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Improving College Students' English Phoneme Acquisition Performance through FiF Oral Training System-Assisted Blended Learning

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ABSTRACT

This study investigated the effectiveness of blended learning using the FiF Oral Training App on English phoneme acquisition specifically fluency, intelligibility, articulation, and rhythm, and explored students' satisfaction and attitudes toward pronunciation learning. A quasi-experimental design was employed with two intact classes of Primary English Education freshmen at Lijiang Normal University: an experimental group (n = 40) using the FiF App and a control group (n = 40) receiving conventional instruction. Both groups were comparable in prior English performance. Quantitative data from pre-and post-tests and pronunciation learning questionnaires were analyzed using descriptive and inferential statistics. The control group showed modest gains: fluency increased from 6.45 to 7.59, intelligibility from 6.21 to 7.35, articulation from 6.34 to 7.26, and rhythm from 6.28 to 7.35 (all at $p < 0.001$). The experimental group demonstrated superior improvements: fluency from 5.83 to 7.86, intelligibility from 5.76 to 7.66, articulation from 5.90 to 7.83, and rhythm from 5.74 to 7.63. The experimental group outperformed the control group across all measures, with articulation reaching statistical significance ($p = 0.022$). Both groups reported positive attitudes toward pronunciation learning. However, the experimental group expressed stronger agreement regarding the importance of pronunciation ($M = 1.23$ vs. 1.41) and perceived greater support from the learning environment ($M = 1.35$ vs. 1.53). Findings suggest that integrating AI-based tools like the FiF App enhances articulation and fosters positive learner attitudes, indicating the pedagogical value of blending technology with pronunciation instruction.

Keywords: FiF Oral Training System; FiF Oral Training System-assisted Blended Learning; English Phoneme Acquisition; Blended Learning; 3P Teaching Model

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1. Introduction

Pronunciation remains a persistent challenge in English as a Foreign Language (EFL) teaching, despite its recognized centrality to successful spoken communication^[1]. As Zavyalova and Primak^[2] emphasized decades ago, phonological competence—unlike grammar and vocabulary—requires near-native mastery to ensure intelligibility, yet this skill remains undervalued and inconsistently developed in many EFL contexts^[3]. In particular, Chinese EFL learners struggle with phoneme acquisition due to systemic instructional shortcomings, contributing to poor articulation, rhythm control, and intelligibility^[4]. The enduring dominance of the Native Speaker Model (e.g., British Received Pronunciation, General American) as the ideal target^[5] has compounded this problem by imposing unrealistic standards that often ignore the local learning context and learner needs. Phonological complexity of English encompassing 44 distinct phonemes, pedagogical approaches to these sounds remain largely theoretical and disconnected from interactive practice^[6].

Despite widespread curricular mandates requiring proficiency in phonetic transcription, phonics, and clear pronunciation^[4], traditional methods anchored in rote imitation and decontextualized drills fail to engage learners or develop automaticity in speech^[5]. Overcrowded classrooms^[1] and limited contact hours^[1,4,7] further erode the possibility of meaningful individual practice. Worse still, these constraints have led to the marginalization of pronunciation teaching in favor of grammar and vocabulary instruction, perpetuating a skills imbalance that undermines learners' communicative competence^[1].

Technology-assisted and blended learning approaches have been proposed to overcome these limitations^[8]. Guevara-Bazán^[9] advocated for computer-mediated tools like Pratt and Speech Analyzer, while other studies^[10–12] explored mobile apps and flipped classroom models, suggesting their promise in personalizing pronunciation training and expanding practice beyond class time. Similarly, blended learning^[13] has demonstrated success in integrating digital resources with face-to-face learning, providing flexibility and learner autonomy^[1,14]. This approach aligns with international educational trends promoting intelligent and data-driven teaching, as seen in initiatives from Singapore, South Korea, and China^[15].

However, critical gaps remain. Existing research on

blended learning in EFL largely emphasizes reading, writing, or general language skills^[15,16], while studies focused specifically on phoneme acquisition, a foundational but often neglected aspect of oral proficiency, are scarce. Moreover, prior works have rarely evaluated the impact of AI-powered tools like the FiF Oral Training System on phoneme-level skills, such as articulation precision, rhythm control, and intelligibility, leaving their potential underexplored^[16,17]. This study therefore addresses this research gap by investigating the effectiveness of a blended learning model in improving the phoneme acquisition performance of EFL college students – an area where empirical evidence remains limited but urgently needed.

2. Literature Review

2.1. The Role of Pronunciation and Phoneme Acquisition in EFL Learning

Pronunciation is widely recognized as a critical component of oral communication in second language learning^[1]. Olsen^[18] and Islam^[19] emphasized that while grammar and vocabulary errors may be tolerated in conversation, pronunciation errors often result in communication breakdowns. This has led to increasing scholarly interest in phoneme acquisition, especially in EFL contexts, where learners' native phonological systems often diverge significantly from English^[19]. Phonemes are the smallest units of sound, and accurate mastery of them underpins intelligibility and fluency. As EFL learners rely heavily on pronunciation for real-time communication, failure to acquire these phonemes correctly can impede both their speaking confidence and listening comprehension^[1,4,19].

Numerous studies have documented challenges specific to EFL learners in acquiring English phonemes. Wang and Wen^[4] note that Chinese learners, for instance, frequently struggle with English vowels and consonants that are not present in their native language, leading to systematic pronunciation errors. These issues persist despite formal instruction, revealing a disconnect between curricular goals and learner outcomes. Such persistent difficulties imply that existing pedagogical strategies are insufficiently targeted toward phonological acquisition^[4]. This raises questions about the extent to which phoneme instruction is emphasized in teacher training and curriculum design and whether learners

receive enough explicit instruction and corrective feedback.

The gap in effective phoneme instruction points to a deeper structural issue in EFL education, a reliance on models of British Received Pronunciation and General American^[5] that may not be adaptable to learners' phonetic needs. Gierut^[5] suggests that the Native Speaker Model, while aspirational, often fails to consider learners' linguistic backgrounds and cognitive load, making it less effective pedagogically. In synthesizing these studies, it becomes clear that there is a pressing need for instructional innovations that address learners' native language influence, individual pronunciation challenges, and the cognitive demands of phoneme acquisition. This underscores the importance of context-specific, data-driven approaches, such as AI-supported tools, that offer tailored feedback and support learners' development in real time^[14,15].

2.2. Limitations of Traditional Pronunciation Instruction in EFL Contexts

While the importance of pronunciation is widely acknowledged, traditional classroom-based instruction often falls short of meeting learner needs. AbdAlgane^[1] and Wang and Wen^[4], identify major limitations, including teacher-centred delivery, mechanical drill practices, and limited communicative context. These approaches lead to rote memorization of phonetic rules rather than internalization through meaningful use^[20]. Consequently, learners may be able to articulate rules in theory but fail to apply them in spontaneous speech^[1,20]. This disconnect between form and function undermines learners' progress in real-world communication^[21].

Further compounding these limitations are systemic issues within the educational context, such as large class sizes and rigid curricula^[22,23]. As Şimon et al.^[24] notes, teachers are often constrained by dense syllabi that leave insufficient time for individual pronunciation practice. With one teacher responsible for dozens of students, the opportunity for targeted feedback is rare, and learners receive minimal scaffolding. In such environments, the corrective loop—crucial for phonological acquisition—is severely compromised, making it difficult for students to overcome fossilized pronunciation errors^[23,24]. These systemic barriers reveal that even when pronunciation is included in the curriculum, structural limitations diminish its pedagogical impact^[24,25].

Synthesizing this evidence reveals a critical pedagogical

gap: the lack of sustained, individualized, and engaging pronunciation instruction. Despite acknowledgement of its importance, pronunciation is treated as peripheral in many EFL contexts. The challenge lies not only in content delivery but also in instructional design and support^[22–25]. This suggests a need for reimagined approaches that leverage technology to offer personalized feedback, repetitive practice, and learner autonomy—elements that traditional classrooms often fail to provide^[22]. It is this instructional shortfall that creates space for innovation through blended learning and AI-assisted tools^[16,17,23–25].

2.3. Technology-Assisted and Blended Learning Approaches in Pronunciation Teaching

Blended learning has emerged as a viable response to the shortcomings of traditional pronunciation instruction^[7,14,15]. Blended learning is an intentional combination of face-to-face and online instructional elements, which enhances learning flexibility and responsiveness^[13]. In pronunciation training, this model allows learners to repeatedly access high-quality input, engage in self-paced practice, and receive immediate corrective feedback outside the constraints of class schedules. Wu^[8] highlighted the advantages of using digital tools like Speech Analyzer and Better Accent Tutor, which allow students to visualize waveforms and adjust their articulation in real time, facilitating more active learning.

Mobile-based applications further advance this innovation by extending learning to everyday environments. Tools like the FiF Oral Training App deliver AI-driven feedback on fluency, rhythm, articulation, and intelligibility^[16,17]. Zhang^[16] found that such systems support learner autonomy and foster positive attitudes toward pronunciation learning, especially among students who might otherwise be reluctant to speak in front of peers. Li^[26] also observed a correlation between technology-mediated pronunciation practice and increased learner confidence suggesting that these tools can address both cognitive and affective aspects of language learning. Through features like gamification, voice recognition, and personalized progress tracking, these platforms offer targeted learning that traditional classrooms cannot match^[27].

Despite promising developments, the literature reveals a research gap in empirical evaluations of such tools within

EFL college settings. While studies broadly affirm the benefits of blended learning^[14–17], few isolate its impact on phoneme-level accuracy or compare AI-supported interventions with traditional methods^[26]. This lack of targeted research limits our understanding of how specific tools contribute to measurable improvements in phoneme acquisition. Therefore, the current study seeks to bridge this gap by examining the impact of the FiF Oral Training System on college-level EFL learners' phoneme acquisition, contributing novel empirical evidence to an area that remains underexplored despite its pedagogical significance. In light of these gaps, the present study investigates the following research questions:

1. Does the use of FiF Oral Training System -Assisted Blended Learning (the intervention used in the present study) improve students from the experimental groups' pre- and post-English phoneme acquisition performance in terms of fluency, intelligibility, articulation, and rhythm?
2. Does the intervention improve students from the control groups' pre- and post-English phoneme acquisition performance in terms of fluency, intelligibility, articulation, and rhythm?
3. Does the intervention provided for the experimental group influence the students' motivation towards English phoneme acquisition in terms of its four aspects:
 - a. Motivation and attitude toward learning English pronunciation
 - b. Importance and perceived value of English pronunciation skills
 - c. Learning strategies, challenges, and effort in pronunciation learning
 - d. Learning environment and teacher's role in pronunciation learning
4. Does the 3P classroom technique provided for the control group influence students' motivation towards English phoneme acquisition in terms of its four aspects:
 - a. Motivation and attitude toward learning English pronunciation
 - b. Importance and perceived value of English pronunciation skills
 - c. Learning strategies, challenges, and effort in pronunciation learning
 - d. Learning environment and teacher's role in pronunciation learning

3. Materials and Methods

3.1. Design

This study employed quantitative research, which emphasizes objectivity and systematic measurement to analyze variables and their relationships. It utilized a quasi-experimental design, a type of experimental research that manipulates independent variables to examine their effects on dependent variables. Unlike nonexperimental designs, which observe phenomena without manipulation to identify relationships or differences, this approach allows for stronger inferences about causality^[27].

For this study, a quasi-experimental design with non-randomized control and experimental groups was employed. Participants were drawn from two intact class sections. The experimental group received the instructional intervention, whereas the control group continued with conventional instruction. The group assignment was based on the existing class structure within the school to minimize disruption to the regular teaching schedule. Prior to the intervention, the two groups were confirmed to be comparable in terms of academic performance, as indicated by their previous English grades, and were similar in size, with each group consisting of approximately the same number of students.

The researcher utilized a pre-test and post-test design, involving 80 newly enrolled freshmen in S.Y. 2024. The experimental group received the intervention, while the control group did not receive the intervention but continued with regular instruction using a traditional classroom technique called 3P classroom technique.

3.2. Participants

The participants in this study comprised 80 first-year students from the 2024 cohort of the Primary English Education program at Lijiang Normal University. A quasi-experimental, non-randomized control group design was employed, selected to accommodate the institutional context and preserve the existing class structure. In a non-randomized design, participants are not assigned to groups by chance; instead, pre-existing groups—such as intact class sections—are used as they are. This approach is often necessary in educational settings where reassigning students to different classes may disrupt normal academic routines or be imprac-

tical due to administrative constraints.

In this study, participants were drawn from two intact class sections, each comprising 40 students. One class was designated as the experimental group, which received the instructional intervention, while the other class served as the control group, continuing with conventional instruction. The group assignment was based on logistical considerations and class schedules and was conducted in coordination with school administrators. While this approach limits random allocation, it allows for implementation in real-world classroom settings and is commonly used in educational research.

Both groups were taught by the same instructor, thereby controlling for teacher-related variables such as teaching style, classroom management, and subject matter expertise. Furthermore, the demographic composition of both groups was nearly identical, with approximately 3 males and 37 females in each group. This comparability, along with consistent instructional conditions, strengthens the internal validity of the study and enhances the credibility of its findings.

3.3. Instruments and Data Collection

3.3.1. Lesson Plans for Experimental Group

The lesson plans were designed by the researcher herself. The researcher applied the FIF Oral Training System-Assisted Blended Learning Approach to the experimental group. According to the syllabus for English Phonology and the school's schedule, the researcher was required to complete teaching the 44 phonemes within 16 periods. It was expected that the experimental group would require less time than the control group. The lesson plans covered all 44 phonemes and were organized into 8 lessons. These lessons focused on pronunciation, fluency, intelligibility, and speed. The researcher presented the lesson plans to the adviser for feedback and revised them based on the adviser's suggestions. The revised lesson plans were then submitted to three experts to rate the appropriateness of the content.

3.3.2. Lesson Plans for Control Group

The lesson plans were carefully designed by the researcher, employing the 3P teaching method, which comprises three main phases: presentation, practice, and production. The lesson typically began with a lead-in phase, which involved checking and reviewing previously learned material to activate students' prior knowledge and set the stage for new

content. After this, the researcher delivered the presentation phase, during which the new material was clearly explained and exemplified to facilitate students' comprehension of key concepts.

Following this, students participated in the practice phase, engaging with textbook exercises that allowed for controlled application of the newly acquired knowledge. This phase served to reinforce understanding and bolster learner confidence. The lesson culminated in the production phase, wherein students were tasked with more complex activities, such as reading aloud supplementary texts, with an emphasis on enhancing pronunciation skills. This stage was intended to promote freer and more creative language use, enabling students to demonstrate their ability to transfer classroom learning to authentic communicative contexts. Throughout the session, the researcher maintained a coherent progression between phases, ensuring a structured and integrated learning experience designed to advance students' overall language proficiency.

3.3.3. Pre-Test

Prior to the intervention, both groups of students undertook the same pre-test to assess their foundational pronunciation skills. The test comprised three components: (1) reading aloud the phonetic alphabet, (2) reading aloud a set of words, and (3) reading aloud a given text. The primary objective of the pre-test was to evaluate students' initial proficiency in pronunciation while also serving as baseline data for post-test comparisons. The test content was carefully aligned with the exercises covered in regular classes to ensure validity. Each student was required to record their responses, and the recordings were independently evaluated by three experienced phonology teachers. The final score for each student was determined by averaging the scores assigned by the three evaluators. To ensure fairness and consistency, all students were given five minutes to prepare before taking the test.

3.3.4. Post-Test

Following the intervention, both groups completed an identical post-test designed to measure improvements in pronunciation skills. The post-test consisted of four components: (1) reading aloud the phonetic alphabet, (2) reading aloud words by recognizing phonetic symbols, (3) distinguishing minimal pairs of sounds, and (4) reading aloud a given text. The primary aim of the post-test was to assess differences

between the experimental and control groups in pronunciation accuracy, fluency, intelligibility, and speed. The test content remained consistent with the regular class exercises to maintain reliability. Students were required to record their responses, and, as with the pre-test, their recordings were evaluated by three phonology teachers, with the final score derived from the average of the three ratings. Each student was allotted five minutes to prepare before taking the test. The pre-test scores were statistically analyzed to control preexisting knowledge differences, allowing for an accurate comparison of post-test results. This analysis aimed to determine whether the instructional method used in the experimental group yielded significantly higher scores compared to the control group.

3.3.5. Questionnaire on Students' Motivation and Attitudes towards Learning Pronunciation

Questionnaire on Students' Motivation and Attitudes towards Learning Pronunciation. The students' motivation and attitude questionnaire were developed by the researcher to assess students' satisfaction, interest, and initiative in learning pronunciation. Specifically, it aims to explore variations in students' engagement and self-regulation concerning pronunciation learning. The questionnaire consists of 30 items, each requiring participants to select the most appropriate response based on their actual experiences. The survey will be administered via wjx.cn, a widely used online platform in China, within the week following the completion of the intervention. To ensure a comprehensive evaluation, the questionnaire is systematically categorized into four key aspects. The first aspect, motivation and attitude toward learning English pronunciation, examines students' enthusiasm, confidence, and willingness to improve their pronunciation skills. The second aspect, importance and perceived value of English pronunciation skills, explores students' beliefs about the relevance of pronunciation in effective communication and academic or professional success. The third aspect, learning strategies, challenges, and effort in pronunciation learning, assesses the techniques students use to enhance their pronunciation, the obstacles they face, and the level of dedication they apply to overcoming difficulties. The fourth aspect, learning environment and teacher's role in pronunciation learning, investigates how classroom settings, instructional methods, and teacher support influence students' pronunciation learning

experiences. Each category will include two representative items, and all responses were recorded using a five-point Likert scale, ensuring a nuanced understanding of students' motivation and attitude towards pronunciation learning.

To enhance the validity and reliability of the questionnaire, three independent experts will conduct a thorough content validation review, focusing on cognitive appropriateness, clarity, and alignment with the study's objectives. Necessary revisions will be made based on their recommendations before final implementation. This structured approach ensures that the questionnaire serves as a reliable and accurate instrument for assessing students' motivation and attitudes towards learning pronunciation. One week after the intervention, both groups completed a structured and attitude questionnaire designed to investigate potential differences in their learning experiences. The questionnaire aimed to assess students' satisfaction and attitudes towards learning pronunciation in terms of (1) motivation and attitude toward learning English pronunciation, (2) Importance and perceived value of English pronunciation skills, (3) Learning strategies, challenges, and effort in pronunciation learning, and (4) Learning environment and teacher's role in pronunciation learning. Moreover, it consisted of 30 close-ended questions, all formatted using a five-point Likert scale to ensure clarity and consistency in responses. The students' motivation and attitude questionnaire were administered online via wjx.cn, a widely used Chinese survey platform.

3.4. Intervention Implemented for the Experimental Group

Before class, the teacher uploads videos on the four front vowels and audio materials for two lessons from New Concept English to the FiF Oral English Learning System and assigns the tasks to the experimental class. Students in the experimental class study the materials in advance, both individually and in learning groups, to prepare for the face-to-face session using the FiF Oral English Learning System. They can access the materials either on their phones or on a computer.

During the face-to-face classes, the teacher checks how well the students have acquired the knowledge and skills, provides timely assistance and corrects those who struggle. The teacher also facilitates more targeted practice activities in the classroom. Students scan a QR code in the textbook to access practice materials and improve their performance.

They may practice with their classmates and explain to each other within their groups how to pronounce the phonemes correctly. The teacher visits each group, offers corrections, and guides students through focused practice exercises. After practice, students take tests in the classroom using the FiF Oral Training app to evaluate their progress and identify areas requiring improvement. They review their errors, reflect on the possible causes, and correct them with the support of sample recordings, peer assistance within their groups, and guidance from the teacher. Students who perform well in the tests may be provided with supplementary materials for further enhancement, while those who need additional support receive targeted instruction and engage in further practice and retesting to achieve improved results.

After the face-to-face classroom sessions, students engage in dubbing activities using British and American dramas, making the learning process enjoyable. They continue to practice and review the materials online, taking additional challenges or tests to achieve higher.

3.5. Intervention Implemented for the Control Group

The lesson commenced with a lead-in phase aimed at activating students' prior knowledge by reviewing previously learned material, thereby establishing a foundation for the introduction of new content. Subsequently, the researcher delivered the presentation phase, during which the new material was clearly explained and exemplified to facilitate students' comprehension of key concepts.

Following this, students participated in the practice phase, engaging with textbook exercises that allowed for con-

trolled application of the newly acquired knowledge. This phase served to reinforce understanding and bolster learner confidence. The lesson culminated in the production phase, wherein students were tasked with more complex activities, such as reading aloud supplementary texts, with an emphasis on enhancing pronunciation skills. This stage was intended to promote freer and more creative language use, enabling students to demonstrate their ability to transfer classroom learning to authentic communicative contexts. Throughout the session, the researcher maintained a coherent progression between phases, ensuring a structured and integrated learning experience designed to advance students' overall language proficiency.

4. Results

4.1. Students' Pre- and Post-Test Performance in English Phoneme Acquisition (Control and Experimental Groups)

Table 1 presents the students' pre- and post-test performance in English phoneme acquisition within the control group. Fluency and intelligibility showed the highest posttest mean scores, reaching 7.59 (SD = 0.92) and 7.35 (SD = 1.03), respectively, while articulation and rhythm had slightly lower posttest means of 7.26 (SD = 0.97) and 7.35 (SD = 1.00). The pretest scores were relatively similar across all four measures, ranging from 6.21 (intelligibility) to 6.45 (fluency). This indicates that fluency and intelligibility improved to a slightly greater extent by the end of the intervention compared to articulation and rhythm. All increases from pretest to posttest were statistically significant ($p < 0.001$).

Table 1. Students' pre- and post- English phoneme acquisition performance in the control group before and after the implementation of the intervention.

Variable		Mean	SD	df	<i>t</i>	<i>p</i>	Interpretation
Fluency	Pre-test	6.45	1.10	39	7.76	< 0.001	Significant
	Post-test	7.59	0.92				
Intelligibility	Pre-test	6.21	1.16	39	7.59	< 0.001	Significant
	Post-test	7.35	1.03				
Articulation	Pre-test	6.34	1.12	39	6.20	< 0.001	Significant
	Post-test	7.26	0.97				
Rhythm	Pre-test	6.28	1.17	39	7.05	< 0.001	Significant
	Post-test	7.35	1.00				

Table 2 presents the students' pre- and post-test performance in English phoneme acquisition within the experimental group. Fluency showed the highest posttest mean score of 7.86 (SD = 0.91), followed closely by articulation at 7.83 (SD = 1.13). Intelligibility and rhythm had slightly lower posttest means of 7.66 (SD = 1.16) and 7.63 (SD = 0.97),

respectively. The pretest scores were fairly consistent across all four measures, ranging from 5.74 (rhythm) to 5.90 (articulation). This shows that fluency and articulation improved to a slightly greater extent by the end of the intervention compared to intelligibility and rhythm. All increases from pretest to posttest were statistically significant ($p < 0.001$).

Table 2. Students' English phoneme acquisition performance in the experimental group before and after the implementation of the intervention.

Variable		Mean	SD	df	<i>t</i>	<i>p</i>	Interpretation
Fluency	Pre-test	5.83	1.48	39	13.7	< 0.001	Significant
	Post-test	7.86	0.91				
Intelligibility	Pre-test	5.76	1.47	39	12.9	< 0.001	Significant
	Post-test	7.66	1.16				
Articulation	Pre-test	5.90	1.47	39	11.5	< 0.001	Significant
	Post-test	7.83	1.13				
Rhythm	Pre-test	5.74	1.36	39	11.0	< 0.001	Significant
	Post-test	7.63	0.97				

4.2. Overall Test of Difference on the Post-test Scores of Both the Control and Experimental Groups

Table 3 presents the post-test performance of both the control group, which received traditional 3P classroom instruction, and the experimental group, which used the FiF

Oral Training App alongside face-to-face learning. The control group showed moderate mean scores across fluency (7.59, SD = 0.92), intelligibility (7.35, SD = 1.03), articulation (7.26, SD = 0.97), and rhythm (7.35, SD = 1.00). These results indicate some improvement, but overall, performance remained relatively stable without significant development in phoneme acquisition.

Table 3. Overall Results on Students' English Phoneme Acquisition Performance in the Experimental and Control Groups.

Variable		Mean	SD	df	<i>t</i>	<i>p</i>	Interpretation
Fluency	Control	7.59	0.92	78	1.35	0.182	Not significant
	Experimental	7.86	0.91				
Intelligibility	Control	7.35	1.03	78	1.28	0.205	Not significant
	Experimental	7.66	1.16				
Articulation	Control	7.26	0.97	78	2.34	0.022	Significant
	Experimental	7.83	1.13				
Rhythm	Control	7.35	1.00	78	1.18	0.242	Not significant
	Experimental	7.63	0.97				

In comparison, the experimental group achieved higher mean scores in all aspects: fluency (7.86, SD = 0.91), intelligibility (7.66, SD = 1.16), articulation (7.83, SD = 1.13), and rhythm (7.63, SD = 0.97). However, statistical analysis revealed that only articulation showed a significant difference between groups ($t = 2.34$, $p = 0.022$). Fluency ($t = 1.35$, $p = 0.182$), intelligibility ($t = 1.28$, $p = 0.205$), and rhythm ($t = 1.18$, $p = 0.242$) did not differ significantly, suggesting that while the blended learning approach with the FiF app led to improvements, its most pronounced effect was specifically

on students' articulation skills.

4.3. Overall Results on Students' Motivation and Attitudes Towards Learning Pronunciation in Terms of the Four Aspects

Table 4 presents the results of students' motivation and attitudes towards learning pronunciation for the control group, which experienced the traditional 3P method. The group showed generally positive attitudes with a mean

score of 1.84 (SD = 0.98) in Motivation and Attitude Toward Learning English Pronunciation, near the “Strongly Agree” range. Students rated the Importance and Perceived Value of English Pronunciation Skills highly at 1.41 (SD = 0.91), demonstrating clear recognition of pronunciation’s role in language proficiency. However, Learning Strategies, Challenges, and Effort in Pronunciation Learning scored a higher mean of 2.28 (SD = 1.12), indicating moderate acknowledgement of difficulties and inconsistent strategy use. The Learning Environment and Teacher’s Role received a positive mean of 1.53 (SD = 0.66), suggesting appreciation for classroom support, though with room for more engagement.

In comparison, the experimental group, which used the FiF Oral Training App blended with face-to-face learning, reported a nearly identical mean of 1.85 (SD = 0.89)

for Motivation and Attitude, showing sustained enthusiasm. They rated the Importance and Perceived Value of Pronunciation Skills even higher at 1.23 (SD = 0.87), reflecting enhanced awareness likely boosted by the app’s interactive features. Learning Strategies, Challenges, and Effort scored slightly higher at 2.36 (SD = 0.99), suggesting greater recognition of pronunciation challenges, possibly due to increased demands from using the new technology. Importantly, the Learning Environment and Teacher’s Role scored 1.35 (SD = 0.56), indicating stronger satisfaction with the learning setting and instructional support, likely influenced by the engaging blended learning format. Overall, the experimental group demonstrated marginally more positive attitudes and a deeper appreciation of pronunciation learning complexities, highlighting the potential benefits of integrating technology into pronunciation instruction.

Table 4. Overall Results on Students’ Motivation and Attitudes towards Learning Pronunciation in Terms of its Four Aspects.

Aspects	Control			Experimental		
	Mean	SD	Description	Mean	SD	Description
Motivation and Attitude Toward Learning English Pronunciation	1.84	0.98	Agree	1.85	0.89	Agree
Importance and Perceived Value of English Pronunciation Skills	1.41	0.91	Strongly Agree	1.23	0.87	Strongly Agree
Learning Strategies, Challenges, and Efforts in Pronunciation Learning	2.28	1.12	Agree	2.36	0.99	Agree
Learning Environment and Teacher’s Role in Pronunciation Learning	1.53	0.66	Agree	1.35	0.56	Strongly Agree

Legend:

1.00–1.49 = Strongly Agree
 1.50–2.49 = Agree
 2.50–3.49 = Neutral
 3.50–4.49 = Disagree
 4.50–5.00 = Strongly Disagree.

5. Discussion

5.1. Students’ Pre- and Post-Test Performance in English Phoneme Acquisition across its Four Aspects Both in Control and Experimental Groups

The results of the present study revealed notable improvements in students’ English phoneme acquisition across both the control and experimental groups, with the experimental group demonstrating greater gains in all aspects of pronunciation—fluency, intelligibility, articulation, and rhythm. Both groups showed statistically significant progress from pre- to post-test measures, indicating that instruction, whether through traditional 3P classroom tech-

niques or through a blended learning approach using the FiF Oral Training App, contributed positively to learners’ phonological development. Furthermore, students in both groups reported generally favorable motivation and attitudes toward pronunciation learning, though those in the experimental group expressed slightly stronger perceptions regarding the value, strategies, and supportive learning environment associated with technology-enhanced instruction. To illustrate these results in greater detail, the following sections discuss the outcomes observed within each group, aligned with relevant prior research:

The control group’s significant improvements in fluency, intelligibility, articulation, and rhythm demonstrate that traditional classroom instruction using the 3P technique can

foster foundational gains in phoneme acquisition. The observed increase in fluency, for example, reflects the positive effect of regular oral reading and pronunciation drills, which have been shown to promote smoother and more natural speech flow^[28]. Similarly, the gains in intelligibility suggest that teacher-led corrections and peer interactions help clarify pronunciation, supporting Derwing and Munro's^[29] argument that guided practice can improve comprehensibility even without advanced technological aids. However, the persistence of certain pronunciation errors and less precise articulation points to challenges identified by Pennington and Rogerson-Revell^[30], who emphasized the difficulty learners face with unfamiliar phonemes in the absence of individualized feedback. Furthermore, while rhythm showed improvement, the gradual nature of this development aligns with Pennington and Rogerson-Revell^[30] and Ward et al.^[31] which suggests that prosodic features require extensive, focused practice which traditional methods alone may not fully provide.

These findings collectively suggest that while conventional teaching approaches effectively build essential phoneme skills through repetitive practice and social interaction, they may fall short in addressing the nuanced and individual-specific demands of pronunciation mastery. The absence of real-time, personalized corrective feedback limits the speed and precision of learning, reinforcing previous research that highlights the crucial role of immediate and adaptive feedback in language acquisition^[28,29]. Consequently, although traditional classroom methods offer a valuable foundation, they are likely insufficient for optimal phoneme development, pointing to the need for targeted, technology-enhanced interventions to overcome persistent phonetic challenges and accelerate learners' communicative competence.

On the other hand, the significant improvements in the experimental group's fluency, intelligibility, articulation, and rhythm after using the FiF Oral Training App combined with face-to-face instruction align closely with prior research demonstrating the efficacy of technology-assisted pronunciation training. A study by Waluyo and Rofiah^[32] emphasized that interactive digital tools with instant feedback led to more accurate and fluent spoken language. This study's findings, including a statistically significant fluency improvement ($t = 13.7, p < 0.001$), echo Rogerson-Revell^[33] results showing

that computer-assisted pronunciation training (CAPT) promotes self-paced, repetitive practice that enhances speech fluidity beyond traditional methods. The blended learning model used here maximizes learner engagement by integrating personalized app-based practice with real-time corrective feedback in the classroom, effectively addressing individual pronunciation challenges.

Similarly, the enhanced intelligibility ($t = 12.9, p < 0.001$) and articulation gains ($t = 11.5, p < 0.001$) observed reflect previous findings that AI-powered phoneme recognition and visual-auditory feedback improve clarity and phonetic accuracy^[29]. The app's capabilities, such as mouth-shape modeling and targeted drills, provided multimodal reinforcement that complemented face-to-face instruction, facilitating more precise phoneme production. Furthermore, the improvement in rhythm ($t = 11.0, p < 0.001$) supports Ward's^[31] conclusions that technology-enhanced prosodic training aids learners in mastering stress, intonation, and timing. Collectively, these results strongly support the integration of CAPT tools like the FiF Oral Training App within blended learning frameworks to significantly advance English phoneme acquisition, reinforcing the growing scholarly consensus on the vital role of technology in L2 pronunciation pedagogy.

5.2. Students' Motivation and Attitudes towards Learning English Pronunciation

The control group, taught through the traditional 3P method, demonstrated generally positive but moderately intense motivation and attitudes towards pronunciation learning, with a mean score of 1.84 (SD = 0.98) in the Motivation and Attitude Toward Learning English Pronunciation category. This score, falling within the "Agree" range but near the "Strongly Agree" boundary, suggests that while students were motivated and held favorable attitudes, enthusiasm was not uniformly strong. This finding echoes Derwing and Munro^[29], who noted that learners in conventional classrooms recognize pronunciation's importance but may experience lower engagement due to limited instructional variety and teacher-centered approaches, which restrict active participation and personalized feedback.

Regarding the Importance and Perceived Value of Pronunciation Skills, the control group strongly agreed on its significance, with a mean of 1.41 (SD = 0.91), aligning with

Rogerson-Revell^[33] who emphasized learners' widespread recognition of pronunciation's role in effective communication, regardless of teaching method. However, the higher mean of 2.28 (SD = 1.12) in learning strategies, challenges, and effort suggests students faced difficulties applying effective strategies. The moderately positive perception of the Learning Environment and Teacher's Role (mean = 1.53, SD = 0.66) further indicates an appreciation for teacher support but also hints at constraints in fostering learner autonomy and interactive practice, consistent with Robillos^[22] observations on the limitations of teacher-centered environments for pronunciation development^[1,34,35].

Conversely, the experimental group, which engaged with the FiF Oral Training App within a blended learning framework, demonstrated a generally positive motivation and attitude toward learning pronunciation, with a mean score of 1.85 (SD = 0.89) in the Motivation and Attitude category, nearly identical to the control group. This suggests that the introduction of technology alone did not significantly boost intrinsic or extrinsic motivation but helped maintain learners' positive outlook. This aligns with Robillos^[22], who noted that technology by itself does not automatically increase motivation unless paired with targeted motivational strategies. The sustained engagement here indicates that the app's novelty and integration alongside traditional instruction effectively prevented declines in learner interest and participation.

Regarding the Importance and Perceived Value of Pronunciation Skills, the experimental group rated this aspect higher, with a mean of 1.23 (SD = 0.87) within the "Strongly Agree" range, implying enhanced recognition of pronunciation's critical role. This aligns with Pennington and Rogerson-Revell^[30] who found that technology-enhanced pronunciation tools with immediate corrective feedback increase learners' awareness of pronunciation's practical importance. The experimental group's slightly higher score in Learning Strategies, Challenges, and Effort (mean = 2.36, SD = 0.99) reflects Derwing and Munro's^[29] observation that detailed, individualized feedback can heighten learners' awareness of the complexity and effort involved in mastering pronunciation. Finally, the positive perception of the Learning Environment and Teacher's Role (mean = 1.35, SD = 0.56) suggests the blended approach fostered a more interactive, supportive atmosphere, consistent with Robil-

los^[22] who emphasize technology's role in promoting learner autonomy while enhancing the teacher's facilitative function.

Notably, the blended learning approach incorporating the FiF Oral Training App appears to offer some advantages in enhancing students' perception of the value of pronunciation and improving the learning environment's interactivity. However, consistent with previous studies, these benefits did not translate into markedly higher motivation, effort, or confidence compared to traditional methods within the duration of this study. This suggests that successful pronunciation instruction likely requires a combination of technology, effective teacher facilitation, and sufficient practice time to foster substantial learner confidence and skill development^[34,35].

6. Conclusions

This study underscores the transformative potential of integrating AI-assisted technology within blended learning frameworks to enhance English phoneme acquisition, particularly in articulation. The findings suggest that while tools like the FiF Oral Training App can effectively support technical improvements through real-time feedback and interactive practice, pronunciation learning remains a multifaceted challenge that extends beyond measurable skill gains. The nuanced results point to the complexity of pronunciation acquisition, where advances in phonetic accuracy do not automatically translate into shifts in learner motivation or attitudes. This highlights a critical tension in language education: technological interventions may refine competence, but fostering sustained engagement and positive learner perceptions requires more than just improved performance metrics.

Moreover, the study reveals that both traditional and technology-enhanced approaches contribute to shaping learners' attitudes and motivation, yet neither fully resolves the inherent difficulties of mastering pronunciation. This indicates that pronunciation teaching must continue to evolve, integrating diverse strategies that address cognitive, affective, and social dimensions of learning. It invites educators and researchers to rethink how blended learning environments can be optimized—not only to deliver feedback but also to cultivate meaningful learner investment and authentic communicative experiences.

To apply these findings in practice, teachers in EFL contexts may consider integrating the FiF App into after-class

speaking tasks to provide additional pronunciation practice. Institutions can support this by incorporating app-based oral training into their language programs and offering guidance on how to use such tools effectively. These practical steps may help bridge the gap between technical skill development and learner motivation.

Ultimately, this research opens avenues for further inquiry into how technological innovations can be combined with pedagogical methods to holistically support pronunciation development. It challenges future studies to explore integrated approaches that balance skill acquisition with motivational and contextual factors, ensuring that learners not only improve their pronunciation but also develop a lasting, positive relationship with language learning.

7. Limitations

One limitation of this study is that, although it identified a gap between improved pronunciation skills and learners' motivation or attitudes, it did not delve into the deeper psychological or sociocultural factors that influence these affective responses. Understanding elements such as learner identity, language anxiety, and past experiences with language learning could provide crucial insights into why motivation remains unchanged despite technical gains. Therefore, future research should incorporate qualitative approaches to explore these dimensions, enabling the development of more targeted and holistic interventions that address both skill and motivation.

Another limitation lies in the study's focus on the FiF Oral Training App as a largely standalone tool, without examining how variations in teacher facilitation or instructional design might shape its effectiveness. The role of teachers and classroom dynamics can significantly influence how technology integrates into learning, potentially amplifying or diminishing its impact. Future studies should investigate different models of blended learning that include teacher mediation and varied instructional approaches to better understand how to optimize technology use for diverse learner populations.

A further limitation is the use of a non-randomized sample drawn from a single institution, which may affect the generalizability of the findings. The specific institutional context, learner demographics, and localized curriculum may not represent broader EFL populations. Future research should

aim for more diverse and randomized samples across multiple institutions to enhance the external validity of the results.

Finally, while AI-driven feedback demonstrated clear benefits in improving articulation, it may fall short in addressing more complex aspects of pronunciation such as intonation, prosody, and pragmatic appropriateness. These subtleties often require the nuanced, adaptive judgment that only human instructors and peer interactions can provide. Consequently, it is recommended that AI tools be complemented by guided teacher support and collaborative learning opportunities to foster a more comprehensive development of both technical accuracy and communicative competence in pronunciation.

Author Contributions

Conception and design, X.W. and R.J.R.; data collection, analysis, and the initial draft preparation, X.W.; the development of the research framework and provided critical revisions to the manuscript, R.J.R. All authors worked on the final editing of the paper. All authors read and approved the final version of the manuscript.

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Institutional Review Board Statement

This research was fully approved by the Ethics Committee for Human Research at Khon Kaen University (Approval No. HE673360). Informed consent was formally obtained from all participants, including both experts and students. For those under the age of 18, parental consent was secured in conjunction with assent appropriate to their age. Data collection began only after all required institutional approvals were granted. Throughout the study, strict confidentiality was maintained, and participants' rights—including the right to withdraw at any time without consequence—were carefully protected.

Informed Consent Statement

All participants, including experts and students, provided informed consent through formal documentation.

For participants under 18 years of age, parental consent was obtained alongside age-appropriate assent forms. The research instruments and procedures were rigorously reviewed for ethical compliance, adhering to the principles outlined in the Belmont Report and the Good Clinical Practice (GCP) guidelines for Social and Behavioral Research. Data collection commenced only after securing all necessary institutional approvals, with strict protocols in place to ensure confidentiality and protect participants' rights, including the right to withdraw from the study without any repercussions.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Conflicts of Interest

The authors declare no conflict of interest.

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