ISSN 2773-9368 (Online)
Rangsit Journal of Educational Studies
Vol.13, No.1, pp.46-68, January-June 2026

The Application of the Four Strands of Language Learning with Digital Technology on the Chinese Oral Communication Skills of Thai Public High School Students

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Received 2025-12-11; Revised 2026-05-20; Accepted 2026-05-27; Published online: 2026-05-29

Abstract

This study examines the effectiveness of applying the Four Strands of Language Learning with digital technology to improve the Chinese oral communication skills of Thai high school students. Using a one-group, pre-test — post-test design with 36 participants, supported by teacher observations and questionnaires, the study found significant improvement. Post-test scores (M = 91.47, SD = 6.51) were higher than pre-test scores (M = 89.36, SD = 8.16), t(35) = -3.36, p = 0.002, Cohen's d = 0.56, indicating a moderate effect. Students reported positive attitudes toward the digital tools (M = 3.57/5), especially valuing videos, AI-assisted pronunciation apps, and online practice platforms for enhancing their comprehension and confidence. Classroom observation findings further showed increased student engagement, more active participation in oral activities, and greater willingness to communicate in Chinese during lessons. However, limited self-directed practice suggested a need for stronger scaffolding and motivational strategies. The study highlights both theoretical and practical contributions: extending Nation's Four Strands framework to a bilingual education context, and offering actionable guidance on integrating AI-based and digital learning tools into Chinese language teaching in Thai public schools.

Keywords*: The Four Strands, Digital Technology, Chinese Oral Communication Skills*

1. Introduction

Improving learners' oral communication skills is a core goal of Chinese language education, especially in contexts where Chinese is taught as a foreign language. However, traditional classroom practices in Thailand often emphasize grammar and rote memorization, leading to students who can recite rules, but cannot communicate effectively. Pronunciation errors, limited fluency, and high speaking anxiety remain common (Li & Zhang, 2025; Jiang, 2024). These challenges reflect an urgent need for teaching models that promote real communication.

Nation's (2007) Four Strands of Language Learning—meaning-focused input, meaning-focused output, language-focused learning, and fluency development—provides a balanced framework that may be suitable for Chinese oral communication teaching. Chinese speaking ability requires not only knowledge of pronunciation, vocabulary, and sentence patterns but also meaningful interaction and repeated practice. The Four Strands

addresses these needs by combining language input, communicative output, explicit instruction, and fluency practice. Previous studies in English learning contexts have reported improvements in speaking fluency and confidence (Sonda, 2021).

Digital technology may further enhance this framework. Multimedia resources increase language exposure, while AI chatbots, speech recognition tools, and gamified applications provide personalized and low-anxiety speaking practice (Leach, 2012; Kern, 2024). Consistent with Krashen's (1985) Affective Filter Hypothesis, technology may reduce anxiety and increase motivation, creating more favorable conditions for oral language development.

Despite these advantages, empirical studies on integrating digital technology with the Four Strands framework in Chinese language teaching remain limited, especially in Thai public schools. In particular, few studies have examined its effects on Chinese oral communication skills, including pronunciation accuracy, speaking fluency, vocabulary use, and communicative performance. Therefore, this study investigates the effects of a digitally supported Four Strands intervention on Thai secondary students' Chinese oral communication skills.The study is expected to contribute to both theory and practice by extending the application of the Four Strands framework in Chinese language education and providing practical guidance for integrating digital technologies into Chinese teaching in Thai public schools.

2. Research Objectives

2.1 To examine the effect of applying the Four Strands of Language Learning with digital technology on the Chinese oral communication skills of Thai public high school students.

2.2 To explore students' perceptions of this instructional approach in Chinese oral communication courses.

3. Research Questions

3.1 To what extent does the application of the Four Strands of Language Learning with digital technology improve Thai high school students' Chinese oral communication skills?

3.2 What are students' views on the use of digital-assisted Four Strands instruction in Chinese oral communication?

4. Literature Review

The rapid spread of Chinese education under the "Belt and Road" initiative has positioned Mandarin as an increasingly important subject in Thailand, particularly in public high schools. Despite this momentum, Thai learners often face persistent difficulties in oral communication, including inaccurate pronunciation, limited fluency, inappropriate pragmatic usage, and low confidence in speaking. In order to address these challenges, scholars have explored frameworks that integrate language learning theories with digital technology. Among these, Nation's (2001, 2007) Four Strands of Language Learning provides a balanced approach to language instruction, while Krashen's (1985) Input Hypothesis emphasizes comprehensible input and affective factors that facilitate

acquisition. Complementary perspectives from bilingual education, such as Cummins' distinction between Basic Interpersonal Communication Skills and Cognitive Academic Language Proficiency (BICS and CALP), and García's (2009) theory of translanguaging, shed further light on how learners navigate communicative competence across different linguistic systems. This review, therefore, examines the Four Strands, the role of digital technology in language learning, their potential integration, the challenges in Thai schools, possible solutions, and related research that points to existing gaps.

Nation's Four Strands include meaning-focused input, meaning-focused output, language-focused learning, and fluency development, all of which are designed to operate in balance. Meaning-focused input stresses the role of comprehensible listening and reading, drawing heavily on Krashens' Input Hypothesis, which argues that learners acquire language most effectively when they are exposed to slightly challenging but understandable material (Krashen, 1985). Meaning-focused output emphasizes the importance of active speaking and writing, which push learners to restructure knowledge for communication. Swain & Lapkin (2001) emphasized that language learning depends, not only on input, but also on active output (oral or written). In contrast, language-centered learning involves explicit instruction in grammar, vocabulary, and pronunciation, which aligns with Ellis's discussion (2006) of the importance of focus on form and explicit instruction for grammar, vocabulary, and pronunciation acquisition. Fluency development emphasizes the importance of automaticity. The experiment conducted by De Jong & Perfetti (2011) revealed that systematic practice and repeated input/output can increase the level of automaticity in language processing, thereby enhancing fluency. This is achieved through repeated and time-limited practice, which improves speed and confidence. Unlike Krashen, who places input above other components, Nation insists on a more even distribution of attention, which is particularly relevant in environments such as Thai public schools, where students encounter limited natural exposure to Mandarin outside the classroom. From the perspective of a bilingual education, Cummins' distinction between BICS and CALP distinguishes between the different developmental paths of conversational fluency (BICS) and academic language proficiency (CALP). This distinction resonates with the functions of "fluency development" and "language-focused learning" within the Four Strands, helping to explain why superficial fluency and classroom academic achievement do not always improve in tandem (Cummins, 1979; 2000).

The advent of digital technology has reshaped the landscape of language learning by providing interactive, multimodal, and personalized experiences (Chen & Yang, 2020). Meaning-focused input can be enriched by digital tools, such as podcasts, VR immersion, and graded readers that deliver authentic and comprehensible content. Yuanyuan's research (2019) analyzed how artificial intelligence technology can assist English learning, and explored its advantages in providing comprehensible input. However, researchers believe that artificial intelligence technology can also assist in learning oral Chinese, the other second language. Output opportunities are amplified through online platforms, such as Flipgrid, which allow learners to record oral performances, and exchange feedback with peers. Language-focused learning is supported by gamified applications, such as Quizlet or Duolingo, and AI-driven pronunciation tools, such as Elsa Speak, which provide structured practice in vocabulary, grammar, and sound patterns. Seddik (2025) investigated the impact of AI-powered language learning tools (such as ChatGPT, Duolingo, and Grammarly) on learners' language proficiency, motivation, and autonomy. The results showed that these tools significantly improved learners' vocabulary acquisition and writing accuracy, while

also enhancing their motivation and autonomy. Gripse & Sellerberg (2025) explored the role of digital tools, in combination with task-based language teaching (TBLT), and found that tools such as virtual reality (VR) applications and gamification platforms can improve learners' engagement, motivation, and language proficiency. Fluency development, in turn, is facilitated by speech recognition systems and shadowing programs, such as Speechling, which encourage repeated and timed practice in low-stakes environments. Zhang's (2025) study focused on analyzing the important role of digital literacy in the development of language fluency. Hasumi's research (2024) on technology-enhanced language learning in higher education emphasizes the role of digital technologies in promoting active, flexible, efficient, personalized, and motivating learning processes. Yet, most of these innovations are tool-driven, and emphasize short-term motivational effects, rather than systematic integration into pedagogical frameworks.

Research suggests considerable potential for combining Nation's Four Strands with the benefits of digital technology. For instance, meaning-focused input can be enhanced through multimodal materials, such as YouTube lectures and adaptive reading systems, that adjust difficulty levels in real time (Lai & Morrison, 2013). Meaning-focused output can be advanced through interactive platforms and AI-powered speech recognition that provide immediate feedback to learners (Zhou, 2022). Language-focused learning is improved by intelligent correction tools that target the tonal and syntactic challenges particular to Thai learners of Mandarin (Liu & Lin, 2021). Fluency development is supported by digital applications that structure repetitive oral practice, and track speed gains over time (Chen & Yang, 2020). Despite these enhancements, existing research tends to address single strands in isolation. Input-based interventions, such as Jaiboon (2023), typically neglect output or fluency; while output-based designs may overlook explicit form-focused learning. Systematic approaches that integrate all four strands through digital platforms are still rare.

The adoption of such integrated frameworks in Thai public high schools faces a number of structural and pedagogical barriers. Technological infrastructure remains uneven, with rural schools often lacking reliable facilities, which restricts access to digital input and fluency tools (OBEC, 2021). Teacher training is another key constraint, as many instructors lack confidence in their own oral Mandarin proficiency, or in their ability to employ digital pedagogy, which often results in classroom practices that emphasize grammar over communication (Prapaisit de Segovia & Hardison, 2008). Thailand's exam-oriented educational system reinforces this imbalance, by prioritizing grammar and reading comprehension in high-stakes assessments, leaving little space for oral practice. Furthermore, the phonological distance between Thai and Mandarin creates challenges for learners, particularly when automated correction systems misinterpret accented speech, which undermines confidence (Li & Hegelheimer, 2013). Learner autonomy also remains limited, as Thai students, accustomed to teacher-centered instruction in traditional classrooms, may struggle with self-directed learning in digital environments (Little, 2003).

A number of strategies can help to address these barriers. Strengthening information and communications technology infrastructure (ICT), particularly through government investment and the use of offline-capable tools, would ensure broader access to digital learning (OBEC, 2023). Professional development for teachers, grounded in the technological pedagogical content knowledge framework (TPACK) (Koehler & Mishra, 2009), could empower educators to integrate AI-based applications, and balance all four strands in practice. Reforms in assessment that incorporate oral components, digital

speaking tasks, and communicative rubrics aligned with the Hanyu Shuiping Kaoshi rubric (HSK), and Canale & Swain's (1980) communicative competence model, would provide stronger incentives for both teachers and learners. Designing culturally responsive instructional materials that explicitly addressed Thai–Chinese contrastive structures, and leveraging AI tools that were fine-tuned to Thai phonological features, would improve both accuracy and motivation. At the learner level, gamified oral tasks, digital storytelling projects, and collaborative peer activities, can encourage autonomy and engagement (Yang & Wu, 2012).

Overall, although numerous studies have shown that digital technology can enhance learning motivation and facilitate oral practice, research in this field is often fragmented—focusing on a single tool or a specific approach (e.g., input only or fluency only). There is a lack of systematic research that integrates Nation's four strands (meaning-focused input, meaning-focused output, language-focused learning, and fluency development) with digital resources. For example, a review of generative AI and its use in the physical and digital environments of shopping centers (MALL) noted that most studies are narrow experiments, lacking longitudinal and cross-study designs (Zhao & Hua, 2025; Asadi et al. 2024). Furthermore, research targeting Thai learners remains limited, particularly regarding the fine-tuning of AI-driven pronunciation/speech models to accommodate the pronunciation characteristics of the Thai language. Similarly, there is a lack of curriculum models or policy implementation plans, based on bilingual education theories (e.g., BICS/CALP, translanguaging), that can be scaled to the public high school system. Recent empirical studies suggest that translanguaging pedagogy can enhance classroom interaction, meaning-making, and English teaching in Thailand, but these approaches are rarely integrated with digital technology and AI-based language tools (Ambele, 2022; Thongwichit, 2025).

Existing studies illustrate both progress and limitations in this field. Fluency-focused instruction has been found to reduce speaking anxiety among pre-service teachers (Putinatr & Kiattikomol, 2022), while meaning-focused output interventions have enhanced motivation and confidence in online contexts (Zhang et al. 2022). Multimedia-based teaching in private universities has improved listening and speaking proficiency (Ma, 2021), and input-focused approaches have led to measurable gains in listening comprehension (Jaiboon, 2023). Digital storytelling has been shown to enhance oral proficiency and learner autonomy (Wei et al., 2018), while task-based learning has successfully developed speaking skills among trilingual primary students (Wang & Tananuraksakul, 2023). Social media platforms have also been employed to strengthen learners' motivation and oral communication skills (Keasornkul, 2022). Taken together, these findings affirm the benefits of technology-enhanced learning, but also highlight a lack of systematic integration across the Four Strands, and insufficient theoretical grounding in bilingual education.

In summary, Nation's Four Strands provide a balanced pedagogical framework for oral communication, while digital technologies offer new opportunities for multimodal, personalized, and interactive learning. Yet, their adoption in Thai public high schools is constrained by infrastructural limitations, insufficient teacher training, exam-driven practices, linguistic distance, and low learner autonomy. Current research remains fragmented and tool-driven, rarely applying a comprehensive model that integrates the Four Strands with digital resources, or situates outcomes within broader bilingual education

frameworks. The present study seeks to address these gaps, by systematically applying the Four Strands and digital technology to enhance Thai students' oral proficiency in Chinese, thereby contributing both theoretical insights and practical solutions for language education in Thailand.

5. Research Methodology

5.1 Introduction

With Mandarin Chinese becoming increasingly important globally, effective teaching methods are essential for developing students' oral communication skills. This study investigated the application of Nation's Four Strands of Language Learning integrated with digital technology to enhance Chinese oral communication skills among Thai public high school students. A mixed-methods research design combining quantitative and qualitative approaches was employed to examine the effectiveness of this instructional intervention and to explore students' perceptions of its implementation.

The independent variable of the study was a digitally supported Four Strands instructional intervention, while the dependent variable was students' Chinese oral communication skills, including pronunciation accuracy, speaking fluency, vocabulary use, and communicative performance. Quantitative data were collected through pre- and post-tests, while qualitative data were obtained from classroom observations and student questionnaires. In addition to examining changes in oral performance, the study explored students' perceptions regarding the use of digital technology in supporting language learning, including its influence on motivation, confidence, and classroom engagement. Through integrating multiple sources of data, the study aimed to provide a comprehensive understanding of the pedagogical potential of combining digital technology with the Four Strands framework in Chinese language education.

5.2 Population, Participants, and Context

The population for this study were students in the Chinese language program at a public secondary school, under the Secondary Educational Service Area Office in Nonthaburi Province, Thailand. The total population included 109 students, aged between 14 to 18 years, with varying levels of Chinese language proficiency, ranging from beginner to intermediate. To conduct the experiment, an intact class was selected from all the Chinese majors in the subject public school. Participants were selected based on their enrolment in the Chinese program during the first semester of the 2025 academic year.

The study focused on a subset of 36 students in Grade 12, who were actively engaged in the researcher's classes during the semester under study. The students were chosen because of their consistent participation in Chinese lessons, and their exposure to both traditional and technology-supported instructional practices. Throughout the research period, they received instruction that integrated the Four Strands of Language Learning—meaning-focused input, meaning-focused output, language-focused learning, and fluency development—with the use of digital tools, such as PowerPoint, audio recordings, videos, and interactive platforms, including Quizizz.

5.3 Intervention Procedure

A single-group, pre-test and post-test design was employed, supplemented with teacher observations and student questionnaires. The pre-test and post-tests measured the students' oral Chinese proficiency, while observations and questionnaires provided qualitative insights into classroom engagement and attitudes.

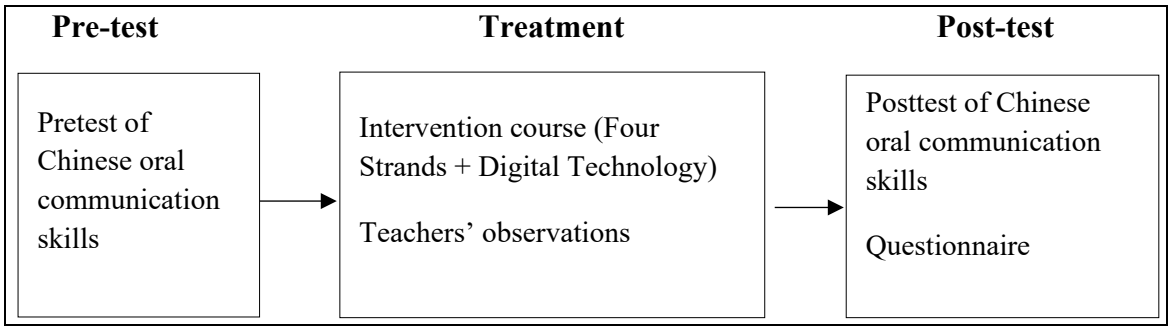

Figure 1 : Research Design of the Study

Pre-Test: The students completed an oral communication test and a listening comprehension test, adapted from the HSK. The oral test included three tasks—reading aloud (15 items), structured questions (10 items), and open-ended responses (2 items)—scored across pronunciation, fluency, grammar, vocabulary, and communicative ability (50% of total). The listening test measured comprehension and accuracy (50%). All responses were recorded and double-rated to ensure reliability.

Intervention (Weeks 1–8, 16 sessions): The intervention lasted eight weeks and consisted of sixteen sessions, with two 100-minute lessons conducted each week. To ensure consistency and systematic implementation, all lessons followed a structured instructional procedure based on Nation's Four Strands framework integrated with digital technology. Throughout the intervention period, classroom observations were conducted during each session by three trained Thai Chinese teachers using structured observation forms. Observation categories included comprehension, classroom participation, learner confidence, oral interaction, and the use of digital tools.

Students received comprehensible language input through videos, dialogues, audio recordings, teacher explanations, and multimedia presentations. Digital resources such as PowerPoint slides and short videos were used to introduce lesson themes and contextualized language use. Students received explicit instruction in pronunciation, vocabulary, sentence patterns, and grammar structures. Digital tools such as Quizizz and Hello Chinese were used to reinforce language forms and provide immediate feedback. Students participated in communicative tasks including pair discussions, role-play activities, information-gap tasks, and AI-supported speaking activities. These activities encouraged students to produce meaningful spoken Chinese in authentic situations. Students completed repeated speaking tasks, oral summaries, and scenario-based presentations to improve speaking fluency, confidence, and automaticity. Speech-recognition applications were used to support pronunciation monitoring and oral practice.

To ensure systematic progression, the intervention content gradually developed throughout the eight-week period. Weeks 1–2 focused on vocabulary acquisition and

sentence pattern practice. Weeks 3–5 emphasized guided speaking practice and interactive communication tasks supported by digital tools. Weeks 6–8 focused on scenario-based communication and independent oral production activities.

Post-Test: The same test format and procedures as the pre-test were administered, using parallel items, but which were modified to avoid memory effects.

Questionnaire: After the post-test, 36 students completed a 22-item Likert-scale questionnaire and open-ended questions, which elicited their attitudes toward the digital learning, their perceptions of the Four Strands, and their self-assessment of their own oral proficiency.

5.4 Research Ethics and Instrumentation

This study adhered to strict ethical standards, to ensure participant protection and research integrity. All research materials—including pre-tests, post-tests, intervention lessons, teacher classroom observations, and questionnaires—were reviewed and approved by Item-Objective Congruence experts (IOC experts), and subsequently by the institutional Ethics Committee, confirming compliance with ethical guidelines. Participants were informed of the study's objectives, procedures, and their rights, including voluntary participation, and the confidentiality of their responses.

A mixed-methods design was employed to evaluate the effectiveness of the Four Strands instructional approach integrated with digital technology on Chinese oral communication skills. Research instruments included pre- and post-tests adapted from HSK materials, classroom observation forms, and post-intervention questionnaires.

The pre- and post-tests assessed students' oral communication skills and listening comprehension. The oral test included reading aloud, structured questions, and open-ended responses, evaluating pronunciation accuracy, fluency, grammatical accuracy, vocabulary use, and communicative ability through standardized scoring rubrics. To ensure scoring consistency, all oral performances were recorded and independently rated by multiple trained assessors. Classroom observations were conducted by three trained Thai Chinese teachers using a structured observation form. Five dimensions were evaluated: language comprehension, class participation, emotional engagement and confidence, use of digital tools, and oral output performance. Each dimension was rated on a five-point scale (1 = very low to 5 = very high) based on observable classroom behaviors, such as students' participation, confidence, and use of Chinese during activities.

Post-intervention questionnaires investigated students' perceptions of the instructional approach and digital tools using a five-point Likert scale. Internal consistency reliability was high (Cronbach's $\alpha = 0.89$). Content validity was confirmed through expert review, while construct validity was supported through alignment with the Four Strands framework and digital learning components.

5.5 Data Collection and Procedures

The data collection procedure consisted of four stages: consent and pre-test, intervention, post-test, and questionnaire administration. First, the researcher introduced

the objectives and procedures of the study and answered participants' questions. After obtaining informed consent, all participants completed the pre-test, which required approximately 100 minutes.

The intervention phase lasted eight weeks and consisted of sixteen sessions (two 100-minute lessons per week), totaling 1,600 minutes. During the intervention, a variety of instructional facilities and digital tools were utilized, including PowerPoint presentations, videos, online vocabulary platforms (e.g., Quizlet and Wordwall), speech-recognition applications (e.g., Google Voice and iFlytek), tablets or computers, and recording devices. These tools supported the implementation of digitally enhanced Four Strands activities throughout the instructional process.

Following the intervention, participants completed the post-test using procedures consistent with the pre-test. Afterward, students completed a questionnaire to provide feedback on their perceptions of the instructional approach and digital learning experience. The post-test and questionnaire administration required approximately 100 minutes.

Detailed weekly instructional activities and classroom procedures are provided in Appendix A.

5.6 Data Analysis

The study employed both quantitative and qualitative data analysis methods to examine the effectiveness of the intervention. Quantitative data from the pre-test and post-test were analyzed using descriptive statistics, including means and standard deviations, to summarize students' performance. A paired-samples t-test was conducted to compare pre-test and post-test scores and determine whether statistically significant differences existed after the intervention. In addition, Cohen's d was calculated to measure the effect size of the intervention. Statistical significance was set at $p < .05$.

Classroom observation data were analyzed qualitatively and descriptively. Observation records from the three teachers were reviewed and compared to identify recurring patterns related to students' comprehension, classroom participation, confidence, oral interaction, and use of digital tools. Observational findings were used to support and triangulate quantitative results, providing additional evidence regarding students' learning behaviors and engagement during the intervention.

Questionnaire data were analyzed using descriptive statistics, including means, and standard deviations, to examine students' perceptions of the Four Strands instructional approach and the use of digital technology.

5.7 Findings

Based on the identified research objectives, findings were organized into two sections. Quantitative findings (pre- and post-tests, questionnaires) and qualitative findings (teacher observations and open-ended responses) were integrated to provide triangulated evidence regarding the effectiveness of applying the Four Strands of Language Learning with digital technology in Chinese oral communication instruction.

5.7.1 The Effect of Applying the Four Strands of Language Learning with Digital Technology to Chinese Oral Communication Skills

To investigate the effectiveness of the instructional intervention, quantitative findings from pre- and post-tests were integrated with qualitative classroom observation data. Together, these findings provided triangulated evidence of students' progress in oral Chinese communication skills.

1) Pre-Test and Post-Test Comparison

Table 2 : Paired Samples t-Test Analysis

Paired Samples Test — Paired Differences										
						95% Confidence Interval of the Difference				
			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pre-Test	Post-Test	-2.11	3.76	0.63	-3.38	-0.84	-3.36	35	0.002

The paired samples t-test showed a significant improvement in students' oral Chinese communication skills after the 8-week intervention, with post-test scores higher than pre-test scores (Mdiff = -2.11, t (35) = -3.36, p = .002, 95% CI [-3.38, -0.84]). These findings confirm the effectiveness of integrating the Four Strands of Language Learning with digital technology, supporting not only linguistic gains, but also enhanced confidence, and engagement in oral communication.

Table 3 : Paired Samples Statistics Analysis

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test	89.36	36	8.16	1.36
	Post-Test	91.47	36	6.51	1.09

Descriptive statistics showed that the mean pre-test score was 89.36 (SD = 8.16), while the post-test mean increased to 91.47 (SD = 6.51), reflecting an average improvement of 2.11 points. The reduction in standard deviation suggests greater consistency in student performance. These results provide preliminary evidence of improvement and formed the basis for subsequent inferential analyses.

Table 4 : Paired Samples Effect Size Analysis

Paired Samples Effect Size					
		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Pair 1 Pre-Test & Post-Test	Cohen's d	3.76	-0.56	-0.91	-0.21
	Hedges' Correction	3.8009	-0.56	-0.90	-0.20

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' Correction uses the sample standard deviation of the mean difference, plus a correction factor.

Effect size analysis confirmed that the improvement was educationally meaningful. Cohen's d was -0.56 (95% CI [-0.91, -0.21]), and Hedges' g showed a similar estimate (-0.56, 95% CI [-0.90, -0.20]). (See Figure 2 below.)

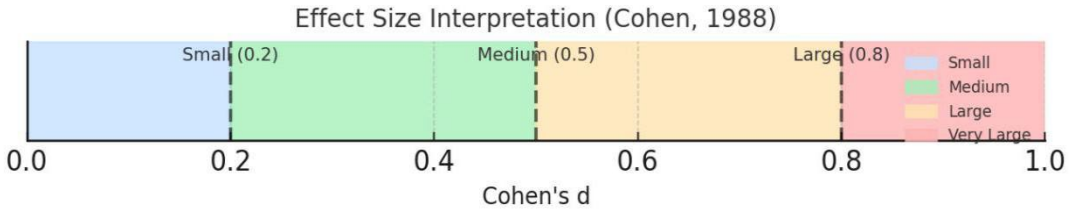

Figure 2 : Effect Sizes based on Cohen's Criteria (1988)

Figure 2 presents the interpretation ranges of effect size, based on Cohen's (1988) criteria. The horizontal axis represents the value of Cohen's d, while the vertical dashed lines indicate the cut-off points for small effect (0.2), medium effect (0.5), and large effect (0.8). The different colored background sections correspond to different effect size levels: light blue for small effect ($0 \leq d < 0.2$), light green for medium effect ($0.2 \leq d < 0.5$), light orange for large effect ($0.5 \leq d < 0.8$), and light red for very large effect ($d \geq 0.8$).

According to Table 4, the effect size in this study was d = 0.56, which falls at the lower end of the large effect range, slightly above the threshold for a medium effect. This indicates that the intervention produced a substantial and practically meaningful improvement.

2) Teacher Observations and Triangulated Findings

Classroom observation data provided qualitative support for the quantitative findings. Over the eight-week intervention, three teachers evaluated students in five dimensions: language comprehension, class participation, emotional engagement and confidence, use of digital tools, and knowledge output.

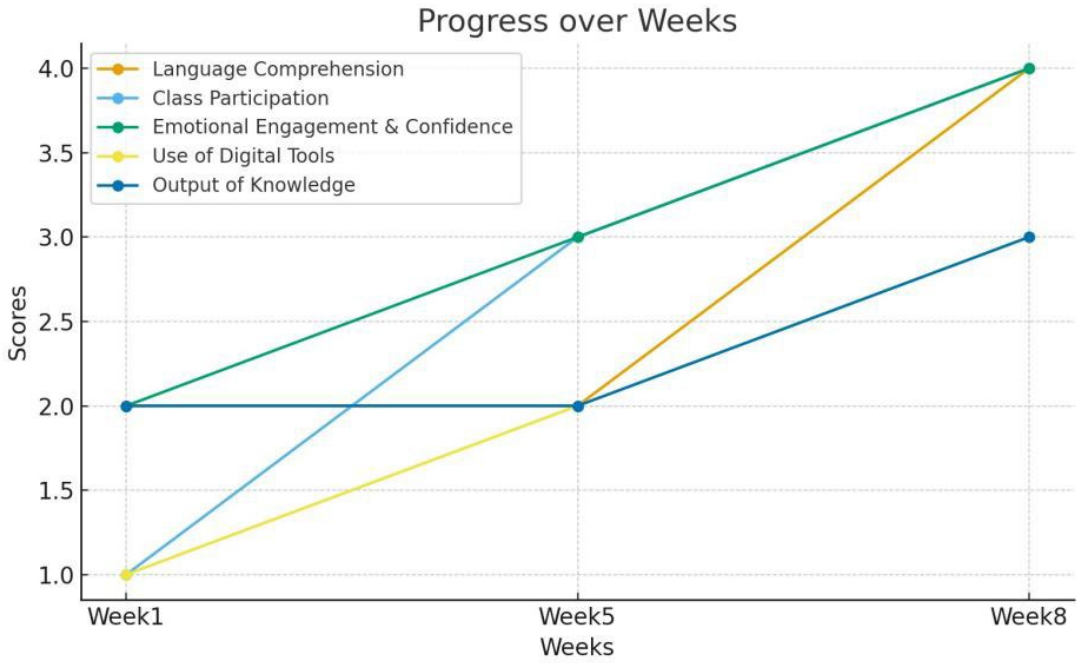

Figure 3 : Descriptive Analysis of Classroom Observations

Language comprehension improved, from 2 points in Week One to 4 points in Week Eight, reflecting students' ability to process classroom input more effectively. Class participation rose markedly, from 1 to 4 points, showing a shift from passive reception to active involvement. Emotional engagement and confidence increased, from 2 to 4 points, suggesting that the students felt more comfortable and self-assured in expressing themselves. The use of digital tools improved gradually (1 to 3 points), but remained moderate, indicating the need for more structured guidance. Knowledge output showed the slowest growth, rising from 2 to only 3 points, pointing to ongoing challenges in transforming input into productive communication.

Importantly, these qualitative observations aligned with the pre- and post-test findings. While quantitative data indicated significant gains in oral performance, classroom observations revealed how these improvements manifested in practice. Students not only achieved higher scores, but also participated more actively, demonstrated increased confidence, and processed classroom input more effectively. Such triangulated findings strengthen the validity of the intervention outcomes.

However, teachers observed relatively limited progress in digital tool use and knowledge output. Although students benefited from technology-supported learning, they still required more structured guidance and opportunities for productive language use.

Overall, both quantitative and qualitative findings consistently suggest that applying the Four Strands with digital technology effectively enhanced students' oral Chinese communication skills.

3) Integrated Summary of Research Objective 1

Overall, triangulated findings from pre- and post-test results and classroom observations consistently indicate that applying the Four Strands of Language Learning

with digital technology significantly improved students' oral Chinese communication skills. Quantitative findings demonstrated statistically significant gains in performance and a meaningful effect size, while qualitative classroom evidence revealed increased participation, stronger comprehension, and greater confidence during learning activities.

The integration of these findings suggests that the instructional approach promoted not only linguistic development but also affective and behavioral improvements. Students became more engaged in classroom interaction and more willing to express themselves in Chinese. However, relatively limited growth in digital tool use and knowledge output suggests that students still require additional scaffolding and opportunities for productive language practice. These triangulated findings provide strong evidence supporting the effectiveness of the intervention in improving oral communication skills.

5.7.2 Students' Perceptions of Applying the Four Strands of Language Learning with Digital Technology

To examine students' perceptions, quantitative questionnaire findings were integrated with qualitative responses from open-ended questions. The combined findings provide a more comprehensive understanding of students' attitudes toward technology-supported Chinese learning.

1) Standardized Questionnaire Findings

Table 5 : Questionnaire Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q4:Frequency of using digital devices to learn Chinese	36	1	5	3.58	0.94
Q5:I use digital tools (e.g., videos, apps) to watch or listen to Chinese conversations which makes it easier for me to understand and remember what I have learned. (Comprehension, Retention, & Confidence in Expression)	36	2	5	3.89	0.92
Q6:I often learn vocabulary or grammar by reading/listening to Chinese content on the Internet. (Post-Class Self-Directed Learning & Online Engagement)	36	2	5	3.39	0.90
Q7:Chinese learning apps help me understand Chinese through real-life topics and culture. (Classroom Support & Teacher Integration)	36	1	5	3.83	1.00

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q8:After class, I often practice speaking Chinese through digital platforms (such as Flipgrid, video recordings). (Post-Class Self-Directed Learning & Online Engagement)	36	1	5	3.33	1.24
Q9:I prefer using Chinese to communicate through online tasks or speaking activities. (Post-Class Self-Directed Learning & Online Engagement)	36	1	5	3.25	1.32
Q10:Using digital tools to speak Chinese helps me express myself more confidently. (in real conversations). (Comprehension, Retention, & Confidence in Expression)	36	2	5	3.89	0.82
Q11:Digital tools can improve my Chinese grammar or pronunciation. (Comprehension, Retention, & Confidence in Expression)	36	1	5	3.61	1.15
Q12:My teacher uses digital resources to explain grammar or pronunciation. (Classroom Support & Teacher Integration)	36	2	5	3.86	0.83
Q13:I use digital apps (e.g., Quizlet) to practice Chinese vocabulary and grammar. (Vocabulary, Fluency Development, & AI-Assisted Tools)	36	1	5	3.67	1.04
Q14:I regularly use mobile apps to practice speaking Chinese more fluently. (Vocabulary, Fluency Development, & AI-Assisted Tools)	36	1	5	3.69	1.01
Q15:I re-record myself using apps to improve my Chinese fluency. (Post-Class Self-Directed Learning & Online Engagement)	36	1	5	3.33	1.12
Q16:Often using voice recognition or AI tools helps me practice natural Chinese conversations. (Vocabulary, Fluency Development, & AI-Assisted Tools)	36	1	5	3.50	1.00
Q17:I can express myself clearly in spoken Chinese. (Self-Efficacy & Peer Interaction)	36	1	5	3.44	1.08
Q18:I can understand spoken Chinese in videos or conversations. (Self-Efficacy &	36	2	5	3.47	0.97

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Peer Interaction)					
Q19:I actively communicate in Chinese with teachers and classmates. (Self-Efficacy & Peer Interaction)	36	2	5	3.42	0.97
Total (All Items)		1.04		3.57	
Valid N (listwise)	36				

A 16-item questionnaire, using a five-point Likert scale, was administered to 36 students. The overall mean score was 3.57 (SD = 1.04), indicating a moderately positive perception of the instructional approach.

(a) Classroom Support & Teacher Integration (2 items: Q7, Q12). Students highly valued teacher use of digital resources, with Q12 (M = 3.86) and Q7 (M = 3.83) receiving relatively high ratings, suggesting that technology-supported instruction enhanced comprehension and contextual learning.

(b) Comprehension, Retention, & Confidence in Expression (3 items: Q5, Q10, Q11). This category received the highest ratings, particularly Q5 and Q10 (both M = 3.89), indicating that digital tools strengthened understanding, memory, and speaking confidence while reducing anxiety.

(c) Post-Class Self-Directed Learning & Online Engagement (4 items: Q6, Q8, Q9, Q15). This category showed the lowest ratings, with Q9 (M = 3.25), Q8 (M = 3.33), Q15 (M = 3.33), and Q6 (M = 3.39) reflecting relatively weak engagement in self-directed learning outside the classroom. Larger SD values (>1.10) suggested substantial individual differences in learning habits.

(d) Vocabulary, Fluency Development, & AI-Assisted Tools (3 items: Q13, Q14, Q16). Students showed moderately positive perceptions (M = 3.50–3.69), indicating recognition of the value of vocabulary learning, fluency practice, and AI-assisted tools.

(e) Self-Efficacy & Peer Interaction (3 items: Q17, Q18, Q19). Students reported moderate confidence in oral communication and classroom participation (M = 3.42–3.47), suggesting that communicative confidence was developing but remained limited.

2) Open-ended Responses and Triangulated Findings

Open-ended responses further explained the quantitative results. Students frequently mentioned YouTube, TikTok, and dictionary applications as useful learning resources. These responses support questionnaire findings showing positive attitudes toward technology-assisted learning.

At the same time, students reported challenges such as inaccurate pronunciation feedback, translation errors, and insufficient opportunities for authentic communication. These concerns help explain the relatively lower scores on autonomous learning and peer interaction items.

Importantly, qualitative findings complemented questionnaire results by revealing students' underlying learning experiences. While survey data indicated generally positive attitudes, open-ended responses showed that students appreciated technology mainly as a supporting tool rather than a substitute for authentic interaction.

Therefore, triangulated findings suggest that students viewed the instructional approach favorably, especially regarding comprehension support and speaking confidence. However, they also emphasized the continuing need for authentic communicative opportunities and stronger encouragement for independent technology use.

3) Integrated Summary of Research Objective 2

Overall, the triangulated findings from questionnaire data and open-ended responses indicate that students generally held positive perceptions toward applying the Four Strands of Language Learning with digital technology in Chinese oral communication instruction. Quantitative findings showed favorable attitudes toward the use of digital tools, especially in supporting comprehension, retention, and speaking confidence, while qualitative responses provided further insight into students' actual experiences and learning preferences.

The integration of both forms of evidence suggests that students appreciated technology as an effective learning support tool, particularly when integrated with classroom instruction and teacher guidance. However, findings also revealed challenges related to self-directed learning, authentic communication opportunities, and the limitations of technological feedback. Therefore, although technology-enhanced instruction was positively received, pedagogical improvements are still needed to encourage learner autonomy and create more meaningful communicative experiences.

6. Conclusion

This study adopted a mixed-method design to examine the effects of integrating the Four Strands of Language Learning with digital technology on the Chinese oral communication skills of Thai public high school students and to explore students' perceptions toward this instructional approach.

Triangulated findings from quantitative and qualitative data consistently demonstrated the effectiveness of the intervention. Integrated evidence from pre- and post-tests and classroom observations revealed significant improvement in students' oral Chinese communication skills, including pronunciation, fluency, grammar, comprehension, confidence, and classroom engagement. Questionnaire and open-ended findings further indicated that students generally perceived the instructional approach positively, particularly regarding comprehension support, retention, and speaking confidence.

Although students appreciated the benefits of technology-supported learning, findings also revealed several limitations, including relatively low engagement in autonomous learning activities and insufficient opportunities for authentic communication. Therefore, future instructional practices should provide stronger scaffolding for independent learning and create more interactive communication contexts to maximize the long-term effectiveness of technology-supported Chinese language instruction.

6.1 Discussion

6.1.1. Improvement of Oral Communication Skills

The improvement in students' oral Chinese communication skills can be interpreted through Nation's (2007, 2013) Four Strands framework and major second language acquisition theories. The findings suggest that integrating digital technology supported balanced development across meaning-focused input, output, language-focused learning, and fluency.

From Krashen's (1982) Input Hypothesis perspective, subtitled videos and mobile applications provided meaningful and comprehensible input (i+1), which may explain improvements in comprehension and oral performance. Previous studies have similarly reported that subtitles improve vocabulary learning, listening comprehension, and speaking confidence (Vanderplank, 2010; Winke et al., 2010; Lin & Tseng, 2019). Interactive speaking activities and speech-recognition tools also created opportunities for repeated practice and lower-anxiety learning conditions, partially supporting the Affective Filter Hypothesis.

However, technology alone may not fully explain students' progress. Although digital tools supported language practice and feedback, improvements in fluency and authentic communication remained limited. This finding aligns with Long's (1996) Interaction Hypothesis and constructivist principles, suggesting that communicative competence develops through meaningful social interaction rather than technological support alone. Therefore, balanced instructional design and authentic communication opportunities remain essential.

6.1.2 Student Perceptions

Students generally showed positive perceptions toward the instructional approach (M = 3.57/5), particularly regarding comprehension support, confidence enhancement, and oral practice opportunities. These findings support Nation's (2007, 2013) view that balanced learning experiences contribute to language development.

Students preferred structured digital tools, such as CAPT systems and guided speaking applications, which provide explicit guidance and timely feedback. Previous studies similarly suggest that MALL and CAPT systems improve pronunciation and oral performance (Mahdi, 2019; Li & Lan, 2021).

However, students showed weaker engagement in autonomous and unstructured speaking activities. This finding suggests that learner autonomy may not develop automatically through technology use. For Thai public high school students,

teacher guidance and structured learning environments may remain important. In addition, concerns regarding inaccurate feedback and limited authentic communication indicate that technology should function as a supportive tool rather than a replacement for meaningful interaction.

Taken together, the findings suggest that technology-supported instruction can enhance learning experiences, but effective outcomes still depend on pedagogically structured activities and teacher support.

6.1.3 Limitations

The study faced several limitations: absence of a control group, short intervention period, reliance on self-reported data, and focus on a single school. These factors limit the generalizability of the findings, and call for cautious interpretation.

6.1.4 Theoretical Implications

This study extends Nation's framework, by demonstrating how technology can operationalize balance across the four strands in resource-limited bilingual contexts. Mobile tools expanded exposure and practice opportunities, while AI-assisted applications strengthened accuracy. The findings highlight the adaptability of the framework to contexts with limited authentic input and cultural reticence toward speaking.

6.1.5 Practical Implications

For teachers, the study underscores the value of pronunciation and feedback apps, project-based speaking tasks, and digital reflective journals. For curriculum developers and policymakers, it provides evidence that integrating the Four Strands with digital platforms aligns with 21st-century language education. For teacher trainers, it stresses the need to prepare educators to scaffold digital tools effectively.

In sum, the findings suggest that integrating the Four Strands with digital technology positively contributed to students' oral Chinese communication development. The results generally support Nation's Four Strands framework. However, technology alone may not be sufficient to develop communicative competence, as limitations remained in fluency and authentic communication. Therefore, balanced instructional design and meaningful interaction remain essential.

6.2 Recommendations

6.2.1 Pedagogical Recommendations for Teachers

The findings suggest that teachers may benefit from integrating AI-based voice technologies, such as iFlytek and Speechling, to support students' tonal accuracy and speaking fluency. In addition, project-based and role-play activities supported by digital tools, such as Flipgrid and Padlet, may create more opportunities for meaningful oral interaction. Digital speaking journals and peer feedback mechanisms through online platforms may also facilitate learner reflection, continuous monitoring, and confidence development in oral communication.

6.2.2 Recommendations for Students

Students are encouraged to engage in regular speaking practice using AI-supported tools and digital platforms that provide authentic communicative opportunities. To promote balanced language development, learners may allocate practice across the four strands, including meaning-focused input, meaning-focused output, language-focused learning, and fluency development, through applications such as Pleco, Quizlet, and Speechling. Collaborative learning through online communication platforms may further enhance speaking practice and learning motivation.

6.2.3 Recommendations for Future Research

Future studies may consider including participants from different schools and regions to improve the generalizability of findings. Comparative research examining the Four Strands framework alongside other instructional approaches, such as Task-Based Language Teaching (TBLT) and Content and Language Integrated Learning (CLIL), may provide broader pedagogical insights. In addition, future investigations could examine the specific contributions of emerging technologies, including Computer-Assisted Pronunciation Training (CAPT), Virtual Reality (VR), and AI chatbots, under controlled instructional conditions. Cross-linguistic studies involving learners from different first-language backgrounds may further contribute to understanding the adaptability of this instructional approach.

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Forms of data collection and procedures used between June 20 and August 20, 2025

Procedures	**Tasks**	**Time**	**Facilities**
Consent Form Pre-Test	The researcher outlined the study objectives, and answered questions from the participants. All students in the class then signed consent forms. All participants completed a pre-test.	100 mins	Consent Form Pre-Test
Week 1	Introduction to Chinese Language, Course Orientation, and integration of digital technology	100 mins	PowerPoint Video
Week 2-3	Greetings, Self-Introduction, Exchanging Information	100 mins	PowerPoint Quizlet,Hello Chinese
Week 4-5	Ordering Food •The teacher played soft background music, while calling the roll, creating a relaxed and stress-free classroom atmosphere, helping students relax and prepare emotionally for language output. (Fluency Development) •Played a short video of a Chinese native speaker ordering food, to help students obtain language input in a real context, and gain a preliminary understanding of key vocabulary and expressions. (Meaning-Focused Input) •When watching the video, pay attention to the speaker's speaking speed and pronunciation.	100 mins	

Procedures	Tasks	Time	Facilities
	•The teacher reviewed the vocabulary and sentence patterns from the previous lesson, through PowerPoint and online vocabulary cards, which guides the students to correct pronunciation, and strengthens the memory and accurate use of key vocabulary. (Language-Focused Learning) •Introduced new vocabulary and sentence patterns related to the theme of this lesson through PowerPoint, with pictures and texts, combined with voice playback, to help students establish a connection between semantics and voice, and improve comprehension and interest. (Meaning-Focused Input + Language-Focused Learning) •Students read sentence patterns and vocabulary in groups, collaborated, imitated, and corrected each other, which enhances the mastery of voice and intonation, and at the same time, improves participation and self-confidence. (Language-Focused Learning) •Students worked in pairs to practice ordering food, and used the learned sentence patterns to communicate. They used menu props, food cards, or simulated the ordering interface on an electronic whiteboard, to enhance the sense of real context and language output ability. (Meaning-Focused Output)		
Week 4-5	•Students used speech recognition software (such as Google Voice, iFlytek input method) to practice reading sentences and observe the feedback results. Through multiple attempts, they improved pronunciation, oral accuracy, and confidence. (Meaning-Focused Output + Digital Technology Application) •Students performed a final dialogue according to a set scenario, "asking for price", and tried to express themselves fluently without prompts. Students used recording equipment to record the performance content and play back the audio for self-evaluation and improvement, thereby improving language fluency and expressive confidence. (Fluency Development + Digital Technology + Feedback Mechanism)	100 mins	•Tablet or Computer Equipment •Recording Equipment or App (e.g. Voice Memo, Audacity, voice recorder) •Audio Playback Equipment
Week 6-7	Chinese Culture & Festivals	100 mins	PowerPoint Quizlet, Hello Chinese
Week 8	Travel & Emergencies	100 mins	PowerPoint Quizlet, Hello Chinese
Post-Test Survey	Following the completion of the post-test, the participants proceeded to complete the survey.	100 mins	Post-Test Survey