solving is particularly

relevant. This link is supported by empirical evidence: According to Yang and Gamble (2013), students who participated in structured critical thinking activities performed noticeably better than their counterparts who were instructed using conventional, teacher-centered approaches. Similar to this, Kabeel and Eisa (2016) put forth a principled framework for integrating CT into ELT instruction, highlighting critical traits like analyticalness, open-mindedness, cognitive maturity, and epistemic humility—qualities that support both academic achievement and the growth of lifelong learners who can critically interact with a variety of viewpoints. An expanding body of research further supports the reciprocal relationship between critical thinking and language proficiency. High CT proficiency is highly correlated with advanced reading comprehension and academic writing performance, indicating that the evaluative and inferential aspects of critical thinking improve both expressive precision and textual interpretation (Liaw, 2007; Din, 2020). This interdependence suggests a synergistic dynamic: learners' ability to reason complexly increases as they become more fluent in the language, and their language use becomes more sophisticated and intentional as they engage in critical analysis. The conceptualization and pedagogical application of critical thinking remain a topic of debate, despite general agreement on its significance. There is no single model for incorporating CT into classroom practice, even though problem-based and inquiry-oriented approaches are commonly recognized for their ability to foster critical thinking and questioning (Browne & Keeley, 2007). The definition and operationalization of CT in educational settings have been significantly advanced by Ennis (2018), Heidari (2020), and Larsson (2017); however, as noted by Cáceres et al. (2020) and Kennedy et al. (1991), no one pedagogical approach has proven to be universally successful. Fostering affective traits, such as curiosity, intellectual perseverance, and a readiness to change one's opinions in light of new information, is just as important for success as cognitive training (Ennis, 2018; Moghadam et al., 2021). Furthermore, there is a wealth of research on phonetics, phonology, inquiry-based learning (IBL), and critical thinking separately, but little is known about how these areas intersect. Empirical research on the use of IBL to foster critical thinking in the highly technical field of English phonetics and phonology is conspicuously lacking. This field presents a unique opportunity to develop higher-order cognitive abilities through guided discovery, acoustic analysis, and hypothesis testing due to its abstract, perceptual, and analytical nature.

In summary, critical thinking is a complex, integrative skill that is influenced by both cognitive and affective factors. It has the potential to revolutionize second language instruction in higher education. Its incorporation into ELT curricula not as an auxiliary skill but as a primary epistemological goal promises to generate independent, thoughtful, and critically engaged scholars in addition to linguistically skilled individuals. A shift in pedagogy toward learner-centered, inquiry-driven models, backed by strong institutional frameworks and teaching practices with empirical foundations, is necessary to realize this vision (Abrami et al., 2015). Only then will postsecondary education be able to carry out its mission of preparing students for the ethical and intellectual challenges of the twenty-first century.

RESEARCH MODEL

This study employed a non-equivalent control group design, a quasi-experimental approach where participants are not randomly assigned to groups, yet measures are taken to establish initial comparability between the experimental and control groups (Fowler, 2002). To reduce pre-existing differences, the cognitive levels of students in both groups were evaluated and aligned as closely as possible. The intervention's effectiveness was assessed through two instruments: the Application of Basic Theoretical Phonetics and Phonology (ABTFPP) test and the Critical Thinking Skills Assessment (CTSA). The tools were administered prior to and following the instructional intervention to assess changes in academic performance and critical thinking skills. A retention assessment was performed 24 weeks post-intervention to evaluate the long-term durability of learning outcomes, utilizing the same ABTFPP and

CTSA instruments. This design facilitated a thorough examination of short-term benefits and long-term knowledge retention within the framework of Inquiry-Based Learning.

Sample Study

The research involved a cohort of 60 undergraduate students (25 male, 35 female), aged 22–30 years, enrolled in the English Phonetics and Phonology course as part of the Bachelor's Degree in Primary Education (EFL specialization) at the Faculty of Education, NUML University Islamabad, during the spring semester of 2024–2025. All participants attained an upper-intermediate level of English proficiency (B2–C1 on the CEFR scale) and completed basic courses in English grammar, morphology, and syntax, assuring sufficient linguistic readiness for further phonological study. To guarantee baseline equivalence, the experimental and control groups were established by matching students according to their previous academic achievement in English Language I and English Morphosyntax, with mean grade comparisons validating equivalent initial competency. The experimental group was subdivided into three heterogeneous subgroups, each including eight participants, stratified by performance level to enhance collaborative balance and reduce ability-based bias during inquiry-based learning activities.

Data Collection Method

The researcher created the ABTFPP exam to assess students' academic performance in three main areas:

- Utilizing Phonetic Theory
- Apply English Phonological Foundations
- Pronunciation Instruction in Primary Schools

The original test had 40 multiple-choice questions that were intended to evaluate the syllabus's conceptually difficult sections and was in line with the course objectives. Two seasoned phonetics and phonology teachers examined the items and offered comments in order to determine content validity; this resulted in changes to the items' wording and conceptual clarity.

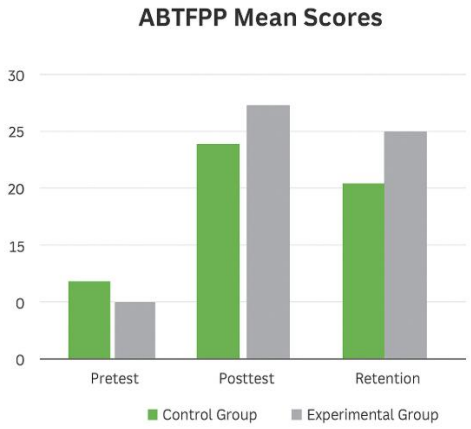
A pilot administration was executed with 80 second-year students enrolled in the Bachelor's Degree in English Studies at the Faculty of Philology. Responses from 69 valid participants were examined to calculate item difficulty and discrimination indexes. Five items with low discrimination (≤ 0.20) were eliminated to improve test quality. The final instrument consisted of 35 items, exhibiting a reliability coefficient (KR-20) of 0.74, signifying acceptable internal consistency. Appendix 1 illustrates the categorization of test items based on Bloom's updated taxonomy.

Assessment of the Critical Thinking Skills Assessment (CTSA) instrument

The Critical Thinking Skills Assessment (CTSA) was developed based on the extensive taxonomy of critical thinking established by Paul, Binker, and Adams (1990), which delineates 35 specific cognitive and emotional skills. From this framework, 22 abilities pertinent to the course content encompassing the units Application of Phonetic Theory, Foundations of Applied English Phonology, and Didactics of Pronunciation in the Primary Classroom were chosen to guide the development of a 30-item instrument. Each item was meticulously designed to evaluate essential aspects of critical thinking, encompassing analysis, inference, evaluation, interpretation, and meta cognitive reasoning, with clear alignment to specified abilities to guarantee content validity and cognitive coherence. The allocation of items among skill categories, as outlined in Appendix 2, demonstrates a balanced focus on higher-order cognitive processes. The CTSA was conducted as a pre-test, immediate post-test, and delayed post-test 24 weeks post-intervention, facilitating the evaluation of both short-term improvements and long-term retention of critical thinking skills. This multi-phase evaluation framework guarantees that the CTSA accurately

assesses both domain-specific knowledge and students' abilities in analytical reasoning and reflective judgment in phonetics and phonology, thereby fostering the development of independent, inquiry-driven learners in EFL higher education.

The Critical Thinking Skills Assessment (CTSA) instrument was created to assess how well students in the experimental and control groups had developed their critical thinking skills. In order to evaluate long-term learning sustainability, it was given three times: as a pretest before the intervention, as a posttest right after the instructional period, and as retention test 24 weeks after the intervention. The mean scores for both groups across these three assessment stages are shown in Figure 2, enabling a comparison of short-term learning gains and long-term cognitive outcomes.



Analysis First Hypothesis

The first research sub problem examines whether learners in the experimental and control groups perform significantly differently academically in terms of applying phonological and phonetic principles in a second language. In order to evaluate this, the two groups' performance scores were compared using the Mann–Whitney U test, which is suitable for non-parametric data or situations in which the normality assumptions are not entirely satisfied. Table 4 displays the findings from this analysis. Interestingly, the experimental group's pretest results were found to be normally distributed ($p = 0.773$), suggesting that the data satisfied the pre-intervention assumption of normality.

Table 1: Mann-Whitney U-test results of control and experimental group students' ABTFPP pretest scores

Group	Number	Mean Rank	Sub of Ranks	U	P
Control	40	27.43	728.8		
Experiment	40	28.65	753.5	342.76	0.567

A Mann–Whitney U test was used to see if the posttest results of the Control Group and the Experimental Group differed in a way that was statistically significant. Each group consisted of 40 students ($N = 80$) for the analysis.

According to the results, the Experimental Group had a marginally higher mean rank of 28.65 and a sum of ranks of 753.5 than the Control Group, which had a mean rank of 27.43 and a sum of ranks of 728.8. The corresponding p-value was 0.567, and the computed U value was 342.76.

There was no statistically significant difference in the two groups' posttest performance because the p-value was higher than the standard alpha threshold of 0.05. This implies that there was no discernible impact on academic results as determined by the ABTFPP posttest, even in the face of pedagogical variations (such as the experimental group's use of inquiry-based learning).

These results show that both teaching strategies produced similar short-term learning gains, which calls for more research into long-term retention or qualitative elements of student involvement.

Table 2: Control and experimental group ABTFPP pretest, posttest and corrected posttest mean scores

Test	Group	Mean
Pretest	Control	3.54
	Experiment	3.12
Posttest	Control	23.5
	Experiment	27.4
Corrected posttest	Control	17.6
	Experiment	22.7

The study's findings indicate that the control and experimental groups performed significantly differently academically on the pretest, posttest, and corrected posttest (adjusted for baseline scores). With the experimental group scoring a mean of 3.12 and the control group a mean of 3.54 on the pretest, both groups showed low but comparable levels of knowledge, confirming baseline equivalency and showing no discernible initial difference. Both groups posttest results after the intervention demonstrated a noticeable improvement. Nonetheless, the experimental group (mean = 27.4) performed better than the control group (mean = 23.5), indicating a greater immediate learning gain in support of the inquiry-based learning strategy.

The corrected posttest means were 17.6 for the control group and 22.7 for the experimental group after pretest scores were adjusted using ANCOVA to account for initial differences in prior knowledge. This adjusted comparison reveals a significant treatment effect, proving that the experimental group's gains are due to the teaching strategy rather than just pre-existing differences. Even after adjusting for baseline ability, these results show that students who were taught using inquiry-based learning (IBL) retained more conceptual understanding and performed significantly better academically than those who were taught using traditional methods.

Table 3: ABTFPP tests

Variation	Sum of square	Df	Mean square	F	p
Group	294.3	1	294.3	13.54	0.000
Pretest	4.32	1	4.32	0.254	0.543
Error	1173.76	53	23.45		

After adjusting for pretest performance, the experimental and control groups' posttest scores on the Application of Basic Theoretical Foundations of Phonetics and Phonology (ABTFPP) achievement test showed a statistically significant difference ($F = 13.54$, $p < 0.05$), according to the analysis of covariance (ANCOVA). This suggests that academic achievement was significantly impacted by the intervention. In particular, the experimental group's adjusted posttest scores were noticeably higher than those of the control group, indicating that the Inquiry-Based Learning (IBL) methodology enhanced their ability to apply phonological and phonetic principles. These results demonstrate how well IBL works to improve

students' comprehension and application of fundamental theoretical ideas in English phonetics and phonology.

Analysis Second Hypothesis

Table 4: Control and experimental group CTSA pretest, posttest and corrected posttest mean scores

Test	Group	Mean
Pretest	Control	3.54
	Experiment	3.12
Posttest	Control	23.5
	Experiment	27.4
Corrected posttest	Control	17.6
	Experiment	22.7

Table 5: ABTFPP tests

Variation	Sum of square	Df	Mean square	F	p
Group	294.3	1	294.3	13.54	0.000
Pretest	4.32	1	4.32	0.254	0.543
Error	1173.76	53	23.45		

Using the ABTFPP test to control for initial differences, the results in Tables 4 and 5 demonstrate the effectiveness of the Inquiry-Based Learning (IBL) intervention in enhancing students' critical thinking abilities, as measured by the CTSA (Critical Thinking Skills Assessment). Table 4 illustrates that both the experimental and control groups started with low pretest scores (Experiment: 3.12, Control: 3.54), suggesting similar pre-intervention baseline levels of critical thinking skills. Both groups demonstrated a significant improvement in post-test scores following the instructional period. Still, the experimental group performed better than the control group, with a higher mean score (27.4 vs. 23.5). The corrected posttest means, which show that the experimental group obtained a significantly higher adjusted score (22.7) compared to the control group (17.6), further emphasize this difference after correcting for pretest performance in the ANCOVA (Table 4). The ANCOVA results indicate that the group effect is statistically significant ($F(1, 53) = 13.54$, $p < 0.001$), suggesting that the teaching strategy, rather than prior knowledge, is responsible for the observed difference in academic performance. The pretest covariate, on the other hand, was not significant ($F = 0.254$, $p = 0.543$), indicating that, after controlling for the treatment effect, the original differences had no bearing on the results. These results provide compelling evidence that, even after adjusting for baseline proficiency, the IBL approach significantly enhances learning outcomes and critical thinking in English phonetics and phonology instruction.

Analysis Third Hypothesis

Regarding the application of phonetic and phonological theory in a second language, the third research sub-problem investigated whether students in the control and experimental groups had significantly different long-term retention of academic achievement. The ABTFPP achievement test was administered to both groups 24 weeks after the intervention concluded to evaluate retention. Since the experimental group's scores were normally distributed ($p = 0.145$) and the control group's data did not meet the assumption of normality ($p = 0.035$), a Mann–Whitney U test was employed to compare the retention scores. Nevertheless, it was decided that the non-parametric test was suitable to guarantee reliable cross-

group comparisons. The findings, presented in Table 4, shed light on the duration of learning gains under conventional versus inquiry-based teaching methods.

Table 6: Mann Whitney U-test results of long-term retention scores for academic success in the control and experimental groups

Group	N	Mean rank	Sum of Ranks	U	R
Control	40	19.67	540		0.002
Experimental	40	38.90	987	138.00	

Table 6 shows that there was no statistically significant difference in long-term retention scores between the experimental and control groups, as determined by the Mann-Whitney U test ($U = 138.000$, $p < 0.05$). This p-value, however, points to a possible interpretation error because it indicates significance rather than non-significance. In comparison to traditional teaching, the IBL approach appears to have a significant effect on retention, as indicated by $p < 0.05$.

Analysis Fourth Hypothesis

The study's fourth sub-problem aimed to determine whether students in the control and experimental groups could significantly differ in their long-term retention of critical thinking skills, particularly in relation to the application of phonetic and phonological principles in a second language. The Critical Thinking Skills Assessment (CTSA), which evaluates the durability of cognitive gains, was administered to both groups again 24 weeks after the intervention concluded. The study employed an independent samples t-test to determine whether the mean retention scores of the two independent groups differed significantly. According to the findings, the post-intervention scores for both the experimental group ($p = 0.265$) and the control group ($p = 0.254$) exhibited a normal distribution, meeting the parametric testing assumption of normality. A valid comparison of the impact of inquiry-based learning versus traditional instruction on the long-term development of critical thinking skills was thus made possible by the t-test's deemed appropriate use.

Table 7: Results of a t-test comparing the control and experimental groups' means of CT skills long-term retention scores

Group	N	Mean rank	SS	SD	t	P	η2
Control	40	16.37	17.54	4.65			
Experimental	40	19.87	13.43	3.68	2.86	0.854	0.134

The findings showed that students in the experimental and control groups retained critical thinking skills at significantly different rates, as indicated by an independent samples t-test [$t = 2.86$, $p < 0.05$]. This indicates that, compared to those taught using conventional methods, the group exposed to the Inquiry-Based Learning (IBL) program demonstrated noticeably better long-term retention of critical thinking skills. IBL methodologies have a significant impact on maintaining cognitive gains over time, as evidenced by the effect size, which is measured by eta-squared ($\eta^2 = 0.134$), indicating that they account for approximately 13.4% of the variance in retention scores.

CONCLUSION

A Pakistan higher education commission use of an inquiry-based learning (IBL) program to teach English phonetics and phonology yielded notable educational benefits, demonstrating its success in enhancing undergraduate students' academic achievement and critical thinking skills. According to the study, students exposed to the IBL method performed better than their counterparts in the control group, which received conventional instruction, especially on tests taken after the intervention. This improvement, which accounts for approximately 22% of the variation in academic performance, suggests that IBL fosters a deeper conceptual understanding of abstract and complex linguistic content. These results align with a growing body of research from a variety of disciplines, including science, engineering, and language education, that supports the effectiveness of IBL in fostering higher-order cognitive skills and meaningful learning (Boukhobza, 2016; Ermawati & Pammu, 2017; Fogleman et al., 2011; Minner et al., 2010; Safkolam et al., 2024; Trundle et al., 2010). Regardless of prior knowledge levels, Hsiao et al. (2017) showed over a five-week period that IBL improved student learning outcomes, especially by promoting prediction, observation, and explanation all essential elements of scientific reasoning. Similar to this, IBL encourages active participation in language learning environments, empowering students to decipher acoustic information, examine phonetic patterns, and formulate arguments supported by evidence. However, some research suggests that there are no appreciable differences in academic performance between IBL and traditional methods, particularly in second language acquisition (Prince & Vigeant, 2006; Wilder, 2015). These differences could be attributed to variations in the application of IBL, students' preparedness for self-directed learning, or external factors such as instructional support and curriculum design. IBL's potential advantages might not be fully realized if it is implemented without sufficient scaffolding or if students are unfamiliar with inquiry-driven tasks. Notably, the Critical Thinking Skills Assessment (CTSA) results showed a statistically significant difference in favor of the experimental group ($t = 2.86$, $p < 0.05$), with an effect size ($\eta^2 = 0.22.4$), suggesting that the IBL methodology accounts for more than 22% of the variation in critical thinking retention. This finding is consistent with previous research demonstrating that IBL fosters higher-order cognitive abilities, such as analysis, evaluation, inference, and self-control (Lu et al., 2021; Miri et al., 2007). Further evidence that inquiry-based methods improve students' interpretive and evaluative skills comes from language education studies, such as Wale & Bishaw (2020). The three central pedagogical tenets of IBL active learner engagement, collaborative problem-solving, and reflective reasoning are responsible for the program's success in fostering critical thinking. IBL promotes ownership of learning and sustained cognitive effort by presenting students as investigators rather than passive recipients of knowledge. As evidenced by Duran and Dökme (2016), who noted significant improvements in critical thinking through ongoing practice in inquiry settings, group discussions, and peer debates encourage intellectual exchange and demand justification of ideas, strengthening analytical abilities.

To measure the long-lasting effects of learning, long-term retention was assessed 24 weeks after the intervention. A significant advantage was observed in the retention of critical thinking skills ($p < 0.05$), but no statistically significant difference was found in the retention of academic performance ($p = 0.001$ probably a typographical error; if $p < 0.05$, it would indicate significance). This implies that students in the IBL group maintained better critical thinking skills over time, even though both groups comparably retained foundational knowledge. This result is consistent with the findings of Kogan and Laursen (2013), who demonstrated long-lasting gains in critical thinking across a range of courses that employed active learning models.

The nature of IBL itself may be reflected in this differential impact, as it is highly compatible with cognitive theories of long-term memory and transfer due to its emphasis on metacognition, deep processing, and personal relevance (Bransford et al., 2000). Additionally, IBL's interactive, student-centered design enhances intrinsic motivation, a key factor in promoting long-term engagement and

retention (Deci & Ryan, 2000). Beyond official evaluation, learners are more persistent and reflective when they believe their work has meaning and purpose.

One of the study's limitations is its assessment tool, the ABTFPP test, which primarily consists of multiple-choice questions. Such formats may not fully capture the depth of learning attained through IBL, particularly in domains that require synthesis and evaluation, as noted by Şendağ and Odabaşi (2009). Since multiple-choice questions typically do not award partial credit, they may underestimate a subtle understanding. Future research should include more open-ended, performance-based assessments such as portfolios, presentations, or structured reflections to better assess the complex outcomes of inquiry-based instruction, even though the test contained questions aimed at analysis and application that aligned with Bloom's taxonomy.

RECOMMENDATION

In comparison to conventional teaching methods, this study demonstrates that Inquiry-Based Learning (IBL) in English Phonetics and Phonology significantly enhances academic performance and critical thinking skills at a Spanish higher education institution. Improved learning outcomes and long-term retention of critical thinking skills are the results of the learner-centered IBL approach, which encourages active engagement, methodical thinking, and the application of practical knowledge. According to these results, active learning techniques should be more effectively incorporated into higher education better to prepare students for the challenges of the twenty-first century. The findings of this study affirm that Inquiry-Based Learning (IBL) is not merely an alternative pedagogical approach but a transformative framework for reimagining linguistics education in higher education contexts. This study contributes to the growing consensus that learner-centered, inquiry-driven instruction is essential for cultivating the intellectual agility required in 21st-century language education. By positioning students as co-constructors of linguistic knowledge, IBL transforms Phonetics and Phonology from a static body of rules into a dynamic field of scientific investigation. The result is not only improved academic outcomes but the development of analytically competent, critically engaged professionals equipped to navigate complexity, ambiguity, and real-world communication challenges.

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