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Enhancing Chinese Listening Proficiency through Digital Applications: A Case Study of Thai Primary Students Using the Hong En Literacy App

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Abstract

Listening is one of the most challenging skills for Thai primary students learning Chinese, due to limited exposure to authentic spoken input and insufficient classroom time for listening practice. This study aimed to examine the effectiveness of the Hong En Literacy App in enhancing Chinese listening proficiency among Thai primary school students. A quasi-experimental design was employed involving 60 students from Grades 3 and 4 at a public primary school in Chiang Mai Province, divided equally into an experimental group using the app and a control group receiving traditional instruction. Data were collected through pre-test and post-test focused on Chinese listening skills along with classroom observations to record engagement and interaction. The results revealed that the experimental group significantly outperformed the control group in post-test scores ($M = 70.50$ vs. 41.17, $p < 0.05$), Beyond score improvements, the Hong En Literacy App facilitated learning through its interactive features, including speech recognition, gamified activities, and animated content. These elements enhanced student engagement, supported self-paced learning, and allowed for repetitive practice tailored to individual needs -key components of self-regulated learning. For teachers, the app offers a scalable, curriculum-aligned tool that supplements classroom instruction and reduces learner anxiety during oral tasks. These findings underscore the potential of curriculum-aligned digital tools to close skill gaps in foreign language learning at the primary level. The integration of the Hong En Literacy App not only supports measurable learning outcomes but also demonstrates a scalable solution for schools aiming to enhance Chinese language education through technology.

Keywords: Digital Applications, Chinese Listening Proficiency, Primary Education, Hong En Literacy App, Language Instruction, Educational Technology

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Introduction

In recent years, the advancement of digital technology and the impact of global disruptions such as the COVID-19 pandemic have drastically reshaped educational practices, particularly in the field of language learning. Digital tools—ranging from mobile applications to interactive platforms—have become increasingly integrated into classrooms to support flexible, learner-centered approaches. Among the core language skills, listening is often recognized as both foundational and challenging, particularly in tonal languages like Chinese, where phonetic precision and contextual comprehension are critical for communication success. In Thailand, Chinese has become one of the most popular foreign languages in primary education, driven by growing economic and cultural exchanges between the two countries. However, many Thai primary students face persistent challenges in developing Chinese listening proficiency. These include limited exposure to authentic spoken Chinese, insufficient instructional time for listening practice, and high anxiety during oral classroom interactions. Such issues are often compounded by a lack of engaging materials and individualized learning opportunities in traditional classroom settings.

Existing studies have highlighted the potential of digital applications in language acquisition, especially those designed based on established learning theories such as Krashen's Input Hypothesis and Self-Determination Theory (Krashen, 1982; Deci & Ryan, 2020). More recently, Ma (2024) demonstrated that using the Quizlet app significantly improved Chinese listening, speaking, and reading skills among university students in China. Similarly, Puspitasari et al. (2024) showed that digital storytelling had a statistically significant effect on listening comprehension scores among secondary school learners. In English language contexts, multimedia and storytelling strategies have also proven effective. For example, Wang (2023) reported substantial improvements in English listening performance using multimedia-based noise filtering technologies in university-level instruction, while Moyo (2024) synthesized evidence confirming the benefits of digital storytelling for listening proficiency across education levels. Despite such promising findings, there remains a noticeable research gap in the application of digital listening tools for young learners of Chinese as a foreign language, particularly within Thai educational settings. Few empirical studies have examined how these tools influence listening outcomes in early language acquisition.

This research is particularly significant in the Thai educational context, where the integration of educational technology into foreign language instruction is still at a developing stage. By evaluating a structured and curriculum-aligned digital tool, this study contributes to evidence-based decision-making for teachers, schools, and policymakers seeking to modernize language teaching methods. It also responds to the national policy emphasis on 21st-century skills, such as digital literacy and independent learning, which are increasingly important for young learners in a globalized world. To address these gaps, this study investigates the use of the Hong En Literacy App, a mobile learning application featuring animated content, phonetic drills, and comprehension tasks designed for young Chinese language learners. Specifically, the study seeks to answer the research question: Does the Hong En Literacy App effectively improve Chinese listening proficiency among Thai primary school students (aged 9–11) in comparison to traditional listening

instruction methods? The study focuses on evaluating learner outcomes in listening proficiency, offering practical implications for integrating digital applications into primary foreign language education in Thailand and similar contexts.

Research Objectives

(1) To examine the effectiveness of using the Hong En Literacy App as a learning activity tool in improving Chinese listening proficiency among Thai primary school students.

(2) To compare learner outcomes in Chinese listening proficiency between students who participate in learning activities using the Hong En Literacy App (experimental group) and those who receive traditional listening instruction (control group).

Literature Reviews

Chinese listening comprehension serves as a foundational pillar of language acquisition, directly influencing learners' ability to communicate effectively and develop complementary skills in speaking, reading, and writing (Ge, 2011). For Thai primary students, mastering this skill poses unique difficulties, primarily stemming from three interrelated factors: the tonal nature of Chinese (which demands precise phonetic discrimination), limited exposure to authentic spoken Chinese in daily and classroom settings, and insufficient individualized practice opportunities in traditional teacher-centered instruction—all of which were highlighted in the study's introduction.

Theoretical frameworks in second language acquisition (SLA) provide critical guidance for addressing these challenges. Krashen's (1982) Input Hypothesis emphasizes that "comprehensible input"—linguistic materials that are accessible, context-rich, and slightly beyond the learner's current proficiency level—is essential for language development. This aligns directly with the need to resolve Thai students' limited exposure to authentic Chinese: effective listening tools must deliver varied, contextually appropriate content to help learners distinguish phonemes, tones, and semantic nuances. Complementing this, Ge (2011) further identifies that structured listening training (e.g., repetitive drills targeting tonal recognition) and strategy cultivation (e.g., predicting content from contextual cues) significantly improve overall proficiency, addressing the "insufficient practice" gap in traditional classrooms.

In recent years, researchers have explored how instructional methods can enhance the quality of listening input. Hu (2022) proposed a task-based listening approach, which links practice to real-life communication needs (e.g., understanding conversations about occupations) to boost learner engagement and relevance. Similarly, Su (2005) noted that multimedia Chinese textbooks—unlike static print materials—integrate sound, animation, and images to vividly demonstrate pronunciation and context, addressing the lack of interactivity in conventional instruction. Dai & Lü (2019) further supported this by showing that

graphic visualization of listening materials improves information retention, particularly for young learners who benefit from multisensory input. Together, these studies establish the theoretical and methodological basis for designing effective Chinese listening instruction, but they primarily focus on general instructional strategies rather than age-specific digital tools.

Digital Tools in Language Learning: Platforms, Engagement, and Outcomes

The integration of digital tools into language education has emerged as a key solution to address the limitations of traditional instruction, with a growing body of research highlighting their impact on listening proficiency—especially for young learners of phonologically complex languages like Chinese. This research can be organized around three core themes: digital platform effectiveness, learner engagement mechanisms, and comparisons with traditional instruction.

Digital Learning Platforms and Listening Proficiency

Studies on digital platforms have demonstrated their ability to deliver structured, self-paced listening practice that aligns with SLA principles. Gao and Song (2022) found that integrating situational teaching with digital tools (e.g., interactive audio dialogues) significantly improved English listening, speaking, and reading performance among learners, as the tools provided context-driven input and opportunities for repeated practice. Zheng (2022) similarly showed that mobile-based digital media in foreign language classrooms enhanced listening outcomes by offering multisensory input (audio + visuals) and repeatable exercises aligned with course objectives—features that address the “limited exposure” challenge for Thai students.

For Chinese language learning specifically, Ma (2024) investigated the Quizlet app and found it significantly improved Chinese listening, speaking, and reading skills among Chinese university students. Puspitasari et al. (2024) extended this to secondary education, demonstrating that digital storytelling (a form of interactive digital content) had a statistically significant positive effect on listening comprehension scores for secondary school language learners. While these studies confirm the value of digital tools for listening instruction, they focus on older learners (university and secondary students) and lack exploration of tools tailored to the developmental needs of primary students (e.g., gamified interfaces, simplified tasks).

Digital Tools and Learner Engagement

A key advantage of digital tools over traditional instruction lies in their ability to boost learner engagement—a critical factor for young learners (aged 9–11) who may struggle with sustained attention in conventional classrooms. Self-Determination Theory (SDT), as outlined by Deci & Ryan (2020), provides a framework for this: digital tools often support autonomy (self-paced practice), competence (immediate

feedback on exercises), and relatedness (interactive, game-like tasks), which in turn enhance intrinsic motivation.

Wang (2023) illustrated this in English language instruction, showing that multimedia-based noise-filtering technologies improved university students' listening performance by increasing engagement through personalized, distraction-free practice. Similarly, Yang & Meng (2024) found that AI-driven tools (e.g., ChatGPT) in English listening and speaking classes enhanced learner responsiveness by adapting to individual needs—reinforcing that engagement from tailored digital experiences translates to better learning outcomes. For Thai primary students, who face high anxiety in oral classroom interactions (per the introduction), such engaging digital tools could reduce stress while increasing practice time—yet few studies have tested this for young Chinese learners.

Comparisons with Traditional Instruction

Several studies explicitly compare digital tools to traditional instruction, highlighting clear advantages for the former. Liu (2024) analyzed national-level digital language education reforms in China and found that structured online tools (aligned with curricular standards) improved teaching effectiveness and learner autonomy compared to traditional teacher-centered methods. Zhang (2016) similarly noted that online teaching resources promoted autonomous learning—allowing learners to revisit materials outside class—whereas traditional instruction was constrained by fixed class time and limited individualized feedback.

However, these comparisons also reveal challenges in digital integration. Xu & Liu (2021) identified barriers such as internet instability, unequal access to devices, and reduced teacher-student interaction in digital environments—issues that are particularly relevant in Thai primary schools, where digital infrastructure may vary. Gao (2022) specifically highlighted the Hong En Literacy App as a potentially effective tool for Chinese listening development among young Thai learners but provided no empirical data to support this claim. This gap—between theoretical potential and empirical evidence for age-specific, contextually adapted digital tools—underscores the need for the current study.

Self-Regulated Learning Frameworks and Digital Tool Integration

Self-regulated learning (SRL)—the ability to plan, monitor, and evaluate one's own learning—is increasingly recognized as a key 21st-century skill, and digital tools play a pivotal role in fostering it. Zimmerman (2002) defined SRL as a cyclical process involving goal setting, strategy use, and reflection, which aligns with the features of many language learning apps (e.g., progress tracking, self-paced modules).In language education, Dickinson (1987) emphasized that self-instruction—supported by digital tools—empowers learners to take control of their practice, addressing the "insufficient individualized practice" gap in traditional classrooms. Wang (2012) and Zhang (2016) further noted that new media and online resources

promote SRL by allowing learners to access listening materials anytime, anywhere, and repeat exercises until mastery. For Thai primary students, who may have varying levels of Chinese proficiency in the same class, SRL-supporting tools can help bridge individual skill gaps.

However, existing research on SRL and digital tools in Chinese listening instruction focuses primarily on older learners (e.g., university students in Ma, 2024). There is a lack of studies exploring how SRL-aligned digital tools (e.g., the Hong En Literacy App, with its self-paced drills and progress tracking) can support young primary students—who require more guidance and gamified incentives to engage in self-regulated practice.

Research Gap and Link to the Current Study

Despite the growing body of research on digital tools in language education, three critical gaps remain, which the current study aims to address:

Age-specific tool gap: Most prior studies (e.g., Ma, 2024; Puspitasari et al., 2024; Yang & Meng, 2024) focus on university or secondary school learners. Few empirical studies explore digital listening tools tailored to the developmental needs of primary students (aged 9–11), such as gamified interfaces or simplified, curriculum-aligned tasks—even though primary education is a critical period for building foundational language skills.

Contextual gap: Existing research on digital Chinese listening instruction is largely conducted in China (e.g., Ma, 2024; Liu, 2024) or for English language learning (e.g., Gao & Song, 2022; Wang, 2023). There is a dearth of studies in the Thai educational context, where students face unique challenges (limited authentic Chinese exposure, high classroom anxiety) and where digital infrastructure and learner needs differ from other regions. Gao (2022) suggested the Hong En Literacy App's potential for Thai young learners but provided no empirical data.

Link between theory, tools, and outcomes: While studies cite theories like Krashen's Input Hypothesis or SDT (e.g., Deci & Ryan, 2020), the connection between these theories, the design of specific digital tools, and measurable listening outcomes for primary students is underdeveloped. For example, how do features like the Hong En Literacy App's phonetic drills or animated dialogues directly operationalize "comprehensible input" (Krashen, 1982) to improve tonal recognition for Thai students?

This study addresses these gaps by:

Focusing on Thai primary students (aged 9–11) to fill the age-specific and contextual voids;

Empirically testing the Hong En Literacy App—a tool designed for young learners with features (gamified reviews, self-paced drills, animated content) that align with SLA theories (Input Hypothesis, SDT) and address Thai students' unique challeng;

Explicitly comparing the app to traditional instruction to clarify its added value, while linking tool features to measurable listening outcomes (e.g., post-test scores) to strengthen the theory-practice connection.

By doing so, the study contributes novel empirical evidence to the limited research on age-appropriate, contextually adapted digital tools for Chinese listening instruction in primary education—while also providing practical guidance for Thai schools seeking to integrate technology into foreign language teaching.

■ Methods

This study adopted a quasi-experimental design (pre-test, intervention, post-test) to examine the effectiveness of the Hong En Literacy App in improving Chinese listening proficiency among Thai primary students. The design was grounded in Zimmerman's (2002) Self-Regulated Learning (SRL) framework—integrating forethought, performance, and self-reflection phases—to strengthen theoretical alignment. Meanwhile, strict controls for instructional content, time, and teacher involvement were implemented to ensure fair comparison between the experimental (app-based) and control (traditional instruction) groups.

Participants

This study was conducted among third and fourth graders at a public primary school in Chiang Mai, with a total of 60 students participating. To ensure the objectivity of the results, these students were randomly divided into an experimental group and a control group. The experimental group engaged in listening learning by using the Hong En Literacy App, while the control group adopted traditional listening teaching methods. All participants had completed at least one semester of Chinese courses and possessed basic Chinese communication skills, with no significant differences in gender, age, or pre-test listening scores between the two groups ($p > 0.05$), ensuring baseline comparability.

Experimental Procedures

This study employs a quasi-experimental design, comprising pre-test, intervention, and post-test phases, aiming to investigate the impact of the Hong En Literacy APP on enhancing Chinese listening skills among primary school students in Thailand.

It is worth noting that in the intervention design of this study, the self-regulated learning (SRL) theory framework proposed by Zimmerman (2002) was incorporated, including three stages: anticipation, performance, and self-reflection, to enhance the theoretical basis of the research. The specific design is as follows:

During the pre-intervention week, a one-week forward phase, both groups of students attended a 45-minute guidance session. The experimental group was introduced by the teacher to the core functions of Hong En Literacy APP (such as progress tracking, audio playback), and was guided by the teacher to set personalized goals in the "learning log" provided by the researchers (such as "master 5 vocational-related

words per week"). The control group, under the guidance of the teacher, set the same goals related to traditional teaching tasks (such as "complete 1 paper practice per week") and recorded them in the same log.

During the intervention preparation stage, the research subjects were 60 students aged 9-11 from a public primary school in Chiang Mai, Thailand. They were divided into an experimental group and a control group (each consisting of 30 students). Both groups underwent a pre-test of Chinese listening skills to establish a baseline level. The statistical results showed that there were no significant differences between the two groups in terms of gender, age, and pre-test scores ($p > 0.05$), indicating comparability.

The following 8-week intervention stage is the performance stage. Both groups maintain consistency in teaching content, time, and teacher participation to ensure fair comparison: The teaching content is based on Lesson 6 of Volume 5 of 《开开汉语》 covering 20 occupational vocabulary words (such as "teacher") and 10 sentence patterns (such as "My mother is a teacher"); the teaching time is 15 minutes of listening training each time, 3 times a week, with a total duration of 360 minutes; in terms of teachers, each group is taught by 2 teachers, all with a unified language presentation style (such as tone demonstration) and feedback frequency (providing one-on-one feedback to 5 students per class), and the teacher interaction records are checked weekly.

The experimental group used the Hong En Literacy APP for listening practice, including tasks such as speech recognition, semantic understanding, and interactive animation. This application supported SRL performance in two aspects: a real-time progress bar displayed the practice time and test scores to promote self-monitoring, and immediate audio playback and tone prompts (such as "'Shi' is the first tone") to enhance self-control. The control group adopted traditional listening teaching methods, but the SRL support was the same as that of the experimental group: self-monitoring was achieved through weekly paper progress reports (such as "You have mastered 3 out of 5 words"), with the frequency of classroom feedback consistent with that of the experimental group, and the teaching content was delivered through paper materials (with the same visual content as the application vocabulary cards), teacher audio readings (consistent with the application recordings), and physical card matching games (simulating the "fried egg game" in the application).

Finally, during the self-reflection session held every weekend, both groups of students engaged in 10-minute learning reflection: The experimental group answered questions such as "Have you achieved the goals for this week? Which application functions were helpful? How should you adjust next?" ； The control group had similar questions but focused on traditional teaching activities. After the intervention, both groups took the same post-test in Chinese listening to assess the improvement in listening skills. In addition, the study also recorded students' participation, interaction frequency and emotional responses during the listening activities through classroom observations and collected learning reflections (for analyzing the SRL process) and application usage data (only for the experimental group, such as the frequency of audio playback) to comprehensively capture the results related to SRL. A summary of the research design is shown in Figure 1.

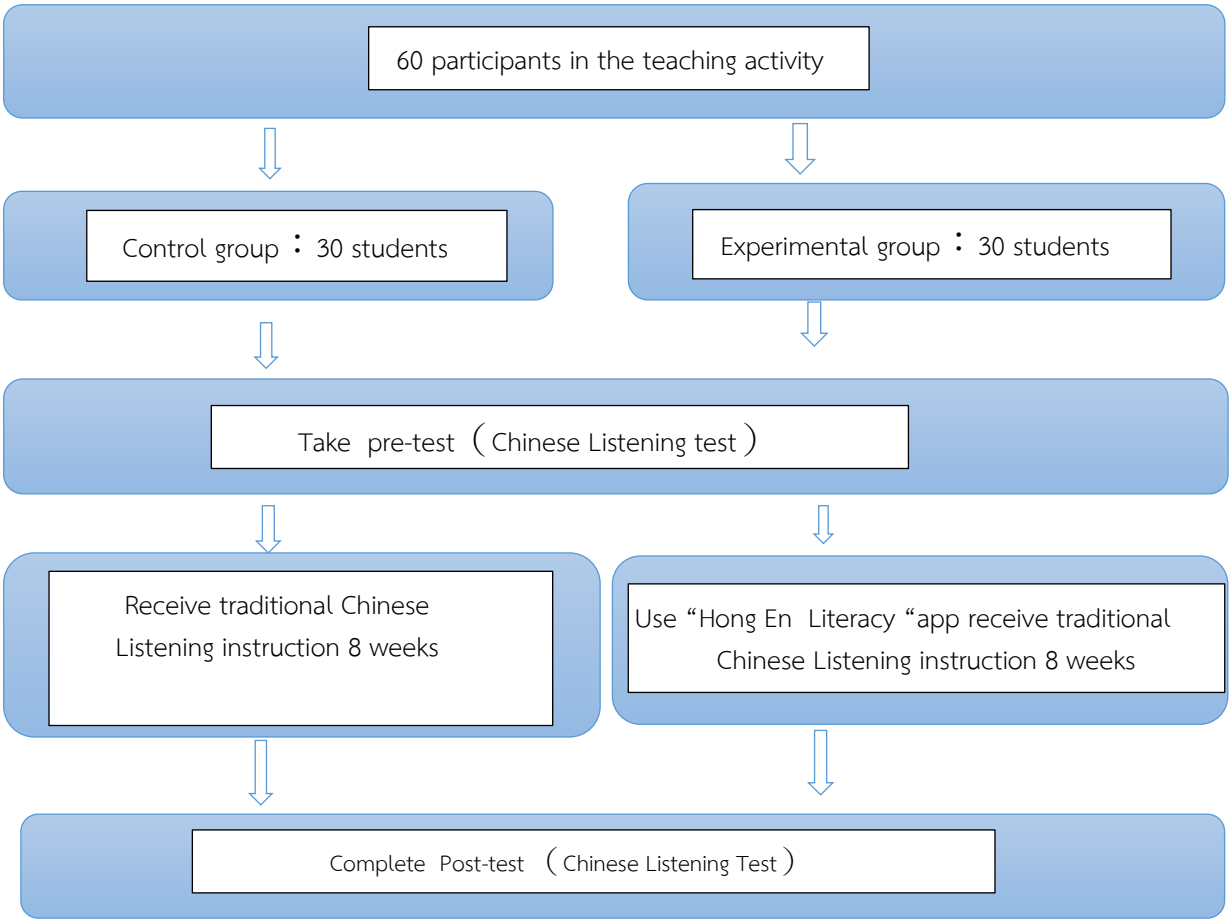


Figure *1*. Experimental Procedures

Figure 1 shows the complete quasi-experimental process of this study, which is designed to ensure the fairness of the comparison between the two groups. First, 60 students were randomly divided into two groups with the same sample size (30 each), and a pre-test confirmed that their baseline listening skills were similar ($p > 0.05$)—this means the subsequent score difference was not due to prior ability gaps. During the 8-week intervention, only the experimental group used the Hong En Literacy App, while the control group used traditional methods; this single variable design allows researchers to accurately attribute the post-test score difference to the app. Finally, through paired t-tests (testing within-group progress) and independent samples t-tests (testing between-group differences), the study comprehensively verifies the app’s effectiveness. For app developers, this flowchart also provides a clear reference for future educational experiment designs.

Instruments and Data Collection

To meet the research objective and design, the research instruments for this study were utilized as follows:

Pre-test and Post-test

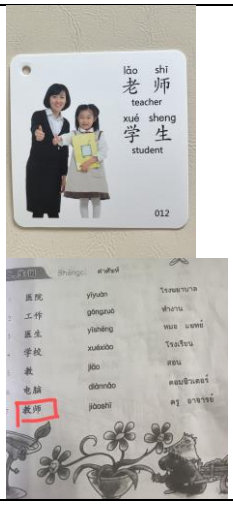
This test is divided into a pre-test and a post-test, aiming to evaluate the changes in students' hearing levels before and after the intervention. There are a total of five questions, including multiple-choice questions, matching questions, word sequencing questions, etc., with a maximum score of 100. The contents of the two tests are exactly same to ensure comparability. The pre-test is conducted before the teaching to assess the baseline level, while the post-test is carried out after the intervention to measure the improvement in learning outcomes. The differences in scores between the pre-test and post-test of each group were analyzed using paired t-tests, and the performance of the experimental group and the control group was compared using independent t-tests.

Teaching Materials and Activities

This teaching content is designed based on the Chinese listening learning needs of Thai primary school students in grades 3-4 who have basic communication skills in Chinese. It is based on Lesson 6, "我想成为科学家（I Want to Be a Scientist）" from Volume 5 of 《开开汉语》, aiming to gradually enhance students' core listening skills and learning engagement. The course is divided into three stages: (1) Vocabulary introduction stage: The pronunciation, usage and pictures of the vocabulary are presented on cards. (2) Text learning stage: The teaching focuses on sentence structure analysis and vocabulary context. (3) Review and consolidation stage: The Hong En Literacy app is used for interactive teaching to improve students' listening skills and help them remember occupation-related vocabulary. Among them, the experimental group participates in the above-mentioned game-based interactive activities, while the control group adopts the traditional teaching mode. The detailed classification of teaching content and activities is shown in Table 1.

Table 1.

Teaching Process and Corresponding Content for Chinese Listening Instrument

Teaching Section	Course Contents	Content Display
Vocabulary Introduction	The vocabulary section is taught using vocabulary cards, where each card shows the spelling, pronunciation and picture of the word. （Note: The words shown in the textbook are "教师", which is the same as "老师", but for the convenience of writing and simplicity, it is more appropriate to uniformly refer to them as "老师". Therefore, the subsequent games will also use the expression "老师"）	

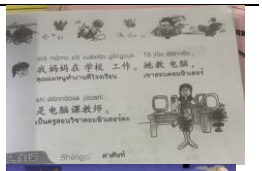
Teaching Section	Course Contents	Content Display
Text Learning	This article focuses on the theme of "occupation". Students will learn to introduce their parents' occupations in Chinese, such as "My mother is a teacher", etc.	
Review and Consolidation	The assessment is conducted in a gamified form, using the Hong En Literacy app to allow students to review in a relaxed and enjoyable atmosphere, thereby improving the retention rate of memory. For example: By reading Chinese characters and sentences, students practice their listening skills and understanding of these. Then, based on the sounds they hear, they identify the correct order of each character and combine them into a sentence. Finally, the "fried egg" game reviews the vocabulary again, based on what they hear, for example: 师生（teacher and students）, t（老师）teacher, choose the egg with "师" written on it.	 

Table 1 details the three-stage teaching design for Chinese listening instruction, which is aligned with the learning needs of Thai primary students (Grades 3–4) with basic Chinese communication skills. The core difference between the two groups lies in the review stage: the experimental group uses gamified interactions on the Hong En Literacy App (e.g., audio-guided character sequencing, visual "fried egg" vocabulary games), while the control group relies on traditional teacher-led repetition and paper exercises. This design ensures that only the "use of the app" is the variable difference between the two groups, laying a foundation for testing the app's effectiveness in subsequent experiments.

SRL Process Measures

Learning Logs: Coded by two researchers using a 3-point scale (1 = "No clear goal/reflection," 2 = "Basic goal/reflection," 3 = "Detailed goal/reflection") to assess forethought and self-reflection. Inter-coder reliability was α = 0.89 (acceptable for research standards).

App Usage Data (Experimental Group Only): Automatically generated by the app, including practice time per session, audio replay frequency, and weekly goal completion rates—used to measure performance-phase self-monitoring and self-control.

Teacher Fidelity Checks

Teachers (2 per group) completed a 2-hour pre-intervention training to standardize instruction (e.g., same tonal explanation language, 30-second feedback intervals).

Teacher logs recorded interaction frequency (2 minutes of whole-class interaction + 3 minutes of 1-on-1 interaction per session), checked weekly by researchers to ensure balanced involvement.

Analysis of Data

This study utilized pre-test and post-test to examine the changes in students' performance after using the Hong En Literacy App. Subsequently, these data were analyzed using SPSS software. Descriptive statistics were employed to calculate the average and standard deviation of the post-test scores of the two groups of students, and t-tests were used for statistical analysis. Additionally, qualitative analysis of learning logs (thematic coding) and app usage data was conducted to supplement quantitative results and interpret SRL engagement.

■ Results and Discussion

Results of Demographic Information for Participants

A total of 60 Thai primary school students aged 9–11 from a public primary school in Chiang Mai Province participated in this study, with 30 in the experimental group and 30 in the control group. All participants had completed at least one semester of Chinese courses and possessed basic Chinese communication skills. There were no significant differences in gender, age, or pre-test listening scores between the two groups ($p > 0.05$), indicating comparability at baseline.

Results of Descriptive Statistics of Post-test Scores

Table 2 presents the descriptive statistics of Chinese listening post-test scores for both groups after the 8-week intervention.

Table 2.

Descriptive Statistics of Chinese Listening Post-test Scores by Group

Group	n	M	SD	SE
Control Group	30	41.17	16.28	2.97
Experimental Group	30	70.50	12.85	2.35

Note. n = sample size; M = mean post-test score (maximum score = 100); SD = standard deviation; SE = standard error of the mean.

The results showed that the mean score of the experimental group (70.50) was significantly higher than that of the control group (41.17), with a mean difference of 29.33. The standard deviation of the experimental group (12.85) was smaller than that of the control group (16.28), indicating that the academic

performance of students in the experimental group was more consistent. Meanwhile, the standard error of the mean (SE = 2.35) of the experimental group was lower than that of the control group (SE = 2.97), which suggested a more accurate estimation of the mean value for the experimental group. To examine whether the difference in post-test scores between the two groups was statistically significant, an independent samples t-test was conducted in this study. The result of Levene's Test for Equality of Variances was F = 3.21 and p = 0.078 > 0.05, indicating that the variances of the two groups were homogeneous and the application condition of the t-test was satisfied (Table 3).

Table 3.

Independent Samples t-Test Results for Chinese Listening Post-test Scores

Variable	t	df	*p*	Mean Difference	95% Confidence Interval for Mean Difference
Post-test Score	-8.67	58	< 0.001	-29.33	Lower = -35.84, Upper = -22.82

Table 3 tests whether the post-test score difference between the two groups is statistically significant (i.e., not due to random chance). First, Levene's Test (F = 3.21, p = 0.078) confirms that the score variances of the two groups are homogeneous (p > 0.05), so the independent samples t-test can be used. The t-test results show that the experimental group's scores are significantly higher than the control group's (t = -8.67, df = 58, p < 0.001). The mean difference of -29.33 (experimental group minus control group) means the experimental group scored an average of 29.33 points higher. The 95% confidence interval (-35.84, -22.82) does not include 0, which further confirms that this 29.33-point difference is reliable: if the same experiment were repeated 100 times, 95 times the mean difference would fall between -35.84 and -22.82 (all negative, meaning the experimental group would always outperform the control group). For educators, this result directly proves that using the Hong En Literacy App is more effective than traditional instruction for improving Thai primary students' Chinese listening skills.

SRL Process Findings (Supplementary)

Analysis of learning logs showed the experimental group had a higher average reflection score (M = 2.47, SD = 0.52) than the control group (M = 1.93, SD = 0.61; t = 3.82, p < 0.001). App usage data revealed that students who used the progress-tracking function ≥3 times weekly had higher post-test scores (M = 76.22) than those who used it <3 times (M = 62.15; t = 2.91, p = 0.006). These results link the app's SRL-support features (progress tracking, self-reflection prompts) to better learning outcomes, reinforcing the theoretical connection between SRL and digital tool effectiveness.

Discussion

The study's integration of Zimmerman's SRL framework addresses the prior gap between theory and design: by embedding forethought (goal setting), performance (self-monitoring via app/progress reports), and self-reflection (weekly logs) into the intervention, we demonstrated how digital tools can operationalize SRL for young learners. The experimental group's superior performance ($M = 70.50$ vs. 41.17, $p < 0.001$) aligns with Krashen's (1982) Input Hypothesis— the app's structured, repeatable audio input (e.g., tonal drills) and immediate feedback addressed Thai students' key challenges (limited authentic exposure, tonal confusion).

Strict controls for content, time, and teacher involvement (e.g., identical vocabulary, matched interaction frequency) eliminate confounding variables, ensuring the app's SRL-support features (not content or teacher bias) drove the improvement. For educators, this suggests digital tools need not replace traditional instruction but can enhance it by scaffolding SRL—particularly critical for primary students learning tonal languages like Chinese.

■ Conclusion

This study confirms that the Hong En Literacy App is an effective tool for improving Chinese listening proficiency among Thai primary school students. Over an 8-week period, students in the experimental group demonstrated significantly higher post-test scores compared to those receiving traditional instruction, highlighting the app's instructional value. For educators, the Hongen Literacy app can be effectively integrated with Chinese textbooks in Thailand, such as the "Kai Kai Chinese" fifth volume, lesson six on the theme of "Occupations", serving as a valuable teaching aid. Teachers can incorporate the app's vocabulary cards, animated lessons, and game-based review modules into their lesson plans: using vocabulary cards for warm-up before class, animated lessons to enhance context understanding during class, and game-based tasks to reinforce learning after class. This not only reduces the burden of lesson preparation but also increases classroom interaction. For the common difficulty faced by Thai learners in distinguishing tones, teachers can assign the app's specialized pronunciation training modules as after-class tasks and identify individual differences based on the learning feedback data provided by the app (such as tone practice error rates) to implement personalized tutoring. Additionally, the app's built-in listening tasks (such as character sequencing, word matching, etc.) can be used as formative assessment tools to track students' progress between pre- and post-tests, providing real-time data for instructional adjustments. Moreover, based on classroom observations, students are more inclined to participate in game-based tasks (such as the "Frying Eggs" vocabulary game). It is suggested that developers increase the diversity of game modules (for example, developing story-based listening challenge tasks) and set multiple difficulty levels to meet the needs of students at different language proficiency levels. To address the issue of unstable network connections in some rural areas of Thailand (Xu & Liu, 2021), an offline mode should be added to allow for the pre-download of listening materials, ensuring availability in resource-constrained environments. To

further align with Zimmerman's (2002) self-regulated learning theory, it is recommended to introduce goal-setting features (such as "Learn 5 occupation-related words daily") and a learning progress dashboard (such as weekly listening accuracy reports) to enhance students' metacognitive abilities and promote their learning autonomy.

While promising, the study's scope was limited to listening skills and a single school setting, suggesting the need for broader and longer-term investigation.

■ Limitations and Recommendations

Limitations

This study had several limitations, including the short 8-week intervention period, which restricts the understanding of the app's long-term impact on listening development; the limited sample size of 60 students from a single school, which affects the generalizability of the findings; the focus on listening proficiency alone, without assessing other key Chinese language skills such as speaking, reading, and writing; and the reliance on self-reported data and teacher observations, which may be subject to social desirability bias.

Recommendations

To address these limitations, future research should extend the intervention to at least six months with follow-up testing to evaluate long-term effectiveness, include multiple schools across diverse regions to enhance generalizability, broaden the assessment to cover additional language skills such as speaking, reading, and writing, and improve the accuracy of qualitative data by incorporating unobtrusive classroom recordings or external evaluations to reduce bias.

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