



The Development of Mobile Phone Applications to Promote Phonic Skills in Primary School

Pisan Pankeaw, PhraWichian Parichano and Lampong Klomkul

Faculty of Humanities, Mahachulalongkornrajavidyalaya University, Thailand

Faculty of Humanities, Mahachulalongkornrajavidyalaya University, Thailand

E-mail: Apkeaw@gmail.com, ORCID ID: <https://orcid.org/0009-0002-8625-1048>

E-mail: wparichano@gmail.com, ORCID ID: <https://orcid.org/0009-0009-0769-3536>

E-mail: research.mcu@gmail.com, ORCID ID: <https://orcid.org/0000-0002-7989-8313>

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Abstract

Background and Aims: Phonics instruction plays a critical role in developing foundational reading fluency, pronunciation, and phonemic awareness, particularly in primary education. However, students in Thailand, especially in rural areas like the Phetchaburi Educational Service Area 2, face significant challenges in mastering phonics. These challenges stem from structural differences between Thai and English phonetic systems, the absence of specialized English teachers, and limited exposure to native speakers, resulting in poor reading comprehension, pronunciation difficulties, and low confidence in using English. These educational gaps highlight the urgent need for innovative solutions to support phonics education beyond traditional classroom settings. This study addresses these issues by leveraging mobile technology to develop an engaging phonics learning application. The objectives of the study are fourfold: First, the study seeks to develop a mobile application specifically designed to promote phonics skills among primary school students. Second, it aims to validate the effectiveness of the application by measuring phonics improvement through pretest and posttest assessments. Third, it compares the learning outcomes of students who used the application (experimental group) with those receiving traditional instruction (control group), providing insights into the app's impact. Lastly, the study evaluates students' satisfaction with the app, assessing usability and its influence on learning engagement. These objectives collectively address the critical need for accessible phonics education tools in resource-limited settings.

Methodology: A mixed-methods approach was adopted to gain comprehensive insights into both learning outcomes and user experiences. The study involved students from a randomly selected school in Phetchaburi Educational Service Area 2, with participants divided into experimental and control groups. Grade 6 students formed the experimental group, using the mobile application for five weeks, while Grade 5 students followed traditional phonics instruction. The quantitative component included pretest-posttest assessments, with a 60-item test covering essential phonics components such as consonants, vowels, clusters, and suffix endings. Qualitative data were gathered through student surveys and focus group interviews, providing deeper insights into their experiences with the application.

Results: The study's results demonstrate that the mobile application significantly enhanced phonics skills among the experimental group. The mean score for the experimental group improved from 14.7 (pretest) to 45.93 (posttest), a gain of 31.23 points. In contrast, the control group showed a modest improvement from 15.1 to 22.5, with a 7.4-point increase. A two-tailed t-test analysis ($t = 29.84$, $p < 0.05$) confirmed that the observed differences between the groups were statistically significant, validating the effectiveness of the mobile app. Students expressed high satisfaction, with average scores of 4.9/5 for learning improvement, 4.8/5 for exercise usefulness, and 4.7/5 for learning at their own pace. These findings indicate the practical effectiveness of the mobile application in enhancing phonics education and student engagement.

Conclusion: This study highlights the potential of mobile learning tools to address the challenges of phonics education in rural Thailand, offering a scalable solution for areas with limited access to specialized teachers and instructional resources. The significant improvements in phonics performance among students using the mobile application suggest that such tools can serve as effective supplements to traditional instruction, supporting students' phonemic awareness, pronunciation, and reading fluency. These findings have broader implications for educational policy and practice, underscoring the need to integrate technology-based solutions into the curriculum to enhance language learning outcomes. Future research could explore the long-term impact of the application, its adaptability to other regions, and the integration of advanced features such as offline access and adaptive learning modules.

Keywords: Phonics Skills; Mobile Learning; Educational Technology; Primary Education; English Pronunciation; Language Acquisition; Rural Education; Mobile-assisted Language Learning; Thailand

Introduction

In an increasingly interconnected world, English language proficiency has become a critical skill for academic success and global competitiveness. English serves as the global lingua franca, playing a key role in international communication, higher education, and career advancement (Crystal, 2003). Many countries prioritize English language education to prepare students for future opportunities in academia and the workforce. However, in Thailand, English proficiency levels remain low, particularly in rural areas, creating significant barriers for students aiming to compete in a globalized economy.

Challenges in Phonics Education in Thailand

Thailand has consistently ranked low in the EF English Proficiency Index, falling to 100th place out of 111 countries in 2023 (EF EPI, 2023). This low level of English proficiency is especially evident in rural areas like the Phetchaburi Educational Service Area 2, where

schools struggle to provide quality English instruction. These educational challenges are exacerbated by a shortage of specialized English teachers and minimal exposure to native English speakers. Kirkpatrick (2010) notes that across Southeast Asia, including Thailand, the lack of trained English teachers limits students' ability to engage with authentic spoken English, thereby impeding their development of essential communication skills. As a result, students in these regions underperform in national assessments such as the Ordinary National Educational Test (ONET), where English proficiency is a core component (Perry & Nichols, 2014).

Phonics instruction, which focuses on the relationship between sounds and letters, is fundamental in early language acquisition (Adams, 1990). Mastery of phonics strengthens students' decoding skills, reading fluency, and pronunciation, enabling them to read unfamiliar words and improve comprehension (Hewings, 2004). However, for Thai students, phonics education presents additional challenges. The Thai language is phonetic, with a simpler structure compared to English, which includes irregular consonant clusters, diphthongs, and silent letters (Jessada Wari, 2014). This structural difference makes it difficult for Thai learners to apply familiar phonetic patterns when learning English, leading to frequent pronunciation errors and reduced reading fluency. Kirkpatrick (2010) highlights that second-language learners in Asia, including Thailand, often face challenges with English pronunciation due to differences in phonological systems, such as the absence of consonant clusters and variations in stress patterns. Without targeted phonics instruction, these students struggle to build foundational literacy skills, limiting their ability to engage confidently with the English language. Without targeted phonics instruction, these students struggle to build foundational literacy skills, limiting their ability to engage confidently with the English language.

Limitations of Traditional Phonics Instruction

In many Thai classrooms, English instruction relies heavily on grammar-based approaches and rote memorization. According to Foley (2005), English language teaching in many Asian contexts, including Thailand, often emphasizes grammar translation and repetition, leaving little room for communicative competence or practical skills like pronunciation and phonics. While these methods may help students pass exams, they do not equip them with practical language skills, such as pronunciation and decoding, which are essential for reading comprehension (Perry & Nichols, 2014). Teachers in rural areas are often required to teach multiple subjects, including English, despite lacking formal training in phonics instruction. According to Hayes (2010) educators in many parts of Southeast Asia, including Thailand, are expected to teach English without sufficient preparation, leading to inconsistent instructional quality. Similarly, Kirkpatrick (2012) notes that rural teachers often lack specialized training, which hinders their ability to provide effective phonics instruction.

Furthermore, opportunities for meaningful language practice are limited to the classroom, preventing students from developing confidence in using English outside academic settings. These challenges highlight the need for innovative approaches that can supplement traditional instruction. Research shows that mobile learning tools offer a viable solution, especially in resource-limited environments. Mobile applications can provide students with self-directed, individualized learning opportunities, allowing them to practice pronunciation and decoding at their own pace (Demir & Akpınar, 2016). Interactive features, such as quizzes, progress tracking, and real-time feedback, enhance student engagement and motivation (Gamlo, 2019). Studies have demonstrated that mobile learning can significantly improve vocabulary retention, pronunciation, and reading comprehension, making it a promising tool for phonics education (Khansarian-Dehkordi & Ameri-Golestan, 2013).

The Role of Mobile Learning in Supporting Thailand's Educational Policy

Thailand's 4.0 Educational Policy emphasizes the use of technology to enhance learning outcomes, promote student-centered education, and develop digital literacy (Jamaldeen, Kim, & Lee, 2019). This policy aims to address the educational challenges faced by rural schools by integrating technology into the curriculum, enabling students to access quality learning resources regardless of their location. Mobile learning aligns with this policy by offering flexible, scalable solutions that empower students to take ownership of their learning. For instance, the use of gamified elements in mobile applications has been shown to sustain student motivation and increase learning outcomes (Mauri Medrano et al., 2023). By adopting mobile technology, schools can complement traditional instruction and address the gaps left by conventional teaching methods, particularly in rural areas (Demir & Akpınar, 2016).

Gaps in the Literature and the Contribution of This Study

Although research on mobile-assisted language learning has grown, few studies focus specifically on phonics education in Thailand's rural context (Gamlo, 2019). Existing mobile applications primarily target vocabulary and grammar skills, with limited emphasis on phonics acquisition. Additionally, studies on mobile learning in non-native English-speaking contexts often overlook the unique linguistic challenges faced by Thai students, such as the difficulty of mastering complex English phonetic patterns (Jessada Wari, 2014). This study seeks to fill this gap by developing and evaluating a phonics-focused mobile application tailored to the needs of primary school students in Thailand.

The mobile application developed in this study offers five core modules: consonants, vowels, clusters, onset and rhyme, and suffix endings. These modules incorporate interactive exercises, video lessons, and real-time feedback to engage students and promote phonics practice. Gamified elements, such as progress tracking and rewards, further motivate students to engage consistently with the material. The app also allows students to learn at their own pace, providing them with the flexibility to revisit challenging concepts as needed.

Objectives

1. To develop a mobile application that promotes phonics skills among primary students.
2. To validate the effectiveness of the application in enhancing phonics skills.
3. To compare the differences in students' phonics skills before and after using the application.
4. To evaluate students' satisfaction with the application's usability and learning impact.

Literature Review

Theoretical Background of Phonics Instruction

Phonics instruction is grounded in two primary approaches: synthetic phonics and analytic phonics. Synthetic phonics teaches students to decode words by blending individual phonemes, emphasizing the relationship between letters and sounds. For example, students learn the sounds for individual letters (e.g., /k/, /a/, /t/) and blend them into words like "cat" (Adams, 1990). Analytic phonics, in contrast, teaches students to analyze whole words to identify common phonemes and patterns, such as learning that "cat" and "bat" share the /at/ rhyme. These two approaches reflect different pedagogical strategies for building phonemic awareness and decoding ability (Hewings, 2004).

These methods align with broader theories of language acquisition. The multi-sensory structured language education (MSLE) approach is particularly relevant, as it integrates visual, auditory, and kinesthetic learning activities to reinforce phonics instruction (Ritchey & Goeke, 2006). The MSLE framework is widely used in phonics education because it caters to diverse learning styles and ensures that students engage with phonics concepts through multiple sensory pathways, facilitating long-term retention (Hook et al., 2017).

Summary: This section introduces key approaches to phonics education, including **synthetic** phonics (building words from sounds) and analytic phonics (analyzing word patterns). The multi-sensory structured language education (MSLE) approach is highlighted as a framework that reinforces learning through multiple sensory pathways.

Challenges in Phonics Education: A Thai Context

The acquisition of English phonics presents significant cognitive and linguistic challenges for Thai learners. While Thai is a tonal language with consistent phonetic rules, English contains numerous irregularities, such as silent letters and consonant clusters, which are difficult for non-native speakers to grasp (Jessada Wari, 2014). Additionally, Thai students often struggle with distinguishing between voiced and unvoiced consonants, such as /b/ and /p/, which pose challenges due to differences between English and Thai phonological systems. Smyth (2001) notes that Thai phonology lacks certain voiced and unvoiced contrasts, leading to difficulties for learners in producing and perceiving these sounds accurately in English.

These phonetic differences contribute to difficulties in reading comprehension and pronunciation, further compounded by limited exposure to native English speakers in rural areas. Hayes (2010) emphasizes that teachers in rural Thailand often lack opportunities for professional development, limiting their ability to expose students to authentic language use. Kirkpatrick (2010) highlights that in many parts of Southeast Asia, students struggle with pronunciation due to minimal contact with native speakers, which affects their oral language development.

Beyond linguistic challenges, Thailand's education system faces significant resource limitations, particularly in rural areas like Phetchaburi. Many schools rely on general educators to teach English, often without specialized training in phonics instruction. Hayes (2010) notes that rural teachers frequently teach multiple subjects, including English, despite lacking subject-specific expertise. Kirkpatrick (2012) also points out that these systemic constraints reduce instructional consistency, limiting students' progress in language learning. This shortage of qualified teachers leads to fragmented instruction, leaving students without the consistent practice needed to develop decoding skills (Perry & Nichols, 2014). Furthermore, traditional classroom methods emphasize grammar and rote memorization, which do not address the practical needs of phonics education. According to Baker and Prys Jones (1998), many education systems in Asia, including Thailand, rely heavily on grammar-translation methods, focusing on rules and repetition at the expense of communicative and phonics skills.

Summary: It explores the linguistic challenges Thai learners face, such as mastering irregular English sounds and distinguishing voiced and unvoiced consonants. The section also discusses how limited resources, teacher shortages, and reliance on rote learning in rural areas, like Phetchaburi, hinder effective phonics instruction.

The Role of Teachers and Instructional Methods in Phonics Education

The success of phonics instruction depends heavily on teachers' qualifications and instructional practices. In rural areas of Thailand, many schools assign general subject teachers to teach English, despite their limited expertise in phonics education. Hayes (2010) highlights that rural teachers in Thailand often face challenges related to inadequate training, leading to inconsistent instruction in specialized areas like phonics. Similarly, Kirkpatrick (2012) points out that across Southeast Asia, the shortage of qualified English teachers forces schools to rely on underprepared educators, reducing the effectiveness of language teaching. This leads to fragmented instruction, with teachers often lacking the skills to provide consistent and structured phonics lessons. Traditional teaching methods in Thailand also emphasize rote learning and grammar instruction, leaving little room for pronunciation practice or phonics-based activities. Kirkpatrick (2012) observes that language education across Southeast Asia often focuses on grammar and memorization, limiting opportunities for students to develop essential pronunciation and phonological skills.

Hewings (2004) argued that such traditional methods fail to equip students with the practical skills needed to decode unfamiliar words, which impairs their reading development and speaking proficiency. Teachers in rural areas face additional challenges, including a lack of resources and professional development opportunities, making it difficult for them to incorporate phonics instruction effectively into their lessons. Addressing these issues requires targeted teacher training programs that equip educators with the skills and resources needed to deliver high-quality phonics education.

Summary: Teacher expertise and instructional methods play a crucial role in phonics education. In rural Thailand, the lack of trained teachers and reliance on traditional teaching methods limit students' ability to develop phonics skills effectively.

Construction of Mobile Learning Applications for Phonics Education

Mobile learning applications offer a practical solution to address the challenges faced by students in learning phonics. Well-designed apps provide structured learning modules that align with the curriculum and cover essential areas such as consonant sounds, vowel patterns, and syllable segmentation (Jamaldeen, F., Kim, S., & Lee, H., 2019). Interactive features such as quizzes, progress tracking, and real-time feedback are critical for keeping students engaged and motivated (Gamlo, 2019). The construction of the mobile application developed for this study follows these principles, providing five modules with interactive exercises that reinforce key phonics concepts.

The inclusion of gamification elements, such as rewards and challenges, further enhances student engagement by creating a positive and enjoyable learning experience. Research suggests that gamified learning environments improve student motivation and encourage consistent practice (Jamaldeen, F., Kim, S., & Lee, H., 2019). This approach is particularly beneficial for Thai students, who may find traditional phonics instruction unengaging or difficult to follow. The mobile application aims to provide students with opportunities for self-directed learning while addressing the gaps in traditional classroom instruction.

Summary: Mobile learning applications are designed to align with phonics curricula and incorporate interactive elements like quizzes and feedback. Gamification helps sustain engagement and motivation, making phonics practice more enjoyable.

Mobile Learning in Language Instruction

The integration of mobile learning tools offers a promising solution to the challenges faced in phonics education, particularly in resource-limited settings. Research suggests that mobile learning enhances language acquisition by offering students personalized, flexible, and self-directed opportunities (Alrasheedi et al., 2015; Viberg & Grönlund, 2017). Mobile applications designed for phonics instruction can incorporate interactive exercises, quizzes,

and gamified elements to maintain student engagement and promote consistent practice (Mauri Medrano et al., 2023).

The use of gamification in mobile learning has gained traction in recent years, with studies highlighting its positive impact on motivation and learning outcomes. Gamified apps include features such as rewards, progress tracking, and leaderboards, which encourage students to engage with the material actively (Jamaldeen, F., Kim, S., & Lee, H., 2019). This approach aligns with motivational theories, such as Self-Determination Theory, which posits that individuals are more likely to engage in learning activities that foster autonomy, competence, and relatedness (Deci & Ryan, 1985).

However, implementing mobile learning in rural areas presents challenges. Technological barriers, such as unreliable internet access and limited availability of devices, can hinder the effectiveness of mobile learning interventions (Perry & Nichols, 2014). Additionally, Martin and Grudziecki (2006) emphasize that effective use of technology in education requires both technical proficiency and pedagogical knowledge, underscoring the need for continuous professional development programs that address these competencies. Addressing these challenges is essential to ensure equitable access to educational technology and maximize the impact of mobile learning initiatives.

Summary: This part reviews how mobile learning offers self-directed learning opportunities with gamification, real-time feedback, and flexibility. It emphasizes the motivational benefits of mobile apps, supported by theories like Self-Determination Theory, but also acknowledges challenges like limited internet access and teacher readiness.

Effectiveness of Mobile Learning for Phonics Education

Mobile learning provides students with flexible opportunities to practice phonics at their own pace, which is particularly valuable in settings with limited teacher support. Research shows that mobile apps for language learning enhance vocabulary retention, pronunciation accuracy, and overall engagement (Cui & Zheng, 2018). These tools offer students the chance to listen to native English speakers and practice pronunciation through repetition, which is critical for building fluency (Gamlo, 2019).

In rural Thailand, where access to trained teachers and native speakers is limited, mobile learning offers a practical way to provide consistent language practice. Students can engage with phonics exercises independently, revisiting challenging concepts as needed. This flexibility makes mobile learning an effective complement to traditional instruction, particularly in remote areas where formal educational resources are scarce. UNESCO (2018) reports that mobile technology enables students in remote regions to access educational content that would otherwise be unavailable, supporting personalized learning. Similarly, Cui and Zheng (2018) highlight the potential of mobile learning to overcome geographical barriers

by providing interactive and accessible resources, making it particularly effective in under-resourced environments..

Summary: Mobile learning enhances phonics education by providing self-directed, flexible practice opportunities. It supports pronunciation development through access to native pronunciation models and is particularly useful in rural settings.

Mobile Learning for Phonics Education: Addressing the Thai Context

Mobile applications designed for phonics education offer tailored solutions to the challenges faced by Thai learners. Video lessons and interactive exercises provide students with exposure to native English pronunciation, helping them overcome phonetic difficulties. Additionally, real-time feedback allows students to identify and correct their mistakes immediately, promoting more effective learning (Gamlo, 2019). The self-paced nature of mobile learning also enables students to revisit challenging concepts, catering to individual learning needs and fostering greater autonomy.

Several recent studies support the effectiveness of mobile learning for phonics education. For example, Burston (2014) found that mobile learning improves pronunciation and reading fluency by offering interactive exercises and real-time feedback. Similarly, Kim et al. (2019) demonstrated that mobile apps enhance student motivation and engagement, leading to better learning outcomes, especially in language education contexts. Similarly, Khansarian-Dehkordi and Ameri-Golestan (2013) reported that mobile learning enhanced vocabulary retention and student engagement, particularly in non-native English-speaking contexts. These findings demonstrate the potential of mobile applications to address the linguistic challenges faced by Thai students and improve phonics education outcomes.

Summary: This section focuses on how mobile apps can address specific challenges in Thailand, providing video lessons and interactive exercises to support pronunciation and reading fluency. It highlights the advantages of real-time feedback and the importance of self-paced learning to cater to individual needs.

Student Satisfaction and Learning Impact

Student satisfaction plays a crucial role in determining the success of educational tools. When students enjoy using learning applications, they are more likely to engage consistently and achieve better outcomes (Gamlo, 2019). The mobile application developed for this study aims to enhance student satisfaction by including features such as personalized feedback, interactive exercises, and progress tracking. These elements help students monitor their performance and identify areas for improvement, reinforcing their learning through regular practice.

Some scholars indicate that students are more motivated to use educational tools that provide real-time feedback, as it makes the learning process more interactive and less intimidating. According to Hattie and Timperley (2007), real-time feedback enhances learning

outcomes by promoting student engagement and allowing for immediate correction of mistakes. Similarly, Kim et al. (2019) found that mobile applications with interactive feedback features foster a positive learning environment by reducing anxiety and increasing motivation. By evaluating student satisfaction, this study ensures that the mobile application aligns with learners' needs and effectively supports their phonics development.

Summary: High levels of student satisfaction are essential for the success of learning tools. Features like feedback and progress tracking increase engagement, leading to improved learning outcomes.

Critical Analysis of the Literature

While existing studies highlight the benefits of mobile learning, they also reveal certain limitations. Many mobile applications lack features that cater specifically to the needs of non-native learners, such as adaptive content or offline access (Mauri Medrano et al., 2023). Additionally, research on mobile learning in rural settings often overlooks cultural attitudes toward technology and teacher readiness to adopt digital tools (Jamaldeen, F., Kim, S., & Lee, H., 2019). These factors can influence the success of mobile learning interventions, particularly in areas where traditional teaching methods dominate.

Another limitation in the literature is the reliance on quantitative measures, such as pretest-posttest assessments, to evaluate learning outcomes. While these metrics provide valuable insights, they may not capture the full range of student experiences or the nuanced challenges encountered during mobile learning interventions. Incorporating qualitative data, such as interviews and focus group discussions, can provide a more comprehensive understanding of the factors that influence learning outcomes (Demir & Akpınar, 2016).

Summary: A critical evaluation of the studies reveals gaps, such as the lack of adaptive content and limited offline access in existing mobile tools. It compares methodologies, noting the importance of combining quantitative and qualitative approaches to capture the full learning experience. Challenges like digital literacy and cultural attitudes toward technology are also discussed.

Summary and Connection to the Study's Objectives

This literature review highlights the cognitive, pedagogical, and technological challenges of phonics education in Thailand, emphasizing the need for innovative solutions that go beyond traditional instruction. Mobile learning offers a promising approach, providing students with engaging, self-directed learning opportunities that address the gaps in phonics education. However, the success of these interventions depends on addressing technological barriers and ensuring that mobile tools align with the needs of non-native learners.

The current study builds on the existing literature by developing and evaluating a mobile application tailored specifically to promote phonics skills among primary students in Thailand. By incorporating interactive exercises, gamification, and real-time feedback, the app aims to

engage students and improve learning outcomes. This research also addresses the limitations identified in previous studies by using a mixed-methods approach to capture both quantitative and qualitative data, providing a more comprehensive evaluation of the app's effectiveness.

Conceptual Framework

The conceptual framework connects the study's objectives with relevant theories, guiding the research by showing how mobile learning, phonics skills, and student outcomes interact. It aligns with constructivism (Piaget, 1950), emphasizing that students build knowledge through interactive learning, and self-directed learning theory (Knowles, 1975), which supports the importance of student autonomy through self-paced learning and real-time feedback. The framework also draws on Vygotsky's (1978) zone of proximal development, where the app acts as a scaffold, helping students gradually develop phonics skills through guided exercises. Gamification theory further supports the app design by using rewards, quizzes, and progress tracking to enhance engagement and motivation (Jamaldeen, F., Kim, S., & Lee, H., 2019).

Visually represented in Figure 1, the framework identifies the mobile app as the independent variable, with phonics skills and student satisfaction as dependent variables. Mediating variables, such as motivation and engagement, and external factors like teacher support, also influence outcomes. This framework ensures alignment between the research objectives and theoretical foundations, offering insights into how mobile learning enhances phonics education for Thai primary students.

Methodology

Figure 1 Conceptual Framework

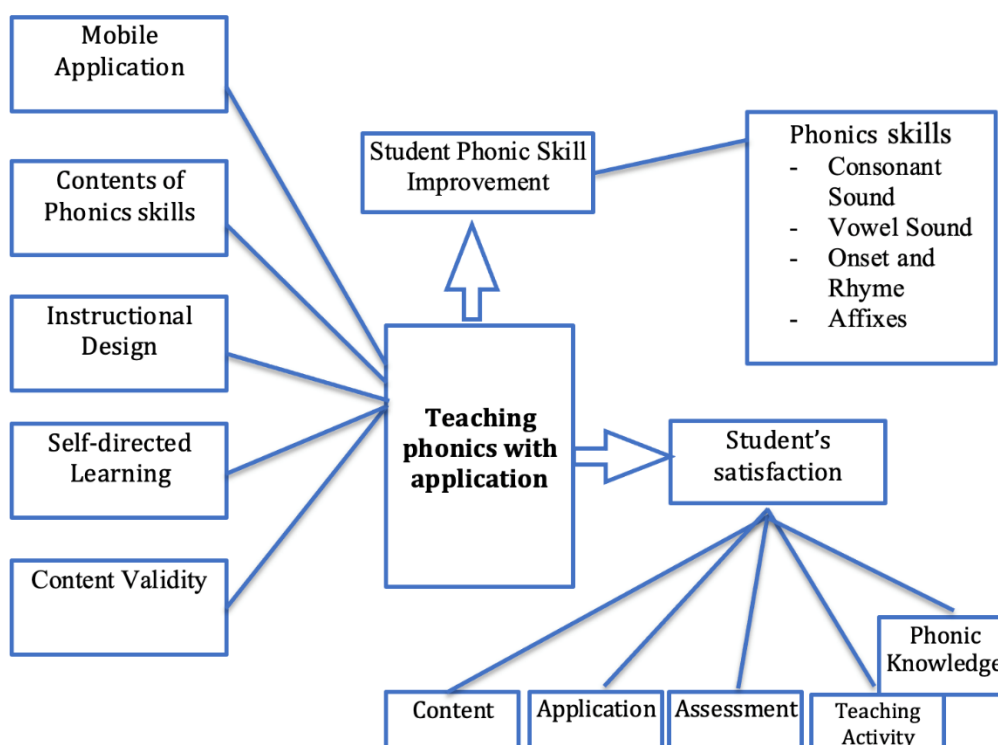


Figure 1 Conceptual Framework

Research Design

This study utilizes a mixed-methods experimental design to assess the effectiveness of a mobile application in improving phonics skills among primary school students. The research combines both quantitative and qualitative approaches, enabling a comprehensive evaluation of both learning outcomes and user experience. The quantitative component follows a two-group pretest-posttest structure, comparing student performance before and after the intervention. The qualitative component gathers feedback through surveys and interviews to better understand student satisfaction with the mobile learning experience. The participants are divided into two groups: (1) **Experimental Group**: Students who use the mobile application. (2) **Control Group**: Students who receive traditional phonics instruction. This mixed-method design ensures both objective measurement of phonics skill improvement and in-depth insights into student perceptions.

Sampling Design

A simple random sampling method was used to select one school, Watpraputhabat Khaolukchang School, from the Phetchaburi Educational Service Area 2. The rationale for choosing this school is based on its typical representation of the educational challenges in

rural Thailand, such as limited access to specialized English teachers. Grade 5 and Grade 6 students were selected because these grades represent a critical stage in phonics education, where students are expected to transition from foundational reading skills to more advanced comprehension. The sample consisted of 30 students, evenly divided into two groups: 15 in the experimental group (Grade 6) and 15 in the control group (Grade 5). Demographic characteristics, such as age, gender, and previous phonics exposure, were recorded to ensure that the groups were comparable.

Measurement Design

Pretest and Posttest Assessments: The study uses **pretest and posttest assessments** with a **60-item phonics skills test**. This test aligns with the national curriculum standards and covers essential phonics components such as consonant sounds, vowel sounds, and syllable patterns. To ensure the content is accurate and relevant, the test items underwent **expert validation using the Item-Objective Congruence method**. Five subject-matter experts reviewed the test and provided feedback to refine the questions.

To further ensure reliability, the test underwent discrimination analysis to identify items that effectively distinguish between high- and low-performing students. Poorly performing items were revised or removed to ensure the test measures phonics skills accurately.

Intervention Design and Implementation: *The experimental group used the mobile application for five weeks. Students engaged with the app both during class sessions and as part of their homework, using it four times per week for 30 minutes per session. Teachers guided students by introducing the modules and providing additional support when needed. Each module in the app focused on specific phonics elements—consonants, vowels, clusters, onset and rhyme, and suffix endings—ensuring comprehensive skill development. Meanwhile, the control group followed traditional phonics instruction, which involved teacher-led lessons using textbooks and worksheets. These lessons were conducted three times per week, focusing on similar phonics topics but relying on repetition and drills rather than interactive learning.*

Assessment Tools

The study used a 60-item phonics skills test for pretest and posttest assessments. The test was developed based on national curriculum standards, with items validated using the Item-Objective Congruence (IOC) method by five content experts. Items were refined through a pilot test to ensure clarity and relevance. The scoring system assigned one point per correct answer, with a total score out of 60. A satisfaction survey, using a 5-point Likert scale, was administered to the experimental group to assess usability, engagement, and learning outcomes.

Data Collection Process

Data was collected in three phases:

1) **Pretest Phase:** Both groups completed a pretest to establish a baseline for phonics skills.

2) **Intervention Phase:** The experimental group used the mobile application for 5 weeks, while the control group received traditional phonics instruction.

3) **Posttest Phase:** At the end of the intervention, both groups completed a posttest to measure learning outcomes.

To complement the quantitative results, satisfaction surveys and focus group interviews were conducted with students from the experimental group. These qualitative tools captured students' perceptions of the app, focusing on usability, engagement, and learning impact.

Data Analysis Methods

Quantitative Data Analysis

1) **Pretest-Posttest Comparisons:** A **paired t-test** was used to analyze the difference between pretest and posttest scores within the experimental and control groups, identifying whether significant improvement occurred.

2) **Between-Group Comparisons:** A **two-tailed t-test** was applied to compare the mean improvement between the experimental and control groups. A **p-value of less than 0.05** was considered statistically significant, indicating that the intervention had a meaningful impact.

3) **Reliability Testing:** To ensure the internal consistency of the test items, the study applied the **Kuder-Richardson 20 formula**. This formula yielded a reliability score of **0.87**, indicating high consistency across the test items.

Qualitative Data Analysis

Thematic analysis was used to analyze responses from the satisfaction survey and interviews. The researchers identified recurring themes related to the usability, engagement, and educational value of the mobile application. These insights provided a deeper understanding of how students experienced the learning process.

Ethical Considerations

The study adhered to ethical guidelines to ensure the safety and privacy of participants. Ethical approval was obtained from the school administration, and informed consent was collected from both students and their parents. Participation was voluntary, with students given the option to withdraw from the study at any point. Confidentiality was maintained throughout the research process, with all data anonymized to protect participants' identities.

Limitations of the Study

Several limitations were identified in this study:

Limited Scope: The research was conducted in one school, which may limit the generalizability of the findings to other contexts.

Short Intervention Period: The four-week intervention may not have been long enough to capture the full impact of the mobile app on phonics skills.

Technological Barriers: Some students encountered difficulties related to device availability and internet connectivity, which may have affected their engagement with the app.

These limitations are acknowledged to provide a balanced interpretation of the study's results.

This study adopts a mixed-methods approach to evaluate the effectiveness of a mobile application in improving phonics skills among primary students. The two-group pretest-posttest design provides measurable insights into phonics development, while qualitative feedback from students offers valuable perspectives on user satisfaction. The use of random sampling ensures fair group assignment, and the combination of statistical analysis and thematic evaluation ensures a thorough assessment of both learning outcomes and user experience. This methodology supports the goal of providing evidence-based insights into the effectiveness of mobile learning tools, particularly in resource-limited educational settings.

Results

This section presents the findings of the study, organized by the four research objectives. The results detail the development and effectiveness of a mobile application designed to improve phonics skills among primary students. It includes an analysis of students' phonics performance before and after using the app, along with a comparison between the experimental and control groups. Additionally, students' satisfaction with the app's usability and learning impact is evaluated to assess its practical value in promoting engagement and phonics development. Each objective is addressed with measurable outcomes, providing a clear overview of the study's achievements.

Objective 1: Development of a Mobile Application to Promote Phonics Skills

The mobile application was successfully developed to enhance phonics skills among primary school students. The app includes interactive modules focused on consonants, vowels, clusters, onset-rhyme patterns, and suffix endings. Each module integrates multimedia features such as audio guides, quizzes, and real-time feedback to ensure an engaging learning experience. The design aimed to align with the needs of young learners, offering self-paced practice opportunities and progress tracking.

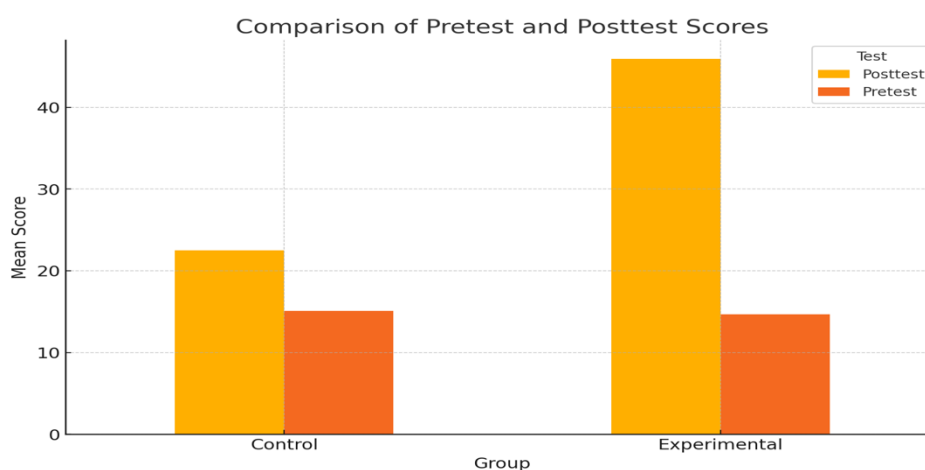
Objective 2: Validation of the Application's Effectiveness in Enhancing Phonics Skills

The research validated the effectiveness of the mobile app by comparing pretest and posttest scores. The experimental group's phonics skills significantly improved, with mean scores increasing from 14.7 in the pretest to 45.93 in the posttest, reflecting an average gain

of 31.23 points. An independent t-test confirmed that the difference between the pretest and posttest scores was statistically significant ($t = 29.84$, $p < 0.05$). This suggests that the mobile application effectively enhanced students' phonics abilities.

Objective 3: Comparison of Students' Phonics Skills Before and After Using the Application

A comparative analysis between the experimental and control groups was conducted to assess the impact of the mobile learning tool. Graph 1 summarizes the pretest and posttest scores for both groups.



Graph 1 Statistical Reporting and Phonics Skill Components

The results of the study demonstrate significant improvements in phonics skills among the experimental group compared to the control group. Pretest scores for the experimental group averaged 14.7, increasing to 45.93 in the posttest, a mean improvement of 31.23 points. The control group showed more modest gains, with pretest scores of 15.1 rising to 22.5 post-intervention, an improvement of 7.4 points. Independent t-tests confirmed the statistical significance of the differences between groups ($t = 29.84$, $p < 0.05$). Additionally, Cohen's d effect size for the experimental group was calculated at 2.3, indicating a large effect, suggesting substantial practical significance.

Confidence intervals for the experimental group improvement ranged from 28.5 to 33.9 points, showing a high degree of certainty in the results. A more detailed breakdown by skill component revealed that the most significant improvements were observed in **vowel sounds** (mean increase of 12.5 points) and **consonant clusters** (10.2 points), with smaller but meaningful gains in consonants, onset and rhyme, and suffix endings. These results highlight specific areas where the mobile app was particularly effective.

Satisfaction Survey Results: The satisfaction survey results indicated that students were highly satisfied with the usability and impact of the mobile application. On a 5-point Likert scale, 87% of students rated their experience with the app at 4 or higher, indicating positive engagement. Students reported that features such as real-time feedback and gamified elements made the learning process enjoyable. One student remarked, "The app was easy

to use, and I liked seeing my scores improve every time.” These findings confirm that the app not only facilitated learning but also created a positive and motivating learning environment.

Qualitative Feedback from Students: Thematic analysis of the focus group interviews revealed several recurring themes. Students found the app highly engaging due to its interactive exercises and real-time feedback. One student commented, “I liked that I could practice on my own and see my progress.” Feedback also highlighted the app’s usability, with students appreciating its straightforward navigation. However, some students reported technical challenges, such as occasional connectivity issues, which affected their ability to complete certain activities.

The feedback was categorized into three main themes: (1) **usability:** Easy-to-use interface and clear instructions. (2) **learning Engagement:** Enjoyment from gamified elements and flexible learning pace. (3) **Technical Challenges:** Occasional internet disruptions and limited device availability.

Linking Satisfaction with Learning Outcomes: An analysis of the satisfaction survey showed a positive correlation between student satisfaction and phonics improvement. Students who reported higher satisfaction scores (4.7 or above) showed a mean improvement of 33 points, compared to 28 points among students with lower satisfaction scores. This suggests that student engagement, driven by enjoyment and app usability, positively influences learning outcomes.

Contextual Challenges: During the intervention, some technical difficulties were encountered, such as inconsistent internet access and varying levels of student engagement. Additionally, a few students had limited prior experience with phonics instruction, which may have contributed to performance variability. These contextual factors provide important insights for refining the app and improving future implementations.

Conclusion

The study demonstrates that the mobile application significantly enhanced phonics skills among primary students, particularly in vowel sounds and consonant clusters, with the experimental group outperforming the control group. The interactive and self-paced nature of the app proved effective in promoting engagement, as students expressed satisfaction with features like real-time feedback and progress tracking, which made learning more enjoyable and reduced anxiety. Some students appreciated the ability to correct mistakes instantly and monitor their progress, which boosted their motivation. However, challenges such as limited internet access and uneven device availability highlighted the need for offline functionality and better technological infrastructure. The positive outcomes, combined with student feedback, confirm that mobile learning tools are a valuable complement to traditional instruction, offering scalable solutions for improving phonics education, especially in resource-limited settings. Future implementations should focus on refining the app, enhancing teacher training in digital literacy, and ensuring equitable access to technology to promote sustainable improvements in phonics learning.

Discussion

Results from Research Objective 1: Development of a Mobile Application to Promote Phonics Skills

The mobile application was successfully developed, featuring interactive modules targeting core phonics areas such as consonants, vowels, clusters, onset-rhyme patterns, and suffix endings. Gamified elements like progress tracking, badges, and rewards were integrated to increase student motivation, while real-time feedback allowed learners to correct mistakes immediately. These design choices reflect principles from behaviorist learning theories (Skinner, 1953) and align with Self-Determination Theory (Deci & Ryan, 1985), which emphasizes the importance of autonomy, competence, and relatedness for student engagement. The self-paced structure of the app also draws on constructivist principles (Piaget, 1950), empowering students to take ownership of their learning process.

Results from Research Objective 2: Validation of the Effectiveness of the Application

The mobile app significantly enhanced phonics skills among students. Pretest scores in the experimental group averaged 14.7, rising to 45.93 in the posttest, with a mean improvement of 31.23 points. Meanwhile, the control group showed a smaller increase from 15.1 to 22.5, with an average gain of only 7.4 points. An independent t-test confirmed the statistical significance of these results ($t = 29.84$, $p < .05$), with a large effect size (Cohen's $d = 2.3$) demonstrating the practical value of the mobile learning tool. The effectiveness of the app lies in its interactive design, offering real-time feedback that reinforces learning through repetition. These findings align with prior research that highlights how mobile apps enhance language learning by enabling frequent, self-directed practice (Hattie & Timperley, 2007; Kim et al., 2019).

Results from Research Objective 3: Comparison of Students' Phonics Skills Before and After Using the Application

The comparison between pretest and posttest scores further confirmed the value of mobile learning. Students in the experimental group exhibited significant gains across all phonics components, particularly in vowel sounds (mean increase of 12.5 points) and consonant clusters (10.2 points). In contrast, the control group showed minimal progress, reinforcing the importance of mobile learning in supplementing traditional instruction. This finding is consistent with studies showing that mobile applications improve language acquisition by providing students with engaging and flexible practice opportunities (Cui & Zheng, 2018). The ability to practice at their own pace, coupled with interactive features, allowed students to build confidence and master phonics skills effectively.

Results from Research Objective 4: Evaluation of Students' Satisfaction with the Application

The student satisfaction survey revealed positive feedback regarding the app's usability and learning impact. On a 5-point Likert scale, 87% of students rated their experience as 4 or higher, indicating high engagement and satisfaction. Students highlighted features like real-time feedback and progress tracking as motivating factors, with one student stating, "I liked practicing at my own pace and seeing my scores improve." The integration of gamified elements also contributed to a positive learning environment by reducing learning anxiety. These results align with research suggesting that interactive mobile tools increase student

motivation and improve academic outcomes by fostering a supportive and engaging learning experience (Viberg & Grönlund, 2017; Kim et al., 2019).

Limitations and Their Impact on the Study

The five-week intervention period may have been too short for students to develop long-term phonics fluency fully. While the results are encouraging, extending the intervention could provide more robust evidence of the app's long-term effectiveness. Additionally, the study was conducted in a single rural school, limiting the generalizability of the findings. Factors such as teacher involvement, student demographics, and the specific educational environment may have influenced the outcomes. Future research involving multiple schools across rural and urban areas would provide broader insights into the scalability of the mobile learning tool (Perry & Nichols, 2014).

Broader Implications for Educational Practices and Policy

The findings emphasize the value of mobile learning tools in resource-limited contexts. Mobile applications offer consistent, interactive phonics instruction, particularly in rural areas with limited access to specialized teachers. These findings align with global trends in educational technology, illustrating how mobile learning can complement traditional teaching methods. The integration of mobile learning tools also supports Thailand's 4.0 Educational Policy, which aims to modernize education through digital innovation (Jamaldeen et al., 2019). Moreover, the study highlights the need for professional development programs to equip teachers with the digital literacy skills necessary for effective technology integration. Research shows that teacher training improves instructional practices and fosters more student-centered learning environments (Hammond et al., 2020; Koh et al., 2017).

Integrating Mobile Learning Tools into Phonics Instruction

Successful integration of mobile learning tools into phonics education can be supported by examining case studies from other regions. For example, South Korea's "Smart Learning" initiative combined classroom instruction with mobile learning, resulting in improved reading fluency and engagement (Kim & Park, 2019). Similarly, the Eneza Education platform in Sub-Saharan Africa demonstrated the effectiveness of mobile apps in providing early literacy support to rural students through interactive exercises and real-time feedback (Tusiime, 2021). These examples offer practical insights into how mobile learning tools can complement traditional teaching and enhance student outcomes.

Future Research Directions

Challenges encountered during the intervention, such as internet disruptions and device limitations, suggest that future research should explore the effectiveness of offline mobile learning features. Additionally, extending the intervention period would provide more comprehensive evidence of the app's long-term impact on phonics mastery. Multi-site studies across diverse educational settings would further clarify the app's scalability and adaptability. Exploring correlations between student satisfaction and academic performance could yield valuable insights into how engagement influences learning outcomes.

Comparison with Previous Studies

The results align with previous research showing that mobile learning tools enhance engagement and improve pronunciation (Burston, 2014; Kim et al., 2019). However, the magnitude of improvement in this study exceeds that reported in other studies, such as Khansarian-Dehkordi and Ameri-Golestan (2013), likely due to the inclusion of real-time

feedback and self-paced learning. Differences between this study's results and those from other regions may also reflect cultural attitudes toward technology and varying levels of teacher involvement.

Alternative Explanations for Results

While the mobile application played a significant role in improving phonics skills, other factors such as teacher support and students' intrinsic motivation may have influenced the outcomes. Students in the experimental group received additional guidance from teachers, which may have contributed to their higher posttest scores. Additionally, students with prior phonics exposure or a greater interest in learning English may have engaged more effectively with the app. Future research could address these variables through stratified sampling or pre-study screening to improve the reliability of the findings.

This study provides compelling evidence for the effectiveness of mobile applications in enhancing phonics skills, particularly in resource-limited settings. The most significant improvements were observed in vowel sounds and consonant clusters, validating the app's targeted approach. However, challenges such as internet access and device availability remain important considerations for scaling mobile learning solutions. This research contributes to the growing body of literature on mobile-assisted phonics education, offering practical insights for educators, policymakers, and developers. Future efforts should focus on developing offline learning features, extending intervention periods, and conducting multi-site studies to provide more comprehensive evidence of the app's effectiveness across diverse educational settings.

Recommendation

Suggestions for Applying Research Results

Results from Research Objective 1: Development of a Mobile Application

The results show that a mobile application was successfully developed to enhance phonics skills through interactive modules focusing on consonants, vowels, clusters, and other key areas. Gamified elements and real-time feedback were key design features that promoted engagement and learning. Therefore, relevant agencies should take action as follows:

- 1) **Educational institutions** should consider adopting similar mobile learning tools to complement traditional phonics instruction.
- 2) **Developers and educators** could collaborate to further refine the app, integrating more features aligned with national curricula and local educational needs.
- 3) **Schools** in rural areas should be equipped with the necessary technology to facilitate the use of mobile learning applications.

Results from Research Objective 2: Validation of the Effectiveness of the Application

The study validated the effectiveness of the mobile app, with significant improvements in phonics skills observed in the experimental group compared to the control group. Therefore, relevant agencies should take action as follows:

- 1) **Education policymakers** should promote the adoption of mobile learning tools within national strategies for improving literacy.
- 2) **School administrators** could implement teacher-led workshops to ensure that educators are familiar with effective ways of incorporating mobile tools into phonics education.

3) Ministries of Education could include mobile learning platforms as a part of standard instructional resources for primary schools.

Results from Research Objective 3: Comparison of Students' Phonics Skills Before and After Using the Application.

The comparison between pretest and posttest scores confirmed that students who used the mobile app significantly outperformed those who received only traditional instruction. Therefore, relevant agencies should take action as follows:

1) School leaders should promote a blended learning model where mobile tools are integrated with traditional instruction to optimize learning outcomes.

2) Technology providers and educational stakeholders could work together to address infrastructure challenges, ensuring that all students have equal access to mobile learning tools.

3) Community organizations should collaborate with schools to create **learning hubs** equipped with devices and internet access, helping students continue learning outside of class hours.

Results from Research Objective 4: Evaluation of Students' Satisfaction with the Application

The satisfaction survey revealed that students responded positively to the mobile app's interactive features, especially real-time feedback and gamification, which reduced learning anxiety and increased motivation. Therefore, relevant agencies should take action as follows:

1) Educational designers should focus on developing student-friendly applications with interactive elements to enhance engagement.

2) Parents and schools should foster home environments that encourage children to use educational apps regularly.

3) Teachers should integrate feedback-driven tools in their teaching practices to maintain student motivation and involvement in learning activities.

Suggestions for Future Research

This research has provided insights into how mobile applications can effectively promote phonics skills, particularly in resource-limited contexts. The important takeaway is that mobile learning tools can bridge gaps in teacher expertise and increase student engagement, especially through gamification and real-time feedback. These findings can be applied to other areas of literacy education, such as vocabulary development and oral communication. Researchers should give importance to the following aspects in future research:

1) Future research should focus on **evaluating the long-term impact** of mobile learning tools on language acquisition beyond phonics, including reading comprehension and spoken fluency.

2) Researchers should explore **adaptive learning algorithms** that tailor content to individual learners' progress and needs, maximizing the effectiveness of mobile tools.

3) Multi-site studies across different schools and regions would provide **broader insights** into how different educational environments affect mobile learning outcomes.

4) Investigations into the **impact of offline mobile learning** features will be essential for ensuring equitable access in areas with limited internet connectivity.

5) Future research could also examine **how teacher professional development programs** impact the successful integration of mobile learning tools, ensuring that technology complements instructional practices effectively.

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