ORIGINAL ARTICLE

Effectiveness of Computer Application in Improving Reading Skills in Chinese Language and Towards Post-Attitudes as Home-based Learning

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Abstract: ***Background***: *As technology continues to advance, language acquisition methodologies have increasingly been integrated into computer-assisted language learning (CALL) systems. In the context of Chinese language acquisition, characters are structured in three phases: the overall character, its components, and its strokes. Proficiency in identifying and distinguishing individual characters hinges upon understanding their structural composition.* ***Objective***: *This study aims to explore the impact of a computer application on Chinese language reading skills and students' perceptions regarding the utilization of computer applications for home-based learning.* ***Method***: *A total of 60 students engaged in home-based learning using a designated computer application were involved in the study. Employing a quantitative approach with a quasi-experimental design, the study assessed the effects of the intervention.* ***Results and Conclusion***: *Following one month of home-based learning through computer applications, participants exhibited higher gain scores in reading skill tests, albeit the differences were not statistically significant. Students expressed a preference for and perceived greater ease in acquiring reading skills through computer applications compared to traditional methods. Furthermore, the integration of computer applications in teaching and learning processes demonstrated the potential to enhance students' motivation, interest, and confidence in language acquisition, albeit without a notable impact on attention levels. The study underscores the pedagogical promise of Computer-Assisted Language Learning (CALL) and advocates for further research endeavors in this domain.*

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Introduction

DEVELOPING strong reading skills forms the cornerstone of successful language acquisition. This is particularly true for languages like Chinese, characterized by its unique logographic writing system and vast vocabulary. Traditional classroom settings, however, can be limited by time constraints and the sheer volume of characters students must learn. These challenges are further amplified for learners in home-based environments, where access to qualified instructors and consistent guidance may be limited. Additionally, the lack of peer interaction and structured learning routines can hinder motivation and engagement (Wen, 2022).

In recent years, educational landscapes worldwide have witnessed a surge in the adoption of technology-based learning tools. Within the realm of language acquisition, Computer-Assisted Language Learning (CALL) applications have emerged as promising tools to enhance learning experiences. These interactive programs offer several advantages over traditional methods.

Firstly, CALL allows for personalized learning paths. Learners can progress at their own pace, focusing on areas requiring additional attention. This is particularly beneficial for beginners in Chinese, where mastering a large number of characters is crucial (Lee & Yeung, 2020). Secondly, CALL programs often incorporate multimedia elements, including audio, video, and games, which can make learning more engaging and enjoyable (Yang & Kuo, 2020). This interactive nature has the potential to boost motivation and engagement, especially for students in a home environment where distractions may be greater (Lahlali et al., 2023).

The potential benefits of CALL extend beyond simply improving reading skills. Studies suggest that technology-integrated learning environments can cultivate positive learning attitudes (Parmaxi et al., 2013). The interactive nature of CALL programs, coupled with immediate feedback and rewards, can make learning more enjoyable and foster a sense of accomplishment (Nawaz, 2022). Additionally, CALL can promote self-directed learning, a valuable skill that can benefit students throughout their academic careers (Zhang, 2020).

Despite the growing popularity of CALL applications, research investigating their effectiveness in improving reading skills and fostering positive learning attitudes amongst students learning Chinese as a home-based language remains limited. While previous studies have explored the integration of various technologies, including CALL, mobile access, and Web 2.0 tools, into the teaching and learning of Chinese as a Second Language (CSL) (Lin et al., 2017), there is a need for more specific research on the impact of CALL in home settings (Gong et al., 2020). Much of the existing research focuses on CSL education within China or foreign language environments (Lyu & Qi, 2020), with limited exploration of its application for heritage language learners in home environments (Lahlali et al., 2023).

This study aims to address this gap by examining the impact of computer applications on reading skills and learning attitudes of Year 1 students in a single primary school learning Chinese as a home-based language. By analyzing the effects of CALL-integrated teaching and learning methods, this research seeks to contribute valuable

insights into the effectiveness of computer applications for enhancing reading skills and fostering positive attitudes towards learning Chinese in a home-based environment.

Research Question

1. Is there a significant difference in Chinese character reading skill achievement as shown in gain scores between the control group and the experimental group?
2. To what extent do students perceive the use of computer applications as beneficial in their learning of Chinese?

Literature Review

The acquisition of strong reading skills is fundamental for successful language learning, particularly for a language like Chinese with its unique writing system and vast vocabulary. Mastery of Chinese characters forms the bedrock of literacy, with each character composed of radicals (components) and strokes (Wang et al., 2022). Numerous studies highlight the importance of character recognition in learning Chinese. Kai-Chee et al. (2018) suggests prioritizing character recognition for beginners, while Hsu (2022) emphasizes the link between character recognition skills and overall reading competency. Similarly, Zhang et al. (2021) underlines the importance of understanding character structure for young learners.

However, memorizing individual characters can be a daunting task. Wang et al. (2021) suggested that focusing on the relationship between components within characters can be more effective. Focusing on the relationship between components within characters can be more effective in fostering orthographic awareness, the ability to infer meaning and pronunciation based on character structure. Studies have shown that Chinese characters are often composed of subcharacter components that are semantically informative, and the internal semantic features of these components can provide additional information for character representation (Wang et al., 2021). By decomposing Chinese characters into components and modeling them as a graph structure, the azimuth relationship among subcharacter components can be preserved, allowing for the explicit modeling of component-level internal semantic features (Leong et al., 2019). Additionally, an improved statistical structure modeling method has been proposed to pick up all meaningful components in a character, effectively reflecting stroke relations and measuring the importance of relationships (Yu et al., 2012). These approaches can help learners develop the ability to recognize and understand Chinese characters more effectively (Xu, 2017; Lee et al., 2011). As students develop metalinguistic awareness, their understanding of characters becomes more nuanced, leading to improved efficiency (Jiang, 2006). Computer-assisted language learning (CALL) applications have the potential to support these learning approaches effectively.

Despite the promise of CALL, the majority of existing research focuses on individual character memorization through drills and exercises based on shape, stroke order, and meaning (Chuang & Ku, 2011). This approach falls short of exploiting the full potential of CALL in fostering deeper understanding of character structure.

While a significant body of research investigates the use of technology for language learning, the focus is often on English vocabulary development (Shadiev & Yang,

2020). Studies specifically exploring the use of ICT in Mandarin Chinese learning and teaching remain relatively scarce. Shadiev et al. (2017) found that research on using ICT for Chinese learning lagged behind that for English by a factor of 10, despite these languages being the world's most spoken (Ghanizadeh et al., 2015). This highlights the need for further research on technology-aided Chinese language learning.

Previous studies have documented several benefits of CALL and CAI (Computer-Assisted Instruction). Current instructional technology can personalize learning experiences, catering to individual student needs (Shemshack et al., 2021). Numerous studies have explored the effectiveness of computer-assisted instruction (CAI) in improving Chinese reading skills. One study found that CAI can be an effective means of addressing literacy deficits and achievement gaps, with kindergarten students who used a computer-adaptive reading program scoring significantly higher than those who used it less (Nini & Kong, 2021). Another study conducted a quasi-experimental research and found that the use of smartphone applications in teaching Chinese language reading skills improved students' reading ability and motivation (Shamir et al., 2023). Additionally, a longitudinal study demonstrated that the use of an adaptive CAI program had a lasting impact on young students' literacy skills, with students who used the program outperforming those who did not, even one to two years after they stopped using it (Chee et al., 2017). These findings suggest that CAI, including computer-adaptive programs and smartphone applications, can be effective tools for improving Chinese reading skills.

Similar positive effects of CAI on young readers have been reported by other studies (e.g., Cassady & Smith 2004, 2005; Hecht & Close 2002; Macaruso et al. 2006; van Daal & Reitsma 2000; Cheung & Slavin, 2011, Macaruso & Rodman, 2011). Additionally, text-to-speech technology has been shown to benefit struggling readers by promoting reading fluency and comprehension (Elkind et al., 1993; Leong 1995; Lundberg & Olofsson 1993; Elkind & Elkind, 2007). Researchers have also explored the potential of CAI programs in directly improving reading comprehension strategies (e.g., Kim et al., 2006; MacArthur & Haynes 1995).

Furthermore, CALL has been shown to be particularly effective in the teaching of Chinese as a Second Language. The unified competition model suggests that optimizing training schemes can enhance L2 learning by fostering various protective factors Zhang & MacWhinney, 2023). In one study, training with familiar stimuli from the textbook and unfamiliar stimuli from novelty design were administered to two groups of learners. The results showed that training with novelty stimuli led to greater improvement for intermediate learners, while training with familiar stimuli was more effective for beginning learners (Kan & Loh, 2022). Another study used drama conventions, such as still image and reader's theater, to teach Chinese literature to CAL students. The findings indicated that students gained a deeper understanding of the text and could evaluate the behaviours of the characters critically (Zhang, 2022). Additionally, a study explored the usefulness of CALL-based communication in conjunction with instruction on learners' L2 pragmatic development. The findings demonstrated that CALL coupled with teaching intervention had a long-term impact on learners' pragmatic development (Li, 2020).

Motivation and interaction with the target language are crucial aspects of successful language learning programs (Narayana, 2023). Studies by Zhang and

MacWhinney (2023) demonstrated positive learner attitudes and improved vocabulary acquisition in CALL environments compared to traditional methods.

Research focused on computer-assisted language learning (CALL) in Chinese reading instruction has yielded positive results. Studies have identified effective practices for CALL reading instruction, including the use of eye-tracking techniques to understand the cognitive mechanisms underlying Chinese reading (Ke, 2020). Additionally, the use of a computer aided Chinese reading platform has been found to promote teaching strategies and improve students' core literacy in Chinese courses (Zhang et al., 2022). These findings highlight the potential of CALL in enhancing reading instruction and literacy development in Chinese as an additional language.

However, it is important to acknowledge that effective CALL implementation necessitates a multifaceted approach. Firstly, CALL programs must cater to diverse learning needs through differentiated instruction. Gamification can engage beginners, while advanced learners benefit from advanced analysis tools and authentic materials (Chua et al., 2021). Secondly, Teacher training is crucial for successful integration of technology in Chinese language teaching. It ensures that computer-assisted language learning (CALL) supplements, rather than replaces, traditional teaching methods. Data analysis from CALL programs can personalize instruction and identify areas for targeted support (Anqi & Yanqun, 2022). Effective teacher training models are needed to develop the essential competencies of Chinese as a Foreign Language (CFL) teaching excellence (Bai, 2022). Teachers should be treated as complete human beings and be prepared for learning, attach importance to professional writing, and build a learning community (Meng, 2020). Integration of content and language learning in teaching Chinese culture to English majors requires strategic planning and reflective evaluation. It enhances language learning and content acquisition, providing learners with a meaningful context (Saisai, 2023). Primary and secondary Chinese language teachers have training needs in skills involving Chinese script, oral skills, teaching exceptional students, composition writing, ICT and media for teaching, and alternative pedagogies. Students' main difficulties include word recognition, lack of interest/positive attitude/confidence, and Hanyu Pinyin (Soh, 2016). Finally, a balance between screen time and traditional activities is crucial. CALL programs should complement activities like discussions and character practice, potentially by providing discussion prompts or digital writing opportunities. This thoughtful integration of CALL fosters a dynamic learning environment that enhances student motivation, personalizes learning, and ultimately deepens understanding and appreciation of the Chinese language (Arundell et al., 2022).

The challenges faced by learners in home-based environments further strengthen the case for CALL in Chinese language acquisition. Limited access to qualified instructors and consistent guidance can hinder progress (Tang et al., 2021). Additionally, the lack of peer interaction and structured learning routines can negatively impact motivation and engagement.

CALL applications have the potential to address these challenges. Firstly, CALL programs offer a structured learning environment that can supplement the lack of formal instruction in home settings. Secondly, the interactive and engaging nature of CALL can help to maintain motivation and make learning more enjoyable, particularly for students who may struggle with distractions in a home environment (Zhang, 2022). Thirdly, some CALL programs incorporate elements of social interaction, allowing stu-

dents to connect with peers and instructors virtually, fostering a sense of community and collaboration.

While research on CALL has yielded promising results, there is a significant gap in the literature exploring its effectiveness in improving reading skills and fostering positive attitudes amongst students learning Chinese as a home-based language. The majority of studies focuses on CALL in classroom settings or explores English language learning (Shadiev & Yang, 2020). Furthermore, existing research on CALL for Chinese language acquisition often emphasizes character memorization drills rather than fostering a deeper understanding of character structure (Chuang & Ku, 2011).

This present study aims to address this gap in the literature by examining the impact of CALL on reading skills and learning attitudes of Year 1 students in a single primary school learning Chinese as a home-based language. By analyzing the effects of CALL-integrated teaching and learning methods, this research seeks to contribute valuable insights into the effectiveness of computer applications for enhancing reading skills and fostering positive attitudes towards learning Chinese in a home-based environment.

Method

Research Design

This quantitative investigation adopted a quasi-experimental design to examine the effectiveness of computer software in enhancing Chinese language reading proficiency among primary school students. The primary aim was to evaluate the impact of digital tools on language acquisition, specifically assessing how an application designed to facilitate Chinese reading skills influences students' learning outcomes. To achieve this, the study utilized a structured quantitative questionnaire to gather data on students' perceptions and engagement levels with the computer application dedicated to improving their reading capabilities.

To ensure the validity of the findings, the research meticulously controlled for extraneous variables that could potentially affect the results, such as differences in teaching personnel, educational environment, and instructional materials. This control was achieved by maintaining uniformity in key aspects of the educational setting, including the employment of a single educator, the use of a consistent curriculum, and the operation within the same school premises for both the experimental and control groups. The experiment delineated two homogenous groups of students: the treatment group, which received instruction through remote learning sessions facilitated by the 'Learn Chinese Mandarin' software as illustrated in **Figure 1**, and the control group, which was taught using conventional methodologies, specifically through the deployment of PowerPoint presentations for remote education.

This quasi-experimental research was conducted within two classes at the same elementary school, with class selection being randomized to ensure methodological rigor. In the conventional instructional approach, detailed guidance on utilizing PowerPoint presentations was provided. Conversely, the experimental teaching strategy showcased the integration of a computer application 'Learn Chinese 2008' as illustrated in **Figure 2**, highlighting a novel approach to language instruction. A singular educator supervised both groups, ensuring consistency in educational delivery. The curriculum
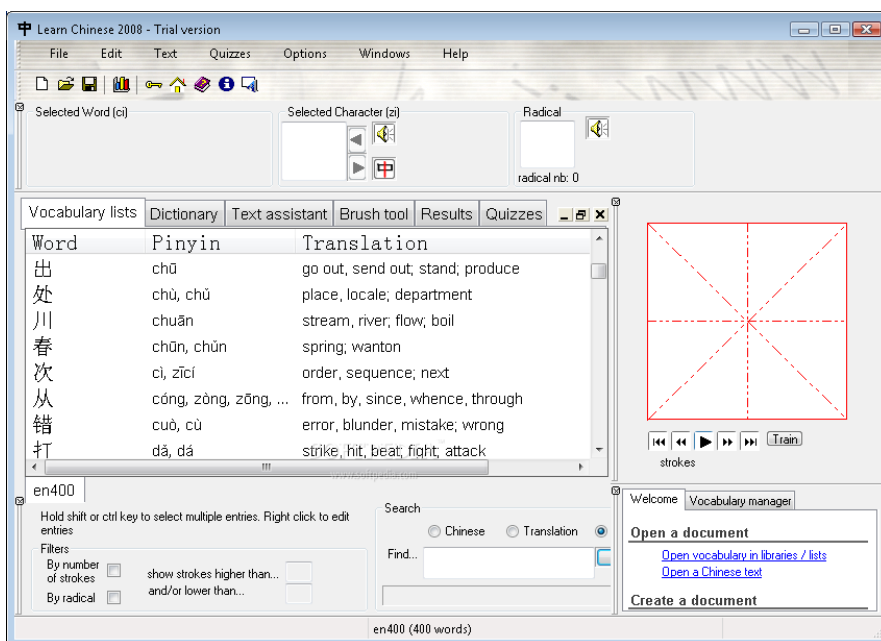
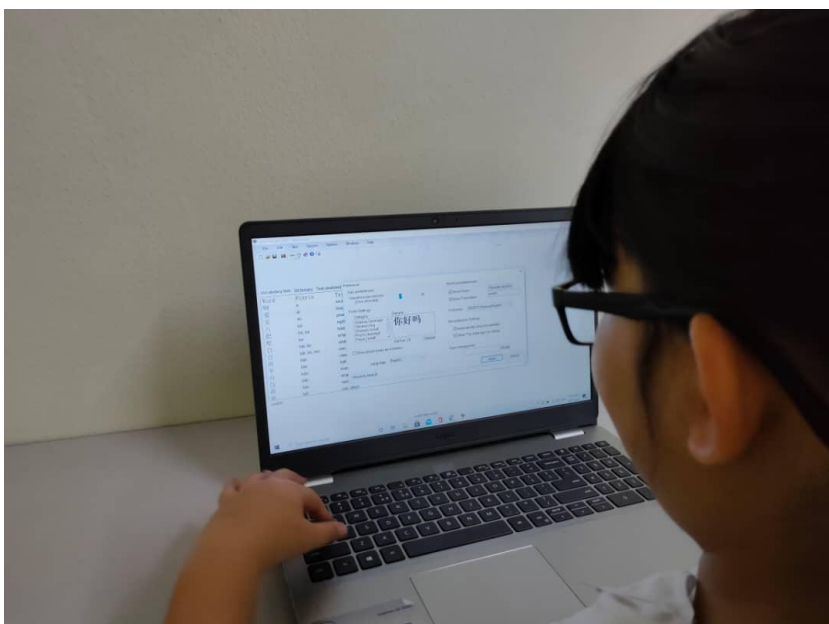**Figure 1. Learn Chinese 2008 Computer App's Interface.**

Figure 2. Student Was Using Their Computer Application during the Study Was Carried Out.

was divided equally, allocating two sessions per week to traditional teaching methods and two sessions to the exploration of computer application-enhanced learning strategies, all within the framework of a home-based learning model.

Sampling

In the present investigation, the researchers employed a convenience sampling strategy for the selection of the sample, a method often adopted owing to limitations related to time, resources, and financial constraints. The research participants consisted of 60 first-grade students from Malaysia, with 30 students in the control group and 30 in the experimental group. These students were selected based on their enrollment in Chinese language classes, ensuring a uniform baseline of language proficiency prior to the intervention. Consequently, the representativeness of the selected sample in accurately mirroring the broader population characteristics is compromised. The scope of the study was confined to a singular elementary educational institution located in Jenjarom, Selangor, Malaysia. Therefore, the aggregate number of respondents encompassed within this study amounted to sixty pupils, distributed evenly between a control group and an experimental group, each comprising thirty students.

Instrument

In the present study, the methodological approach involved the utilization of both a test and a questionnaire as primary instruments for data collection. Initially, an oral pretest comprising 30 questions was conducted to establish baseline data prior to the initiation of the experimental intervention. This pretest was designed to assess the subjects' competencies relevant to the study's focus. Upon the conclusion of the intervention period, an oral post-test was administered, featuring questions randomly selected from the initial pretest to evaluate the efficacy of the therapeutic intervention. Individual assessments of reading proficiency were conducted by an educator for each participant, with a designated duration of 20 minutes per assessment.

Subsequent to a one-month period of the investigation, both control and experimental groups were presented with a questionnaire employing a four-point Likert scale to measure their perceptions and attitudes towards the intervention. The Likert scale ranged from 4 ("strongly agree") to 1 ("strongly disagree"), enabling a nuanced analysis of participant responses in relation to the study's outcomes following the disclosure of test results. This methodological framework was carefully selected to ensure the reliability and validity of the data collected, facilitating a comprehensive understanding of the intervention's impact on the participants.

Pilot Study

The study used a self-developed test and questionnaire, both rigorously designed for validity and reliability. Test items derived from curriculum objectives were reviewed by experts, pilot-tested, and statistically analyzed, with revisions made based on item discrimination and difficulty. Cronbach's alpha assessed internal consistency. The questionnaire development included a literature review to identify relevant constructs, re-

finement by educational psychologists and teachers, pilot testing, and feedback collection. Factor analysis confirmed construct validity, and Cronbach's alpha assessed reliability. These steps ensured the instruments were robust and valid for measuring the intended constructs.

To ensure the relevance and alignment of the research questions with the objectives of the study, the researchers administered questionnaires to seasoned lecturers for evaluation, thereby assessing the content validity of the instrument. Furthermore, to ascertain the reliability of the instrument, the researchers conducted an analysis of its Cronbach's Alpha value, which was found to be 0.669. It is noteworthy that according to Hatcher and Stepanski (1994), Cronbach's Alpha values as low as 0.66 are deemed acceptable within the realm of social sciences.

Procedure

The procedure of the study is meticulously structured to assess the impact of integrating computer applications in enhancing Chinese reading skills among participants. Initially, participants are subjected to a pretest consisting of 30 questions in Chinese (detailed in Appendix A) to evaluate their baseline reading proficiency. Subsequently, they engage with 30 vocabulary items from the Year 1 Chinese Language syllabus, during which educators meticulously record each participant's ability to accurately read and write the given vocabulary. Following the intervention, a post-test comprising randomly ordered question is administered to measure the effectiveness of the treatment. Educators then analyze the data to develop a formula aimed at assessing the feasibility of incorporating computer apps in teaching Chinese characters to improve reading skills. Additionally, participants complete a 10-question questionnaire to capture their perceptions and interest in using computer programs for reading enhancement. The final step involves a thorough evaluation of questionnaire responses by educators, aimed at drawing conclusions about the participants' attitudes and interests towards the utilization of computer applications as a supportive tool in developing reading skills, thereby providing valuable insights into the pedagogical approach.

The data collection was subject to rigorous analysis employing both frequency and percentage methodologies. The analytical procedures commenced with the administration of a preliminary test designed to evaluate any performance disparities between two distinct cohorts: the treatment group and the control group. This initial phase included a pretest wherein students were tasked with answering questions pertinent to the instructional content prior to the commencement of the teaching sessions. Utilizing the Mann-Whitney U test to assess the outcomes of the oral pretest, the findings indicated no substantial variance between the groups (U = 450.000, p = 1.000). The experimental group demonstrated a median score of 7 with a range of 7, contrasted with the control group's median score of 8 and a range of 6. Consequently, the inference drawn was that student performance between the two classes did not significantly differ.

Subsequent analysis aimed at discerning the differential impact on achievement attributable to the two pedagogical strategies post-intervention. Owing to the non-normal distribution of gain scores within the control group and a breach of Levene's test assumption concerning homogeneity of variances—$F(1,58) = .00$, $p = 1.00$—a non-

parametric approach was necessitated, thus the Mann-Whitney U test was once again employed to evaluate the disparities in scores between the pre- and post-tests.

In addition to these methods, a questionnaire was disseminated to amass data pertinent to the investigation. Prior to the analytical phase, the questionnaire underwent a validation process through a pilot study and was critically assessed by two subject matter experts to ascertain both its reliability and its alignment with the research objectives.

The analysis of the questionnaire data was conducted using descriptive statistical techniques, with a focus on frequency, percentage, and median scores. The purpose was to evaluate the effectiveness of integrating computer programs into teaching and learning processes, specifically to enhance reading skills. For the data analysis, both SPSS version 26.0 and Microsoft Excel were utilized, facilitating a comprehensive examination of the data collected for the study.

Result

In the pretest and posttest phases of the study, ten vocabulary items in Chinese were employed to evaluate the participants' performance in examinations. This evaluation involved tabulating the count of items each participant correctly answered within each group, followed by an assessment to ascertain if there were statistically significant median differences through the application of the Mann-Whitney U Test. The application of the Shapiro-Wilk test for normality on the achievement scores of the control group yielded a value of 0.001, leading to the rejection of the hypothesis that the dataset follows a normal distribution.

Conversely, this study also incorporated a questionnaire designed to gauge the perspectives of students by soliciting their responses to ten inquiries. The primary aim of this segment was to explore the impact of computer applications on the enhancement of students' reading proficiency in Chinese. The questionnaire items were rated on a four-point Likert scale ranging from "strongly agree" to "strongly disagree" to measure the respondents' reading aptitude for texts in Chinese. The research methodology utilized median scores, frequency counts, and percentage distributions to analyze the influence of the respondents' interest levels and their perceptions regarding the efficacy of computer applications on their proficiency in reading Chinese language materials as indicated by their responses to the questionnaire items.

Differences of Gain Score between Experimental Group and Control Group in Achievement Test

The Mann-Whitney U test was used to compare the median for the procurement of teaching reading Chinese using a computer program to the traditional way (see **Table 1**). The Mann-Whitney test revealed that the experimental group mastered reading Chinese at a greater rate (Mdn = 21.00) than the control group (Mdn = 15.00), U = 450.0, p = 1.000. However, this result indicates that there are no significant differences in reading achievement scores between the control and experimental groups in the Chinese language as indicated in **Figure 3** where the experimental group's flagship has a higher

Table 1: Analysis of Mann Whitney Test on Gain Score for Experimental Group and Control Group in Achievement Test.

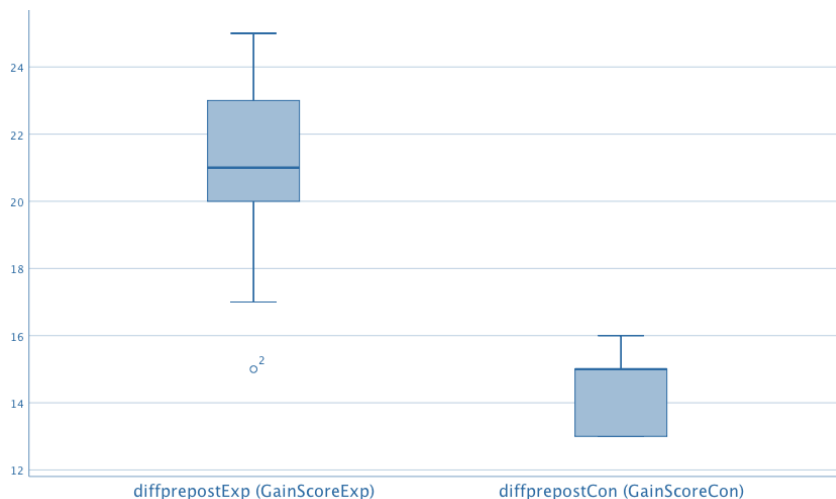| Group	N	Median	U	Z	P-value
Control	30	15.00	450.0	0.000	1.000
Experimental	30	21.00			

*Significant *p < 0.05.*

Figure 3. Boxplot Shows Comparison for Gain Score between Control Group and the Experimental.

median than the control group. In any case, the null hypothesis cannot be rejected: there are no significant changes in the median student accomplishment scores in Chinese reading skills between students subjected to computer-assisted instruction and students exposed to traditional instruction. To clarify, the results suggest that there are few differences in gain score between the two groups, indicating that using a computer application that runs at home has no effect on students' reading competency in Chinese vocabulary when compared to a control group that received no intervention from the computer application.

Difference in Learning Attitudes between Groups

Item 1 examines the level of interest in Chinese culture among respondents. The findings show that 80 percent of both the control (24 respondents) and experimental (27 respondents) groups strongly agree (scale 4) with a keen interest in Chinese culture. This outcome suggests an enhanced interest in Chinese language subjects among the

experimental group participants, attributable to their engagement with the computer program.

Item 2 assesses the readiness of respondents to learn Chinese subjects. A notable difference was observed, with 20 percent (6 respondents) in the control group and approximately 21 percent (21 respondents) in the experimental group selecting "highly agree" (scale 4). This indicates a significant increase, exceeding 15 individuals, in the experimental group's readiness to learn Chinese, likely as a consequence of their interaction with computer programs.

Item 3 concerns the level of attention devoted during Chinese language instruction. Sixty percent (18 respondents) of the control group and a slightly higher proportion in the experimental group (21 respondents) chose "highly agree" (scale 4). Conversely, a lower level of agreement (scale 3) was noted among 40 percent of the control group and none in the experimental group, with a few experimental respondents (6 individuals) selecting "disagree" (scale 2). This suggests a potential increase in inattentiveness among students during Chinese lessons when computer programs are used.

Item 4 explores the satisfaction derived from independently solving Chinese-related problems. An increase of six respondents in the experimental group selecting "strongly agree" (scale 4) compared to the control group indicates that computer-assisted teaching and learning methods enhance students' satisfaction and their ability to develop proficiency in reading Chinese.

Item 5 addresses the review of previously taught Chinese concepts. A significant increase, with 15 additional respondents in the experimental group selecting "strongly agree" (scale 4), indicates a higher willingness and autonomy in reviewing Chinese concepts among students exposed to computer applications.

Item 6 investigates the frequency of inquiries about Chinese language challenges with teachers and peers. The data show that 50 percent of the control group (15 respondents) and a slightly higher proportion in the experimental group (18 respondents) strongly agree (scale 4) with engaging in such inquiries, suggesting that students in the experimental group are more proactive in seeking help.

Item 7 evaluates the extent to which students feel unafraid and not bored with Chinese subjects. Ninety percent of respondents in both control (27 respondents) and experimental (30 respondents) groups strongly agree (scale 4), highlighting a significant improvement and the effectiveness of the innovative instructional method in increasing interest and engagement through interactivity.

Item 8 investigates participants' attitudes towards learning Chinese, specifically regarding its perceived ease of comprehension. The experimental group, with an addition of three participants over the control group, displayed a marked improvement in positive reactions towards the language. This enhancement in positive sentiment underscores the efficacy of the intervention in fostering favorable attitudes towards Chinese.

Item 9 addresses individuals' confidence levels in engaging in verbal communication in Chinese. Again, the experimental group saw an increase of three participants compared to the control group, suggesting that innovative educational methods can significantly bolster learners' confidence in speaking Chinese.

Item 10 delves into the participants' self-assessment of life achievements in correlation with their proficiency in Chinese. A striking 90 percent of the control group (27 respondents) strongly agreed with feeling successful due to their Chinese language

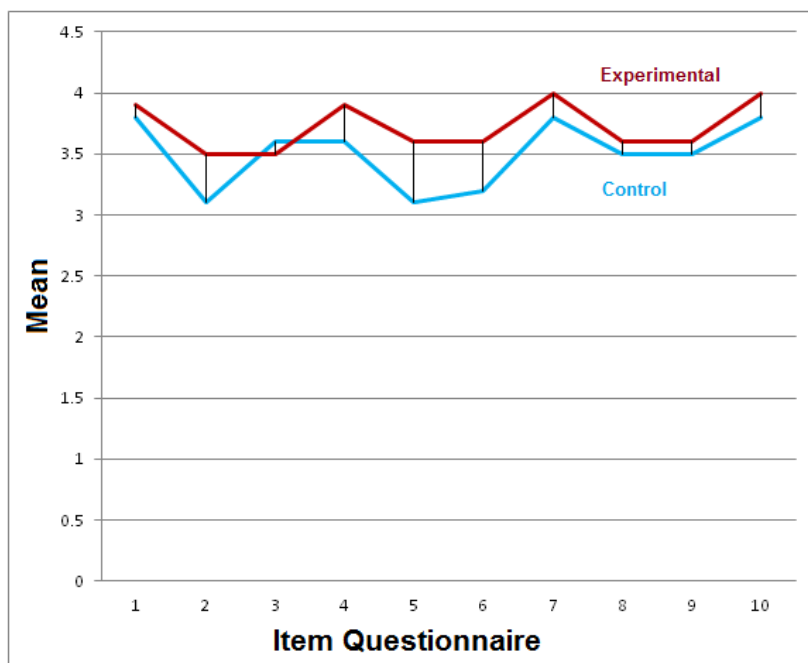| Number	Questionnaire Item	Mean of Control Group	Mean of Experimental Group
	Table 2: Mean Comparison Based on Students' Perceptions of Reading Skills of Chinese Language Subjects for the control and Experimental groups.		
1	I am very interested in the Chinese Subject.	3.8	3.9
2	My reading skill in Chinese had been increased.	3.1	3.5
3	I pay full attention during Chinese Subject class.	3.6	3.5
4	I feel excited when I can read the Chinese language correctly by myself.	3.6	3.9
5	I continually revise the topic in the Chinese language class that had been taught.	3.1	3.6
6	I always ask the question to teacher and friend when I came across difficulty reading the Chinese language.	3.2	3.6
7	I feel not so fear and not so fast boring towards Chinese subject.	3.8	4.0
8	I feel that Chinese subject is a subject that is not too difficult to understand and read.	3.5	3.6
9	I am confident when I communicate or verse in the Chinese language.	3.5	3.6
10	I think I will see success in my life if I can verse in the Chinese language skillfully.	3.8	4.0

Figure 4. Mean Comparison Based on Students' Perceptions of Reading Skills of Chinese Language Subjects for the Control and Experimental Groups.

skills, as indicated by their selection of scale 4. Conversely, this sentiment was unanimously shared by all thirty participants in the experimental group, indicating a heightened sense of accomplishment post-intervention among those proficient in Chinese.

The analysis also categorizes various items based on the psychological constructs they pertain to. Items 2, 4, 5, and 6 are linked to motivation, while Items 1, 7, and 8 are associated with interest. Furthermore, Items 9 and 10 are identified with confidence, and Item 3 is related to attention. Notably, the experimental group's average scores for perceptions on the efficacy of computer-assisted instruction in enhancing Chinese reading proficiency are above 3.0. Table 4.2, which contrasts the mean scores for each item from both groups' perceptions on Chinese reading skills, reveals that the experimental group consistently outperforms the control group across most metrics, with the exception of Item 3, where the control group scored marginally higher.

The comparative analysis based on **Table 2** and **Figure 4** demonstrates that the integration of computer applications in Chinese language learning generally enhances students' perceptions of their reading skills and attitudes towards the subject. The experimental group consistently outperforms the control group across most metrics, except for attention levels during class. This suggests that while computer applications are effective in improving motivation, confidence, and engagement, attention span remains an area for further investigation and improvement. Overall, the use of computer applications appears to be a valuable tool in enhancing the learning experience and outcomes for students in Chinese language education.

Discussion

The integration of computer applications in language acquisition has been a subject of considerable interest, particularly in the context of Chinese language learning. This study aimed to investigate the effectiveness of such applications in enhancing reading skills and fostering positive learning attitudes among primary school students engaged in home-based learning.

Impact on Reading Skills

The results of the study indicate that while there was an improvement in the reading skills of students who used the computer application, the differences in gain scores between the control and experimental groups were not statistically significant. This finding aligns with previous research, which suggests that while technology can enhance learning experiences, the extent of its impact may vary depending on several factors, including the design and implementation of the application, the learners' initial proficiency levels, and the overall learning environment (Shadiev & Yang, 2020).

However, the qualitative feedback from students highlighted a preference for computer-assisted learning over traditional methods. This preference can be attributed to the interactive and engaging nature of CALL applications, which often incorporate multimedia elements such as audio, video, and games, making the learning process more enjoyable and stimulating (Xue, 2022). The ability to progress at one's own pace and receive immediate feedback also contributed to a more personalized and effective learning experience (Lee & Yeung, 2020).

Student Perceptions and Attitudes

The study found that students generally had positive attitudes towards using computer applications for learning Chinese. They reported greater ease and enjoyment in acquiring reading skills through these digital tools compared to conventional methods. This is consistent with the findings of Parmaxi et al. (2013), who noted that technology-integrated learning environments could enhance students' motivation and engagement. The immediate feedback and rewards provided by CALL programs can foster a sense of accomplishment and encourage self-directed learning (Nawaz, 2022).

Motivation and Engagement

One of the significant benefits of CALL highlighted in the study is its potential to maintain student motivation and engagement, particularly in home-based learning environments where distractions are prevalent. The structured and interactive nature of CALL applications helps to create a more engaging learning experience, which is crucial for maintaining students' interest and focus (Lahlali et al., 2023). Furthermore, the ability to connect with peers and instructors virtually through some CALL programs can mitigate the lack of peer interaction and foster a sense of community and collaboration, which is often missing in home-based learning settings (Zhang, 2022).

Challenges and Considerations

Despite the positive outcomes, the study also underscores the challenges associated with implementing CALL in home-based learning environments. Limited access to qualified instructors and consistent guidance can hinder the effectiveness of technology-based learning tools (Tang et al., 2021). Additionally, the success of CALL depends heavily on the quality of the application and the extent to which it aligns with educational objectives and students' learning needs (Chuang & Ku, 2011).

Teacher training is another critical factor for successful CALL integration. Educators need to be well-versed in both the technical and pedagogical aspects of using technology in language instruction to ensure that CALL supplements rather than replaces traditional teaching methods (Bai, 2022). Effective teacher training models are essential for developing the competencies required for integrating CALL into the curriculum and for using data from CALL programs to personalize instruction and identify areas for targeted support (Anqi & Yanqun, 2022).

Future Research Directions

The findings of this study highlight the need for further research to explore the long-term impact of CALL on reading skills and learning attitudes. Future studies could focus on larger and more diverse samples to enhance the generalizability of the results. Additionally, research could investigate the specific features of CALL applications that are most effective in promoting language acquisition and how these tools can be optimized for different learning contexts.

There is also a need to explore the potential of CALL in fostering deeper understanding of character structure, rather than merely focusing on memorization drills. Approaches that incorporate semantic and orthographic awareness could be more effective in developing comprehensive reading skills (Wang et al., 2021).

Conclusion

This study explored the effectiveness of a computer application in improving reading skills in Chinese language among primary school students engaged in home-based learning. The quasi-experimental design involving 60 students revealed insights into both the potential and limitations of using technology in language education.

Firstly, while the improvement in reading skills among students using the computer application was observed, the difference in gain scores between the experimental and control groups was not statistically significant. This finding suggests that while computer-assisted language learning (CALL) applications can support learning, their impact may vary and is influenced by several factors including the design of the application, initial proficiency levels of the students, and the learning environment.

Secondly, the qualitative feedback from students indicated a clear preference for computer-assisted learning over traditional methods. Students found the CALL application engaging and enjoyable, highlighting the benefits of multimedia elements and interactive features that make learning more stimulating and personalized. This aligns with existing literature suggesting that technology can enhance motivation and engagement in learning.

Furthermore, the study demonstrated that CALL applications have the potential to foster positive learning attitudes. Students reported greater ease and enjoyment in acquiring reading skills through digital tools, underscoring the role of technology in creating a more engaging learning experience. This is particularly significant in home-based learning environments where maintaining motivation and focus can be challenging.

Despite these positive outcomes, the study also highlighted several challenges. The effectiveness of CALL is contingent on the quality of the application and its alignment with educational objectives. Additionally, limited access to qualified instructors and consistent guidance can impede the success of technology-based learning tools. Teacher training emerged as a critical factor for effective CALL integration, emphasizing the need for educators to be proficient in both the technical and pedagogical aspects of using technology in language instruction.

In conclusion, while the integration of computer applications in Chinese language learning shows promise, it is essential to address the challenges associated with their implementation. The study underscores the importance of high-quality application design, teacher training, and alignment with educational objectives. Further research is needed to explore the long-term impact of CALL on reading skills and learning attitudes, and to identify the most effective features of these applications. By addressing these areas, the potential of CALL to enhance language learning can be fully realized, providing a valuable tool for educators and students alike.

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Appendix A

Chinese Vocabulary Reading Test (Pre-test & Post-test)

No.	Vocabulary	Able to read	Bil	Vocabulary	Unable to read
1	用		16	重	
2	朋		17	侯	
3	明		18	猴	
4	晴		19	主	
5	睛		20	住	
6	蓝		21	往	
7	篮		22	今	
8	鸟		23	令	
9	鸡		24	铃	
10	鸭		25	零	
11	鹅		26	邻	
12	告		27	己	
13	休		28	已	
14	体		29	该	
15	量		30	孩	

Total Correct Reading Answer=   / 30