

The Effectiveness of Digital Game-Based Pedagogy in Language Abilities Among Children With Delay

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ABSTRACT

Language delay impacts children's social development. Game-based teaching has shown promise in enhancing language skills, however, the effectiveness of digital game-based teaching for children with language delay remains underexplored. This study, focusing on Chinese kindergarten students, investigated the impact of digital game-based teaching pedagogy on the language development of children with delay. Employing a mixed-method approach, quantitative data from teachers' assessment scale, while qualitative data from semi-structured interviews. A randomized controlled trial was conducted among 60 students. Results revealed a significant improvement in the experimental group post-intervention compared to the control group. Interview findings showed positive attitudes from teachers and parents towards digital game-based teaching, alongside concerns such as distracted academic attention, excessive reliance on games, and prolonged screen radiation. These findings indicate benefits for improving language abilities of children with delay, while calling for attention to potential threats.

KEYWORDS

Digital Game-Based Teaching, Educational Games, Early Childhood Interventions, Language Delay, Instructional Design, Kindergarten Students, Special Education, Developing Country

INTRODUCTION

Globally, language delay is a pervasive issue that significantly affects children's social, emotional, and academic development (Aram & Nation, 2016). Traditional approaches to addressing language delays, such as direct instruction and therapeutic interventions, have been widely adopted in both Western and Eastern contexts (Conti-Ramsden & Durkin, 2012; Kim & Kim, 2017). However, these methods often lack the engagement and motivational elements essential for sustained learning, particularly for younger children (Fisher & Frey, 2012). Game-based teaching offers a promising solution by leveraging children's natural interest in games to create engaging and interactive learning environments. This approach has been shown to enhance various aspects of language development, including vocabulary, grammar, and syntax, by promoting active learning and cognitive development (Hwang & Wu, 2012; Papastergiou, 2009). Grounded in Vygotsky's (1978) theories on the educational

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potential of play, game-based teaching incorporates social interactions and cognitive development through interactive mediums. While Vygotsky's work did not explicitly address digital platforms, it laid the theoretical foundation for understanding the benefits of game-based learning. Prensky (2001) later expanded on it by emphasizing the motivational advantages of integrating games into educational environments. Despite these theoretical advancements, the growing reliance on digital and remote learning environments highlights the need for innovative strategies that can be effectively implemented in distance environments beyond face-to-face settings.

Digital game-based learning denotes the process of acquiring knowledge or completing objectives when facilitated by electronic devices such as computers or mobile phones. It emphasizes games, fun, competition, and problem solving (Sandberg et al., 2014). Previous studies have demonstrated the effectiveness of digital game-based learning in English (Yang & Chen, 2020), mathematics (Deng et al., 2020), and science, technology, engineering, art, and mathematics, often referred to as "STEAM" (Chen & Huang, 2023). It can improve students' learning motivation (Su, 2016) and academic performance (Lin et al., 2018). However, most of the studies were conducted in face-to-face classrooms as a trial without focusing on distance education environments. Moreover, there is a lack of research on students with special needs.

Whether in developed or developing countries, rapid technological advancements have driven the integration of digital tools in education, and addressing language delays through innovative approaches is a pressing concern. As a developing country, China has recognized the importance of innovative means in promoting educational equity, but current interventions remain traditional and classroom-based, with limited exploration of digital tools for remote or hybrid learning environments (Craft, 2016; Wu et al., 2014). This gap is especially significant given that access to face-to-face interventions may not always be feasible, underscoring the need for scalable, technology-driven solutions that can be implemented in distance education contexts.

This study aims to address the above gaps by investigating the effectiveness of digital game-based teaching on the language proficiency of kindergarten students with language delays. Existing research often employs either a strictly qualitative or quantitative method without integrating both to capture the multifaceted impact of digital game-based teaching in remote learning contexts. This study uses a mixed research method to obtain students' scores through different pedagogies and feedback from teachers and parents, emphasizing the potential and effectiveness of digital game-based pedagogy in distance education environments. The findings inform future educational practices and policies, particularly in the context of remote and hybrid learning environments.

The research questions are as follows:

- Is digital game-based pedagogy effective in improving the language ability of children with language delays?
- Is there a significant difference in language proficiency among children with language delays who receive digital game-based instruction compared to those who receive traditional instruction?
- What are the views of parents and teachers of children with language delays on digital game-based pedagogy, particularly in the context of distance education?

LITERATURE REVIEW

Conti-Ramsden and Durkin (2012) highlighted that language delay is associated with various negative outcomes, such as academic difficulties, social withdrawal, and lower self-esteem, emphasizing the urgency of effective interventions. Fisher and Frey (2012) analyzed traditional teaching methods, such as repetitive drills and direct instruction, which are commonly used to address language delays. While these methods can be effective in structured learning environments, they often lack engagement for young children, limiting their long-term impact. These studies underscore the

limitations of traditional approaches and suggest the need for alternative methods that are more interactive and engaging.

Gamification has been advocated in the field of education in recent years, especially in early childhood education. Vygotsky's (1978) work on the Zone of Proximal Development laid the theoretical foundation for game-based teaching by emphasizing the role of play in promoting cognitive and social development. However, Vygotsky's theory did not incorporate the concept of digitalization. Prensky (2003) expanded on this by highlighting the motivational and engagement benefits of game-based learning, arguing that games can make educational content more enjoyable and relevant. Kress and Van Leeuwen (2001) analyzed the multimodal nature of digital games, noting that their integration of visual, auditory, and kinesthetic elements could cater to diverse learning preferences, making them particularly beneficial for children with unique needs. Gee (2003) further articulated the broader advantages of digital game-based teaching, such as fostering problem-solving and critical thinking skills. Zhang and Li (2023) found that online game-based learning significantly improved language proficiency in children with delays, particularly in tonal languages like Chinese, where pronunciation and tone differentiation pose additional challenges. These studies offered a framework for understanding the potential benefits of digital games in education. However, there are still some issues that need to be addressed. For example, studies like those of Prensky (2003) and Gee (2003) generally focused on broader educational outcomes rather than specifically addressing children with language delays. This leaves a gap in understanding how digital games can be tailored to meet the unique needs of this demographic. Researchers such as Hwang and Wu (2012) highlighted the potential benefits of digital game-based teaching but noted the lack of comparative studies that evaluate its effectiveness against traditional methods for language-delayed children. Without such comparisons, it is difficult to determine whether digital games offer significant advantages over established approaches. The linguistic complexity of Chinese, including its reliance on tones and monosyllabic vocabulary, presents additional hurdles for language-delayed children that are not addressed in current research (Kim & Kim, 2017; Nakamura, 2018).

After the COVID-19 pandemic, distance education and digital teaching have developed rapidly. Digital development opens up new possibilities for addressing language delays. Kim and Kim (2022) indicated that digital game-based learning can enhance language development in young learners by providing immersive and interactive environments. Their study highlighted the role of digital games in fostering engagement and motivation, which are crucial for sustained learning. Nakamura (2023) similarly explored the benefits of remote game-based interventions for children with language delays, emphasizing the importance of culturally relevant content and personalized learning experiences. Despite digital game-based teaching and learning becoming increasingly feasible with innovations in educational technology, its implementation faces challenges. For instance, Delgado et al. (2022) and Wu and Zhang (2024) identified barriers such as cost, access to technology, and the need for teacher training. Bruggeman et al. (2022) further emphasized the critical role of teachers in distance education, noting that teachers' technical skills and acceptance of new teaching methods directly influence the effectiveness of distance education. It can be seen that while distance education and digital game-based learning have shown theoretical advantages, their practical application still faces challenges, such as the cost of technology, access to devices, internet connectivity, and insufficient teacher training.

This study aims to fill the gaps in the above literature and provide increasing evidence for the effectiveness of digital game-based teaching as well as specific recommendations for its implementation in early education. Moreover, it may provide practical insights for educators and policy makers to address theoretical and practical issues, ensuring that digital game-based learning can be effectively integrated into the real-world educational environment.

METHOD

Research Design

The current study employed a mixed research method and data collected from March to July 2023. Randomized controlled trials and pre-test/post-test were used to compare the differences between digital game-based teaching and traditional teaching methods. The quantitative data came from the teacher's evaluation of students through a language scale. Qualitative data came from interviews with class teachers and parents. Specifically, during the 12-week intervention period, the experimental group participated in a teaching activity based on digital games, while the control group experienced traditional teaching methods. The 12-week intervention period was chosen based on prior studies in digital game-based learning, which suggest that this timeframe is sufficient to observe measurable changes in language development among young learners (Kim & Kim, 2022). Within the 12 weeks, the teaching objectives and duration of the two groups were the same, but the teaching methods and strategies were different. The curriculum was designed based on the pronunciation of Mandarin and the characteristics of Chinese characters and conformed to the standards of the Chinese kindergarten curriculum. Since both teaching methods targeted the same language development goals, it facilitated objective comparison and was consistent with the method proposed by Conti-Ramsden and Durkin (2012). Table 1 shows the details.

Table 1. Lessons for experimental group and control group

Week/ Lesson	Lesson Objectives	Digital Game-Based Teaching Strategy (Experimental Group)	Traditional Teaching Strategy (Control Group)
1	Introduction and Vocabulary Building	Play "Pictionary" on Lingokids, starting with simple daily life vocabulary. Children guess the words from the images shown.	Use Audio-lingual method to introduce basic vocabulary related to daily life using flashcards. Encourage children to repeat the words after the teacher.
2	Expanding Vocabulary	Play "Flashcard Match" on Quizlet to introduce more complex daily life vocabulary. Children match words with their corresponding images.	Use Direct method to introduce more complex vocabulary related to daily activities using flashcards. Use repetition and practice to help children memorize the new vocabulary.
3	Simple Sentence Formation	Play "Sentence Scramble" on Lingokids. Children arrange words in the correct order to form a sentence using the learned vocabulary.	Use PPP model to encourage children to form simple sentences using the learned vocabulary. Use group activities and hands-on exercises to promote sentence formation.
4	Comprehension and Storytelling	Use Lingokids's "Story Time" feature. Children listen to simple stories and identify the learned vocabulary in the context of the story.	Use Storytelling method to introduce simple stories or narratives featuring the learned vocabulary and concepts using printed materials. Encourage children to retell the stories in their own words.
5	Listening Skills	Play "Listen and Choose" on ABCmouse. Children listen to simple instructions or stories and respond by choosing the correct image or word.	Use Audio-lingual method for listening activities using audio recordings, role-playing, and group discussions. Encourage children to practice listening by participating in conversations and responding to questions.
6	Speaking Skills	Play "Speak and Record" on Quizlet. Children listen to the pronunciation of words or sentences and then mimic them, recording their voices.	Use Direct method to encourage children to practice speaking by repeating after the teacher, participating in conversations and asking questions.

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Table 1. Continued

Week/ Lesson	Lesson Objectives	Digital Game-Based Teaching Strategy (Experimental Group)	Traditional Teaching Strategy (Control Group)
7	Pronunciation	Play “Phonics Games” on Lingokids and ABCmouse to enhance pronunciation. Children listen and then mimic the pronunciation of words.	Use Audio-lingual method to help children learn the pronunciation of new vocabulary. Encourage them to repeat after the teacher.
8	Comprehension	Play “Quiz Mode” on Quizlet to check comprehension of the learned vocabulary and sentences. Children need to match words with their meanings or images.	Use PPP model with teacher-led question–answer sessions and quizzes to gauge comprehension.
9	Sentence Formation	Play “Word Order Games” on ABCmouse to promote sentence formation. Children need to arrange words in the correct order to form sentences.	Use PPP model to encourage children to form sentences using the learned vocabulary. Use group activities and hands-on exercises to promote sentence formation.
10	Vocabulary Reinforcement	Play “Flashcard Review” on Quizlet to reinforce vocabulary. Children need to match words with their meanings or images.	Use Direct method to reinforce previously learned vocabulary using flashcards. Use repetition and practice to help children memory.
11	Review	Play “Vocabulary Review Game” on Lingokids, Quizlet, and ABCmouse. Children review vocabulary and sentence structure through various matching, ordering, or comprehension games.	Use PPP model with teacher-led review activities to revisit vocabulary and sentence structure. This could involve flashcards, repetition, and quizzes.
12	Review & Assessment	Play a “Comprehensive Review Game” on Lingokids that covers all the lessons to assess overall progress. This could involve a mix of all the games used before.	Use a mix of Audio-lingual, Direct, and PPP methods in a comprehensive review and assessment session. Review all learned vocabulary and sentence structures and assess the children's overall progress.

Note. PPP = presentation, practice, and production.

Each group was assigned one class teacher who implemented the respective teaching strategies and monitored students’ progress. To ensure the reliability and validity of the observational data, two external observers—experienced kindergarten teachers with eight years of teaching experience—were tasked with monitoring the entire process. Before and after the experiment, class teachers were invited to assess students' abilities according to a language scale. The data collection process began with language assessment prior to intervention to establish a language proficiency baseline. Non-participatory observation refers to the observer observing without directly participating in the classroom to reduce interference with the learning environment (Cohen et al., 2002; Merriam & Tisdell, 2015). This kind of observation could help researchers maintain a certain level of objectivity and to some extent validate research results (Patton, 2014).

Participants

Purposive sampling selected kindergarten students who were both learning Chinese and diagnosed with language delay. Sixty five-year-old kindergarten students were selected, including 27 girls and 33 boys. Students were randomly assigned to either an experimental group (engaging with digital game-based teaching) or a control group (utilizing traditional teaching methods) with 30 students in each group. The

randomization process was conducted using a computer-generated random number table to ensure unbiased group allocation, as recommended in educational research to minimize selection bias (Delgado et al., 2022). The sample size of 60 students was determined through a power analysis conducted prior to the study, which indicated that a minimum of 54 participants would be required to detect a medium effect size (Cohen's $d = 0.5$) with 80% power at a significance level of 0.05. This statistical justification ensured that the sample size was adequate to meet the study's objectives and provided sufficient power to detect meaningful differences between the groups (Imran et al., 2023).

Instruments

Preschool Language Scale-5

The Preschool Language Scale-5 developed by Zimmerman et al. (1979) was employed to assess the language competencies of the preschool children in this study. The scale featured 20 items, providing a comprehensive evaluation of a child's linguistic abilities. To ensure accurate and reliable assessment, a response-based scoring protocol was utilized (Aram & Nation, 2016; Zimmerman et al., 1979). The protocol delineated the criteria for assigning points based on the child's performance and the level of assistance required. Each item was rated using a six-point Likert scale, ranging from 0 to 5. Higher scores indicated stronger language skills of students. The total score of the scale consisted of five levels (Aram & Nation, 2016), ranging from 0–35 (very limited), 36–50 (limited), 51–65 (moderate), 66–80 (good) and 81–100 (excellent). The Preschool Language Scale-5 demonstrated a good internal consistency in this study, as evidenced by Cronbach's alpha coefficient of 0.854.

Semi-Structured Interview

After the pedagogical intervention, a semi-structured interview was conducted with teachers and parents, consisting of 20 questions—10 for teachers and 10 for parents. The purpose of the interview was to supplement and enhance the quantitative data obtained from the language assessment, providing an in-depth understanding of participants' individual experiences and perceptions of the implemented teaching strategies (Fisher & Frey, 2012). The interview questions were designed to explore the impact of game-based teaching on children's language development, engagement, and motivation.

For teachers, the questions focused on classroom observations, including changes in children's vocabulary acquisition, sentence formation, comprehension, and pronunciation, as well as their engagement in learning activities. Teachers were also asked about the challenges they faced while implementing the teaching strategies and their recommendations for improving language teaching methods. For parents, the questions explored their perceptions of their child's progress in language skills, such as vocabulary usage, sentence construction, and pronunciation, as well as the child's attitude toward learning and the application of new language skills in daily life. This design ensured that the interviews captured a comprehensive understanding of the intervention's impact on both classroom and home environments.

Observational Checklist

An observational checklist was used as a tool to evaluate teaching strategies and classroom dynamics, providing a systematic and reliable method for assessing language acquisition and classroom engagement. Observational checklists have been validated as effective tools for evaluating pedagogical strategies and classroom interactions (Hailey et al., 2016; Sandall, 2005). In this study, the checklist was designed to assess 12 lessons, each focusing on five key domains: vocabulary development, sentence formation, comprehension skills, speaking and pronunciation, and classroom participation and engagement. These domains were selected based on the framework proposed by Sandall (2005), which highlights their importance in evaluating language acquisition and teaching effectiveness.

The checklist contained 60 items in total, with five items for each domain in every lesson. For example, in vocabulary-building lessons, observations included whether the child could

identify and use new vocabulary, actively participate in activities, and retain and apply the vocabulary in sentences. In sentence formation lessons, the checklist focused on whether the child could arrange words in the correct order, construct declarative and interrogative sentences, and correctly apply grammar rules. These detailed observations provided a comprehensive understanding of the effectiveness of digital game-based teaching compared to traditional pedagogical strategies by capturing real-time classroom dynamics and individual student responses. This structured approach ensured that the observational checklist offered a thorough evaluation of the intervention's impact on language acquisition and classroom engagement, providing valuable insights into the effectiveness of the teaching methodologies. More details can be found in the appendix.

Data Analysis

Quantitative data were collected through pre- and post-intervention language proficiency tests, which measured key aspects of language development, including vocabulary, grammar, and sentence construction. For language assessments of pre-test/post-test by SPSS 28, *t* tests including an Independent Samples *t* test and a Paired Samples *t* test were adopted. A *t* test was chosen because it is appropriate for comparing means in small sample sizes and is particularly effective when analyzing pre- and post-test designs where the same participants are measured before and after an intervention. As the primary goal of the study was to determine whether digital game-based teaching significantly improved language outcomes compared to traditional teaching, the *t* test provided a straightforward and statistically sound method to assess these differences.

Qualitative data were gathered through semi-structured interviews with 10 parents and two class teachers after the intervention (Fisher & Frey, 2012; Hoff, 2013). Thematic analysis was used and strictly followed the standards of Braun and Clarke (2012). More specifically, six steps involved familiar, coding, searching for themes, reviewing, naming themes and presenting themes (Fan & Nkansah, 2024). This mixed-method strategy aligns with recommendations from the methodological literature, which emphasizes the importance of triangulating data sources to strengthen the validity of findings in educational research (Delgado et al., 2022; Imran et al., 2023).

RESULTS

This study compared the different outcomes of digital game-based teaching and traditional teaching on language development of kindergarten students with language delay through a randomized controlled trials. The quantitative and qualitative results highlighted the effectiveness and challenges of digital game-based teaching strategies.

Quantitative Findings

The results of the Independent Samples *t* test revealed no significant difference in pre-test scores for language abilities between the experimental and control groups prior to the intervention ($p = 0.398$, Cohen's $d = 0.23$). This finding confirms the homogeneity of the two groups at the beginning of the study. However, a significant difference in post-test scores was observed between the groups after the intervention ($p = 0.018$, Cohen's $d = 0.63$). Specifically, the experimental group, which received game-based teaching, achieved higher scores (*Mean* [M] = 67.75, *standard deviation* [SD] = 9.12) compared to the control group ($M = 62.32$, $SD = 8.07$). The effect size (Cohen's $d = 0.63$) indicates a moderate practical significance of the intervention, suggesting that game-based teaching had a meaningful impact on language abilities.

Further analysis using the Paired Samples *t* test demonstrated that the language abilities of the experimental group significantly improved following the intervention ($p < 0.001$, Cohen's $d = 0.83$). The average score for this group increased from 60.58 ($SD = 7.94$) to 67.75 ($SD = 9.12$), reflecting a substantial improvement. In contrast, no significant change was observed in the control group ($p = 0.825$, Cohen's $d = 0.01$), whose scores remained virtually unchanged. These findings provide strong evidence

supporting the effectiveness of digital game-based teaching in enhancing the language abilities of kindergarten students with language delays.

The sample size of 60 students, with 30 in each group, was determined through power analysis. This analysis was conducted to ensure the study was adequately powered to detect a medium effect size (Cohen's $d = 0.5$) with 80% power at a significance level of 0.05. By meeting these criteria, the study design ensures that meaningful differences between the groups could be reliably detected, lending further credibility to the results.

Table 2. Results of the t tests

<i>t</i> Test					
Group	Pre-test ($M \pm SD$)	Post-test ($M \pm SD$)	<i>t</i> value (Paired Samples <i>t</i> test)	<i>p</i> value (Paired Samples <i>t</i> test)	Effect Size (Cohen's <i>d</i>)
Experimental Group ($n=30$)	60.58 \pm 7.94	67.75 \pm 9.12	-8.744	<0.001	0.83
Control Group ($n=30$)	62.30 \pm 7.72	62.32 \pm 8.07	-0.223	0.825	0.01
<i>t</i> value (Independent Samples <i>t</i> test)	-0.851	2.441			
<i>p</i> value (Independent Samples <i>t</i> test)	0.398	0.018			0.63

Note. M = mean; SD = standard deviation.

Qualitative Findings

The findings from the semi-structured interviews partially supplemented the quantitative results. Based on the interview content from two teachers and 10 parents, five themes were extracted: engagement, vocabulary acquisition, language skills improvement, comprehension, and confidence. To maintain privacy, the names of individuals expressing their opinions are not disclosed. Instead, the two teachers are referred to as Teacher A and Teacher B, and parents are assigned numbers 1–10.

Engagement

The experimental group demonstrated heightened interest and participation, largely fueled by the inclusion of digital games. Teacher A highlighted that digital games sparked excitement, leading to high levels of student engagement. Parent 1 observed that their child was enthusiastic about lessons but sometimes became overly engrossed in the games. However, concerns were raised about potential distractions caused by the game features, which could occasionally hinder focus. Conversely, the control group exhibited satisfactory attentiveness during lessons, but Teacher B noted that additional prompts were sometimes required to maintain engagement. Parent 6 mentioned that their child's interest fluctuated, and at times, passivity was observed. These remarks suggest that while traditional teaching strategies maintain a baseline level of engagement, they may lack the dynamic elements of digital games to sustain consistent interest.

Vocabulary Acquisition

The experimental group showed accelerated vocabulary acquisition, which Teacher A attributed to the interactive and stimulating nature of the games. Parent 3 noted noticeable vocabulary growth in their child but expressed concerns about a growing reliance on games for revision, raising the issue of potential game addiction. On the other hand, the control group demonstrated a slower but steady pace of vocabulary development, with Teacher B emphasizing the need for repeated exposure to reinforce new terms. Parent 7 observed that while their child was learning new words, the practical application of these words in everyday conversations remained limited. These data indicate that while digital

games can expedite vocabulary acquisition, they may also pose challenges related to overdependence and limited transfer of knowledge outside the learning context.

Language Skills Improvement

Respondents from both groups acknowledged progress in language skills. Teacher A observed notable improvements in the experimental group's language skills but also expressed concerns about an overreliance on gaming as a primary learning tool. Parent 5 similarly noted significant language skill enhancement in their child but mentioned that their child seemed to prefer games over traditional study methods. In contrast, the control group showed gradual yet consistent improvement, with Teacher B and Parent 8 highlighting better sentence formation over time. While the traditional method fosters steady progress, it may lack the immediacy and engagement provided by digital games, which could explain the slower pace of improvement.

Comprehension

The experimental group demonstrated an improved understanding of lessons, as noted by Teacher A. However, challenges with complex sentence structures persisted. Parent 2 expressed concerns about excessive screen time potentially impacting their child's overall learning habits. The control group, on the other hand, showcased adequate comprehension, with Teacher B mentioning that some students required extra support to fully grasp complex topics. Parent 9 noted that their child could follow most lessons but struggled with more advanced material. This indicates that while digital games can enhance comprehension, particularly for simpler concepts, they may fall short in terms of addressing more advanced topics without additional support.

Confidence

The experimental group displayed a significant increase in confidence and a reduced fear of making mistakes. Teacher A observed that digital games helped create a safe environment for students to learn and take risks without fear of failure. Parent 4 similarly noted that their child was more willing to participate and less afraid of making errors. However, concerns about dependency on games were raised, as some students seemed to rely heavily on them for motivation and validation. In contrast, the control group demonstrated a slower but steady increase in confidence. Teacher B and Parent 10 pointed out that while students were gradually gaining confidence, some still exhibited anxiety about making mistakes. This suggests that while digital games can foster confidence more quickly, traditional methods may build a more gradual but potentially more sustainable sense of self-assurance over time.

Table 3. Interview quotes

Theme		Digital Game-Based Teaching Strategy (Experimental Group)	Traditional Teaching Strategy (Control Group)
Engagement	Views from Teachers	Teacher A: “Digital games have sparked much excitement, leading to high levels of student engagement. However, some students are easily distracted by game features.”	Teacher B: “Children are attentive during lessons but occasionally require prompting to fully engage.”
	Views from Parents	Parent 1: “My son seems very enthusiastic about his lessons now, although he can be a little too engrossed in the games.”	Parent 6: “My son attends his lessons, but his interest fluctuates and at times, he appears quite passive.”
	Challenges	Although digital games increase engagement, it may lead to overexcitement or distractions, as students focus more on the gaming aspect rather than the educational content.	Traditional methods maintain a baseline level of engagement but lack the dynamic elements of games, leading to occasional passivity or reduced interest.
Vocabulary Acquisition	Views from Teachers	Teacher A: “The digital group absorbs new vocabulary swiftly, largely due to the interactive games.”	Teacher B: “Children are learning new vocabulary, albeit at a slower pace that requires more reinforcement.”
	Views from Parents	Parent 3: “My daughter's vocabulary has grown noticeably, but her insistence on using games for revision has raised some concerns about potential game addiction.”	Parent 7: “My child is picking up new words gradually but does not use them frequently in conversations.”
	Challenges	The interactive nature of digital games accelerates vocabulary acquisition but may lead to overdependence on games for learning, limiting independent application.	Vocabulary acquisition in traditional methods is slower and requires repeated exposure, with less immediate engagement or retention outside of lessons.
Language Skills Improvement	Views from Teachers	Teacher A: “Language skills have notably improved in the digital group, though a reliance on games is observable.”	Teacher B: “Improvements in language skills are seen with the traditional method, but the progress is less rapid than I'd like.”
	Views from Parents	Parent 5: “My son's language skills have significantly enhanced, but he seems to prefer games over traditional study methods.”	Parent 8: “My daughter shows slow yet consistent improvement, with better sentence formation over time.”
	Challenges	Digital games enhance language skills but may foster a preference for gaming over traditional study methods, potentially impacting students' adaptability to other formats.	Traditional methods lead to gradual progress but lack the immediacy and engagement of digital games, which could slow development.
Comprehension	Views from Teachers	Teacher A: “Digital games have enhanced the students' comprehension, though complex sentences still pose a challenge.”	Teacher B: “Children generally understand the lessons, but some require extra assistance for a full understanding.”
	Views from Parents	Parent 2: “My child has a better grasp of the lessons, but I worry about the potential impact of excessive screen time.”	Parent 9: “My son can follow most lessons but struggles with more complex topics.”
	Challenges	Digital games improve comprehension for basic concepts but may struggle with teaching complex sentence structures and advanced topics. Screen time concerns are also notable.	Traditional methods provide adequate comprehension but may require more teacher intervention and support for complex material.

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Table 3. Continued

Theme		Digital Game-Based Teaching Strategy (Experimental Group)	Traditional Teaching Strategy (Control Group)
Confidence	Views from Teachers	Teacher A: “The digital games enhanced students’ confidence, reducing their fear of making mistakes and promoting learning.”	Teacher B: “Children are gradually gaining confidence, but some still exhibit anxiety about making mistakes.”
	Views from Parents	Parent 4: “My daughter exhibits increased confidence and less fear of making mistakes. However, I am noticing a growing dependence on the games.”	Parent 10: “My child’s confidence is slowly growing, but she still seems anxious about making errors.”
	Challenges	Digital games foster confidence quickly but may lead to dependency, as some students rely on games for validation and motivation.	Traditional methods build confidence gradually, but some students may remain hesitant or anxious about making mistakes for longer periods.

In summary, although quantitative results showed the effectiveness of digital game-based teaching in developing students' language ability, qualitative findings provided a more comprehensive perspective of the strengths and weaknesses of digital game-based teaching from teachers and parents, highlighting that while digital game-based teaching presents opportunities, challenges cannot be ignored. One significant challenge was the potential for overdependence on digital games as a learning tool. This overreliance could hinder students’ ability to adapt to more traditional or independent learning methods. Additionally, concerns about distractions caused by game features were raised, with some students becoming overly engrossed in the gaming aspect rather than focusing on the educational content. Another key weakness was the issue of screen time, as highlighted by Parent 2, who worried about the potential negative impact of prolonged exposure to digital devices on their child’s overall learning habits and health. Furthermore, while digital games were effective in teaching basic vocabulary and comprehension, they seemed less effective in addressing complex sentence structures and advanced topics, as noted by Teacher A and Parent 9. This suggests that although the experimental group made faster progress in general, potential concerns highlighted the necessity of adopting a balanced and monitored approach when integrating digital games into teaching strategies.

Observation

Two observers recorded and evaluated the entire intervention process, and found that the experimental group demonstrated greater engagement, rapid vocabulary acquisition and use, improved sentence formation, enhanced comprehension and storytelling skills, and superior listening, speaking, and pronunciation skills compared to the control group. Additionally, the experimental group showed a higher retention rate. These observations validated the effectiveness of digital game-based teaching strategies for enhancing language skills among kindergarten students with language delay, thereby corroborating the quantitative and qualitative findings. Due to the participation of two teachers in the intervention process, the feedback from external observers to some extent avoided the subjectivity of qualitative interviews.

DISCUSSION

The results demonstrate key points related to the main research questions. The quantitative findings support the first and second research questions, while the qualitative findings serve as explanations for the second and third research question.

First of all, the effectiveness of digital game-based pedagogy in improving the language ability of children with language delays is recognized. The quantitative findings concur with prior research conducted by Papastergiou (2009), highlighting the value of digital games as potent pedagogical instruments that could be leveraged beyond domain-specific instruction to assist language-delayed children. This result underscores the premise that digital games could serve as pedagogical “scaffolds” to facilitate language skill development. At the same time, digital games have the potential to act as “scaffolds” for social interaction skills. For instance, games that incorporate multiplayer modes or require teamwork could be designed to explicitly target social communication goals, such as initiating conversations, responding appropriately, or negotiating roles within a group. Nakatsu (2017) highlighted the importance of scaffolding in game-based learning, and this concept could be extended to include scaffolding for social interaction. Teachers could play a pivotal role in facilitating these interactions by guiding students on how to communicate effectively during gameplay and by integrating post-game discussions to reflect on the social dynamics experienced during the activity.

Second, the difference between digital game-based teaching and traditional teaching can also be seen from the quantitative results. In particular, the qualitative findings provide a better explanation for this difference. Echoing the findings of Gee (2003) and Hainey et al. (2016), this study detects an enhancement in student engagement when instructional delivery was game-based, suggesting that such a pedagogical approach may foster a motivational climate conducive for language skill development among children with language delays. By comparing the effectiveness of digital game-based teaching with traditional methods, this study addresses the lack of comparative research highlighted by Nakatsu (2017) and Hwang and Wu (2012). However, while the advantages of game-based learning were acknowledged, apprehensions emerged concerning the potential pitfalls. Specifically, concerns centered around the possible adverse effects of excessive screen time and the risk of distraction and overreliance on games. For example, while digital games can enhance engagement and motivation, they may inadvertently limit opportunities for face-to-face communication if not carefully integrated into a broader pedagogical framework. These concerns underscore the importance of a prudent and balanced application of game-based learning in the pedagogical landscape, highlighting the need for measured integration of digital games in teaching strategies and teacher monitoring. At this point, there are cost requirements, including teacher training and technology procurement (Bruggeman et al., 2022; Zhao & Xu, 2022).

Third, perceptions of stakeholders, a critical aspect of this research, indicated a broad acceptance of digital game-based learning as an effective instructional methodology consistent with the findings of Dichev and Dicheva (2017). Furthermore, by focusing on Chinese children with language delays, this study considers the unique challenges posed by tonal languages and incorporates culturally relevant content and teaching strategies, building on the findings of Kim and Kim (2017) and Nakamura (2018).

LIMITATIONS

While the study provides insights into digital game-based teaching and learning, its limitations must be acknowledged. First, due to the special research method, the sample size is relatively small. Second, the study focuses on short-term effects, leaving issues about the long-term sustainability of the improvement observed unanswered. Future research should address these gaps by expanding the sample size, incorporating participants from diverse backgrounds, and conducting longitudinal studies to examine whether the benefits of digital game-based teaching persist over time. Third, current study could delve deeper into the broader developmental impacts of game-based teaching, especially regarding its influence on children's social interaction skills. Digital game-based teaching, by its nature, often involves collaborative and interactive elements that can foster social engagement. For example, many digital games require students to work together, take turns, or communicate with peers to achieve goals. Future studies should include a more focused analysis of how game-based teaching impacts social behaviors, such as the frequency and quality of verbal exchanges, turn-taking, and

collaborative problem-solving among students. By addressing the above aspects in further research and practice, educators and policymakers can better harness the potential of digital games to support both language and social development in children with delays.

IMPLICATIONS AND CONCLUSION

This study provides empirical evidence supporting the use of digital game-based pedagogy as an effective method for improving language ability in kindergarten students with language delays. The findings give a comprehensive understanding of digital game-based pedagogy in language development, not only revealing its role in addressing the unique language difficulty of tonal languages such as Chinese, but also emphasizing the potential risks, filling a critical gap in the existing literature that focuses on Western contexts and non-tonal languages. By paying attention to the specific group, the findings challenge traditional assumptions about the limitations of digital-based learning for young children. The study also extends existing theories of digital game-based learning by showing how culturally relevant and linguistically specific content can enhance the effectiveness of digital interventions, especially in early childhood education. By integrating the strengths of traditional game-based teaching into a systematic and convenient digital framework, digital game-based teaching offers unique advantages, such as multimodal learning experiences and opportunities for personalized instruction.

The implications of this study are significant for distance educators, early education practitioners, and policymakers. Although digital games offer unique advantages, a balanced approach is essential to ensure positive development. While digital games can enhance engagement and motivation, careful monitoring is required to prevent overdependence and ensure that students develop the ability to learn through traditional and independent methods. The findings indicate that digital game-based teaching has the potential to significantly enhance engagement and confidence in young learners. However, this method is not without challenges. Overdependence on games, distractions caused by game features, and concerns about excessive screen time were recurring issues highlighted by both teachers and parents. For distance educators, it is worth considering how to effectively integrate digital tools into early childhood education or teaching practices for special needs groups. Considering the young age of kindergarten students, how to solve the problems exposed in this research, such as distraction, prolonged screen time, etc.

In addition, while digital games were effective in improving basic language skills, their limitations in addressing complex sentence structures and advanced topics suggest the need for supplemental teaching strategies. In comparison, traditional teaching methods, such as storytelling and physical role-playing can complement digital tools by providing opportunities for face-to-face interaction and fostering social-emotional skills. Early education practitioners should accept new teaching methods in a positive way. A blended approach that combines digital games with traditional activities may be an optimal choice to help mitigate concerns about overreliance on technology and excessive screen time while maximizing the benefits of both methods.

Finally, practical challenges relevant to this research need to be addressed, such as technology costs and investment, technology access, and teacher training. For policymakers, the study underscores the necessity of investing in infrastructure and resources to ensure equitable access to digital learning technologies, particularly in underserved areas. Developing scalable and sustainable solutions is the priority. Furthermore, the study highlights the potential risks associated with overreliance on digital tools, particularly for young children who may lack self-regulation skills. These challenges underscore the importance of adopting a balanced approach to integrating digital game-based teaching into early education, ensuring that it complements rather than replaces traditional teaching methods.

In conclusion, this study not only provides empirical evidence for the effectiveness of digital game-based teaching but also advances our understanding of its potential in addressing language delays in young children. By critically examining both the advantages and challenges of this approach, the

study contributes to the growing body of knowledge on digital interventions in special education and offers practical insights for educators and policymakers. The results may potentially be replicated with regard to the educational needs of other special groups, such as children with autism or learning disabilities, to expand its applicability and impact. As the field of distance education continues to evolve, digital game-based teaching represents a promising avenue for innovation, particularly in early childhood education. However, its successful implementation requires careful consideration of the challenges and a commitment to addressing the gaps identified in this study.

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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AUTHOR CONTRIBUTIONS

Dr. Guanzheng Chen is the first author, and he was responsible for writing the original draft, visualization, validation, resources, project administration, investigation, formal analysis, data curation, and conceptualization.

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APPENDIX

Table 4. Observation checklist

Lesson	Topics	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5
1.	Introduction and Vocabulary Building	Can the child identify the new vocabulary?	How accurately does the child respond to the new vocabulary?	Does the child participate actively in the learning activity?	How well does the child retain the new vocabulary?	Can the child use new vocabulary in a sentence?
2.	Expanding Vocabulary	Can the child correctly identify and use the more complex vocabulary?	How well does the child respond to the more complex vocabulary?	Is the child actively participating in the vocabulary learning activity?	Is there an improvement in the child's ability to understand and use the new vocabulary?	How well does the child remember the vocabulary from the previous session?
3.	Simple Sentence Formation	Can the child form simple sentences using the new vocabulary?	Does the child understand the correct order of words in a sentence?	How active is the child in participating in sentence formation activities?	Is the child using the new vocabulary in the correct context?	How many new sentences can the child form with the new vocabulary?
4.	Comprehension and Storytelling	Can the child identify the vocabulary in the context of a story?	How well does the child retell the story in their own words?	How active is the child in participating in storytelling activities?	Does the child comprehend the main idea of the story?	Can the child answer questions about the story using the new vocabulary?
5.	Listening Skills	Can the child accurately respond to instructions or stories?	Does the child actively participate in conversations and respond to questions?	How well does the child understand and follow along with the audio materials?	Can the child identify the new vocabulary in the audio materials?	How well does the child follow multistep instructions?
6.	Speaking Skills	Can the child mimic the pronunciation of words or sentences?	Does the child actively participate in speaking activities?	Is there an improvement in the child's speaking skills?	How clear is the child's pronunciation of the new vocabulary?	Can the child construct sentences and express ideas using the new vocabulary?
7.	Pronunciation	Can the child mimic the pronunciation of new vocabulary?	How active is the child in pronunciation activities?	Is there an improvement in the child's pronunciation skills?	How many new vocabulary words can the child pronounce correctly?	Can the child distinguish between similar sounding words?
8.	Comprehension	Can the child match words with their meanings or images?	Does the child actively participate in comprehension activities?	Is there an improvement in the child's comprehension skills?	Can the child explain the meaning of new vocabulary in their own words?	How well does the child understand sentences or stories containing the new vocabulary?

continued on following page

Table 4. Continued

Lesson	Topics	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5
9.	Sentence Formation	Can the child arrange words in the correct order to form sentences?	How active is the child in sentence formation activities?	Is there an improvement in the child's sentence formation skills?	Can the child form both declarative and interrogative sentences with the new vocabulary?	How well does the child understand and apply grammar rules in sentence formation?
10.	Vocabulary Reinforcement	Can the child match words with their meanings or images?	How active is the child in vocabulary reinforcement activities?	Is there an improvement in the child's vocabulary retention?	Can the child use the reinforced vocabulary in a sentence?	Does the child remember the vocabulary from earlier sessions?
11.	Review	Can the child correctly identify and use all the taught vocabulary?	How active is the child in review activities?	Is there an improvement in the child's overall language skills?	Can the child form sentences with the vocabulary from all the lessons?	How well does the child remember the vocabulary and concepts from earlier sessions?
12.	Review & Assessment	Can the child correctly identify and use all the taught vocabulary?	Does the child actively participate in the review and assessment activities?	Is there an improvement in the child's overall language skills?	Can the child answer questions about the stories or narratives used in the lessons?	Can the child communicate effectively using the vocabulary and sentence structures taught in all the lessons?

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