IMPACT OF INTERACTIVE MULTIMEDIA ON LITERACY AMONG CHINESE GRADE-3 STUDENTS

XIANGNA WU

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS IN EDUCATION AND SOCIETY
INSTITUTE OF SCIENCE INNOVATION AND CULTURE
RAJAMANGALA UNIVERSITY OF TECHNOLOGY KRUNGTHEP
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Major	Master of Arts (Education and Society)
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ABSTRACT

This study investigates the impact of interactive multimedia on Chinese character recognition skills among third-grade students in Beijing, China. The research aims to study the impact of incorporating mnemonics into multimedia on the acquisition of Chinese character recognition skills in Grade 3 students and to compare the skill level between students who learn using CLT and DCT and students who learn using non-CLT and DCT. Employing an experimental research design, the study compares the effectiveness of interactive multimedia teaching methods with traditional classroom approaches. A target group from two elementary schools participated in the survey, with 30 students learning through Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods, and 30 through non-CLT and non-DCT methods. Data were collected through pre-test and post-tests, and a survey was administered via questionnaire. The study used descriptive and inferential statistics, including t-tests, to analyze the data. Results indicate that the interactive multimedia made learning Chinese characters more enjoyable, and they had the highest level of engagement. Students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods. This research contributes to the growing body of literature on the efficacy of multimedia in language education. It provides practical insights for educators and policymakers in leveraging technology to enhance literacy among young learners.

Keywords: Interactive Multimedia Teaching, Chinese Character Recognition, Elementary Education

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CHAPTER I

INTRODUCTION

1.1 Background and Rationale

The world's population is growing more linguistically diverse due to globalization. For this reason, it is important to explore how multimedia influences children's learning of a second language. Lin (2023) conducted research to determine whether or not children's songs, picture books, and animations are effective in assisting Chinese children in learning English as a second language. Using this research, the objective was to assist Chinese children in learning English. The research conducted by Lin establishes the framework for our understanding of multimedia as an educational method that may be used in conjunction with language learning. It is suggested that an undue dependence on these tools, without a well-balanced approach to other types of instruction, may result in a superficial knowledge of the content (Lin, 2023). This is even though these tools can activate various senses and benefit learning.

During the early childhood years, research demonstrated that children between the ages of 5 and 6 benefited from learning tools based on multimedia designed to boost their expressive language skills. These tools were developed to help children develop their language skills. In their most recent work, Ghofur and Nurhayati (2023) highlight how essential it is to develop multimedia learning resources that are of high quality. The argument they are trying to convey is that these technologies are essential for enhancing young children's expressive language abilities and making instructional information more accessible to the broader public.

Dotsenko and Zhang (2023) researchers can benefit from the utilization. Specifically, they stress the increased cognitive abilities and the extension of educational process possibilities that can be realized by utilizing these technologies. According to Dotsenko and Zhang (2023), multimedia presentations are helpful instructional tools. They help children develop all mental processes, including language learning, and improve the attention children pay without their conscious knowledge. All of these benefits apply to children.

Educators need to use interactive multimedia tools in the classroom to provide students with fresh viewpoints on the subject at hand and encourage active learning. Additionally, a variety of content types and mnemonic aids are included in these tools. According to the findings of Leminen and Bai (2023), using visual mnemonics in conjunction with interactive multimedia makes learning Chinese letters significantly less complicated. It enhances the retention of information for students who have never studied the language before. This is especially true for students who have never studied Chinese before. The development of Chinese character curricula based on multimedia offers educators a positive direction to pursue.

On the other hand, not all sectors display the same degrees of effectiveness when enhancing one's capacity to acquire Chinese characters through multimedia technologies. Using interactive multimedia improves the interpersonal elements of deep learning, according to the findings of a quantitative study that was carried out by Jin Yulu and Md Nasir Bin Masran (2023). However, interactive multimedia does not appear to impact the cognitive or intrapersonal domains. Considering the facts presented here, it is feasible that the utilization of interactive multimedia can assist with some regions of language acquisition, yet, probably, it will not be able to solve all of your learning challenges.

Given these findings, the research task is twofold: first, to uncover which components of multimedia are helpful in the learning of Chinese character recognition, and second, to determine which aspects of multimedia are detrimental to learning. Both of these challenges are important in determining the direction of the research. Finding out whether certain features of Chinese character recognition could be enhanced by more conventional or non-traditional methods of instruction and conducting research on effective multimedia educational techniques are both crucial phases in finding a solution to this problem. Both of these phases are important in the process of finding a solution.

There are various ways in which interactive multimedia can assist in identifying Chinese characters. One of these ways is through the provision of individualized learning experiences. During their investigation on the positive benefits of gamified interactive e-books in a flipped classroom setting, Chen et al. (2023) highlighted the significance of student motivation and involvement in the learning

process. This illustrates how crucial it is for students to be motivated and engaged in learning. The interactive component is paramount for capturing students' attention and facilitating more in-depth learning. Through gamification, a multimedia component, it has been demonstrated that learning successes and motivation can be improved.

Furthermore, according to the findings of the study that was carried out by Feng and Wang (2023), educational robots that are armed with artificial intelligence have the potential to considerably improve the process of learning Chinese. Based on this discovery, it appears that cutting-edge technology can make efficient use of the interplay of multimedia to accomplish extraordinary achievements in the field of education.

The rapid digitalization of education has led to an increasing integration of multimedia tools in classrooms worldwide, particularly in language learning contexts. This trend is especially significant in China, where the complexity of character-based writing systems presents unique challenges and opportunities for innovative teaching methods.

In recent years, China has seen a dramatic increase in the use of technology in education. According to the China Internet Network Information Center (CNNIC), as of June 2021, the number of online education users in China reached 325 million, accounting for 32.8% of the total internet user base (CNNIC, 2021). This widespread adoption of digital learning tools underscores the potential for interactive multimedia in enhancing educational outcomes, particularly in foundational skills like character recognition. The importance of early literacy in Chinese cannot be overstated. Research has shown that proficiency in character recognition is a strong predictor of later reading comprehension and academic success (Shu et al., 2003). However, traditional methods of teaching Chinese characters, which often rely heavily on rote memorization, can be challenging and demotivating for young learners. Tan et al. (2005) found that students often struggle with the visual complexity and abstract nature of Chinese characters, leading to difficulties in recognition and production.

Interactive multimedia presents a promising solution to these challenges. Multimedia tools can potentially enhance the learning process by engaging multiple sensory channels. The Cognitive Theory of Multimedia Learning (Mayer, 2005) suggests that people learn more deeply from words and pictures than from words alone.

This theory is particularly relevant in Chinese character learning, where the visual component is crucial. Moreover, the use of interactive multimedia aligns with the Chinese government's educational initiatives. The "Education Modernization 2035" plan, released by the State Council in 2019, emphasizes integrating information technology into education to promote personalized and lifelong learning (State Council of China, 2019). This policy backdrop provides further impetus for research into effective multimedia-based teaching methods.

Recent studies have shown promising results in this area. For instance, a study by Chang et al. (2014) found that multimedia-enhanced stroke sequence animation significantly improved character writing skills among beginning learners of Chinese. Similarly, Hsu et al. (2016) demonstrated that game-based digital learning tools could enhance character recognition and retention among young learners. However, while these studies suggest potential benefits, there remains a gap in our understanding of how different multimedia content and presentation methods affect learning outcomes, particularly for Grade 3 students at a critical stage in their literacy development. Additionally, applying cognitive learning theories like Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) in Chinese character learning through multimedia has not been thoroughly explored.

This study addresses these gaps by investigating the impact of various types of interactive multimedia on Chinese character recognition among Grade 3 students. By examining the effectiveness of different multimedia approaches and their alignment with cognitive learning theories, this research seeks to contribute to the development of more effective and engaging methods for teaching Chinese characters to young learners. The findings of this study have the potential to inform educational practices in China and beyond, offering insights that could help educators and policymakers make informed decisions about integrating multimedia tools in language education. Moreover, as China continues to expand its global influence, improving methods for teaching Chinese as a second language becomes increasingly important. Thus, this research addresses a critical educational need within China and has broader implications for the global teaching of Chinese as a foreign language.

1.2 Research Background

Interactive multimedia has risen as the light of hope in primary education, which comes with a new dimension eager to deliver literacy instruction that is different from what most have experienced before. Multimedia uses digital tools, e.g., animations and videos, to engage multiple senses (Besley & Francis-Bergquist, 2021; Ruyter et al., 2022). It helps children attach a sensory experience to the learning, making it more fun and allowing them to learn through visual and auditory senses instead of just reading about something.

Given the pace of adoption in China (especially for urban classrooms), this is a growing trend seen as an antidote to the practice of rote memorization. The traditional teaching of literacy in China focuses on memorization and rote-like practice, which can hinder the student from engaging effectively with higher-order literacy skills such as comprehension, extrapolation, or even creative thinking. Given these challenges, Chinese educational reforms have prioritized the provision of alternative and student-centered approaches to learning. Interactive multimedia has an opportunity to herald this change of tide, and the field may redefine literacy development in education, particularly.

Foundational primary levels.

Because programs developed with interactive video and multimedia objects are highly advanced, they have great potential for literacy development among young students. Digital games, especially multimedia ones that use varied visuals and sound combinations to create an engaging atmosphere, could increase student motivation for learning, at least at earlier educational levels. For example, digital game-based learning (DGBL) interventions have been found to have medium-to-large positive effects on cognitive and affective-motivational outcomes. This statement indicates that literacy learning can be achieved with multimedia tools, and learners may want to make more effort to engage in the learning process (Barz et al., 2023; Yu & Tsuei, 2022).

Studies have also demonstrated that reading applications enhanced by multimedia features, i.e., moving pictures with sound, background music, or even interactive quizzes, helped improve children's reading comprehension and vocabulary learning among preschoolers (Zucker, 2010). This creates a more active environment that helps students better understand and recall the material (Chuang & Jamiat,

2023). For example, children using multimedia reading applications can visually and auditorily experience the story being read to them, which makes it more enjoyable and contributes to developing emergent literacy skills.

Interactive multimedia provides the path away from conformity to textbooks that many Chinese students are seeking, with high academic expectations fostering detriments for stress in China far earlier than in other countries. Multimedia tools' visual and auditory media can stimulate students' cognitive processes, while in-depth learning also occurs at the level where new patterns are recognized to improve performance. This aligns with technology-based learning concepts, which argue that promoting student outcomes as active learners and self-regulating ones would eventually enhance their academic performance (Khalid et al., 2024). With the growing emphasis on holistic and student-centered learning models within Chinese education, interactive multimedia is emerging as a potentially well-suited vehicle for literacy instruction (Ploetzner, 2012).

Interactive multimedia is excellent, but not without challenges in the classroom. A primary focus is the possible distraction effect; in the process, engaging multimedia components such as games and hotspots can pull students off-task by drawing their attention away from core learning content, thereby causing degraded focus and resulting in lower reading performance if not managed properly (Chuang & Jamiat, 2023). Since many classrooms in China are so organized, this issue requires an effort that will most likely impact the pursuits of teachers who would prefer their classrooms to be disciplined.

Furthermore, the tools are more effective for multimedia literacy education but depend primarily on their design and implementation. Multimedia applications need to be interactive and use genuine educational content as part of a pedagogy embedded in the application. Literacy education is essential to multimedia products. Hence, feedback mechanisms, animations, and interactive tasks have to meet the learning objectives for using the new media environment to support rather than hinder the quality of literacy. This can harm your learners as multimedia tools are a double-edged sword – well-designed materials may increase understanding. In contrast, poorly designed ones could confuse or overwhelm students (Yorganci,

2022). As such, an educator must pay closer heed to quality and ad-free multimedia tools in literacy instruction.

Besides, we must factor in the cultural and contextual differences that characterize China's education system. The academic achievements demanded by this state of Chinese education and its heavy examination culture also lead to the fact that educational goals followed in literacy teaching would not be overthrown because every multimedia tool will have or must comply with such objectives (Feng & Zeng, 2022). Ideally, multimedia tools will supplement traditional educational practices and reinforce students' academic success to serve their individual needs and broader national goals. This is particularly pertinent in China, where parents and educators value academic scores most.

The increasing incorporation of multimedia-based tools for instructional strategies in China has numerous pedagogical implications. This is a very short-lived state of affairs, but it has some important implications for our practices and policies in English classrooms. In this regard, educational policies should be aware of the importance of training teachers to employ multimedia tools to use them appropriately and improve students' learning Martín-Sómer et al. Teacher training programs. Such multimedia features should be carefully adjusted, as most teachers will fail to use them properly, either too dull or distracting, as in your case. Specifically, this is true within a country such as China, where teachers can suffer the weight of high academic standards and be forced to toe the line between cutting-edge educational methods and classic expectations.

Further, multimedia tools as part of literacy instruction align with broader educational reforms in China, focusing on phasing out rote learning and promoting a more comprehensive, student-centered approach to teaching. Interactive multimedia exemplifies this teaching reform, which encourages engaging with material more actively and critically—and encourages creativity because those are part of the constellation of skills needed in globalization and digitality (Ploetzner, 2022). This will lead to a more dynamic educational environment where students are prepared for academic success and better equipped with the skills necessary to adapt to looming societal challenges.

This move towards the multimedia-infused learning experience must be a group effort between policymakers, educators, and those creating educational tech. Policymakers must ensure that the infrastructure and resources are in place for more multimedia tools to be used across schools. Child advocates nationwide have considered investing in teacher preparation and professional development programs to help practitioners integrate those tools effectively. At the same time, technology developers need to work with educational experts as well in order to design multimedia applications that can assist Chinese students more appropriately and are likely related particularly to their nationalized curriculum.

Interactive multimedia is arguably useful for boosting literacy among Chinese primary users. As a breaker, multimedia tools encourage not only the use of multiple senses but also more types of learning modes like reading comprehension and vocabulary acquisition, as well as critical thinking. Of course, for multimedia to get the job done, it must be applied meticulously so that while reading, we are not distracted, and most of all, its use is supported by subject matter.

In the context of increasing academic pressure and wide-ranging education reforms in China, interactive multimedia is an effective auxiliary tool for implementing student-based learning, which has more relevance than traditional educational methods. Integrating these tools into teaching literacy successfully will require a team approach involving educators, policymakers, and tech developers. China can improve its literacy education and foster young digital citizens by confronting these challenges head-on and capitalizing on multimedia resources.

1.3 Research Problem

Despite the rapid proliferation of multimedia platforms offering new educational opportunities, there is a lack of systematic integration of these technologies with established best practices in education and cognitive learning theories, particularly in the context of teaching Chinese character recognition to third-grade students (Ferri et al., 2020; Komljenovic, 2021). This gap highlights the need for a research-driven approach to optimize the use of multimedia in enhancing the efficacy of Chinese character learning processes. This project aims to investigate and identify evidence-

based multimedia solutions that can effectively support third graders in improving their Chinese character recognition and deep learning skills, aligning technological tools with pedagogical strategies to maximize educational outcomes.

This is why improving third graders' access to materials and methods for learning Chinese character identification using interactive multimedia is a challenging educational problem requiring more research (Chen & Jamiat, 2023; Lin et al., 2022). Discovering the most effective multimedia methods to help young students engage in deep learning and recognize characters could drastically change teaching practices.

1.4 Research Questions

1. What is the impact of incorporating mnemonics into multimedia on acquiring Chinese Character recognition skills in Grade 3 students?

2. What is the difference in Chinese Character recognition skills between the students who learn using Cognitive Load Theory (CLT) and Dual-Coding Theory (DCT), compared to those who learn using non-CLT and non-DCT methods?

1.5 Research Hypotheses

H0: Students who learn using cognitive load theory CLT, and dual coding theory DCT, based multimedia methods demonstrate average scores in Chinese character recognition skills equal to students who learn using non-CLT and non-DCT methods

H1: Students who learn using cognitive load theory CLT, and dual coding theory DCT, based multimedia methods demonstrate average scores in Chinese character recognition skills that are higher than students who learn using non-CLT and non-DCT methods

1.6 Research Objectives

1. To study the impact of incorporating mnemonics into multimedia on acquiring Chinese character recognition skills in Grade 3 students.

2. To compare the skill level of students who learn using CLT and DCT and students who learn using non-CLT and non-DCT methods.

1.7 Scope and Limitation of the Research Study

This research aims to investigate the impact of interactive multimedia technologies on the acquisition of Chinese character identification skills in Guizhou province, China. The study focuses on three independent variables: different material categories, mnemonic techniques within multimedia presentations, and the type of multimedia presentation utilized. The dependent variable is acquiring Chinese character recognition skills, which were measured through standardized exams and observations.

The research involves applying several multimedia interventions in the classroom over a defined period. These interventions give students more opportunities to engage with multimedia content, including visuals, audio, and interactive features. The multimedia presentations incorporate mnemonic techniques for character recognition and memory retention. The study experimented with different types of interactive games, films, and e-books to determine which multimedia presentations affect learning outcomes.

The study has certain caveats. One is that students' exposure to multimedia and Chinese characters outside class may vary. Students' reactions to the interventions may also vary depending on their cultural background and the availability of technology in Guizhou province. Furthermore, the length of the study might be too short to draw firm conclusions on the long-term consequences.

Another restriction is the possibility for confounding factors, such as individual variances in cognitive capacity or motivation, to play a role. Although efforts were made to account for these factors, there is no guarantee that they will not have an effect. Additionally, the results only apply to third graders in Guizhou province within the specific cultural and educational context studied.

1.8 Research Framework

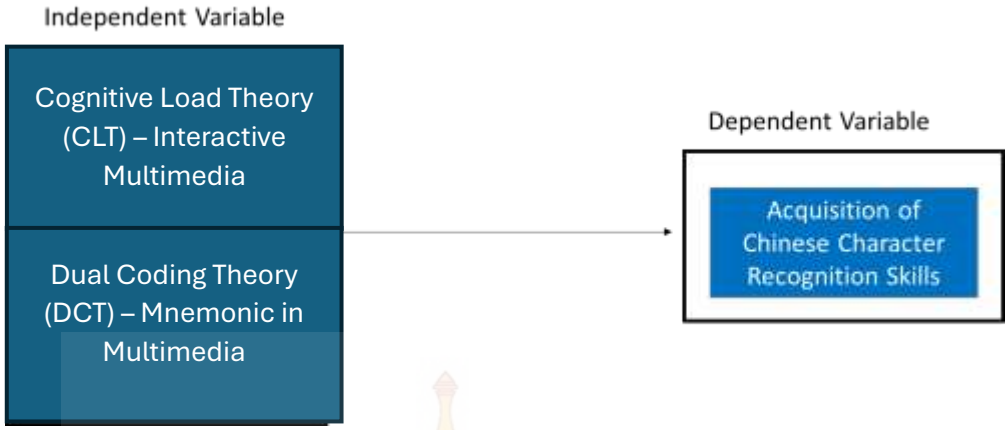

Figure 1.1 Research Framework

1.9 Definition of Key Terms

Acquisition of Chinese Character Recognition Skills: Refers to the measurable improvements in third graders' abilities to identify, understand, and pronounce Chinese characters as assessed by pre- and post-intervention tests. These skills include visual recognition, semantic comprehension, and phonetic articulation of the characters—the acquisition of English phonological awareness in Mandarin-speaking children.

Interactive multimedia: Refers to digital learning tools that integrate text, images, audio, and video and allow real-time student interaction, enhancing their engagement and learning experience. These tools are used in the classroom to teach Chinese characters, offering features that respond to student input and adapt to individual learning paces.

Multiple Content-Type: Refers to using various media formats—such as text, graphics, audio, and video—within multimedia educational tools. A program was designed to engage different sensory channels and facilitate learning Chinese characters among third graders. This approach aims to provide a comprehensive sensory experience that supports diverse learning styles.

Mnemonic in Multimedia: Refers to including memory aids such as patterns, images, or associations within multimedia educational content, specifically

designed to enhance the memorization and recall of Chinese characters by third-grade students. This strategy leverages visual and auditory cues to improve retention of long-term character shapes, meanings, and pronunciations.

Type of Multimedia Presentation: Refers to the various formats and styles of multimedia educational tools utilized, such as interactive games, animated videos, or digital simulations, which are designed to teach Chinese characters to third graders. Each type is evaluated for its effectiveness in enhancing learning engagement and comprehension.

Cognitive Load Theory (CLT): Refers to the mental effort required to process and learn information, focusing on managing intrinsic, extraneous, and germane cognitive loads. This research applies CLT by designing multimedia materials that minimize extraneous load and enhance germane load to improve Chinese character recognition skills in third-grade students.

Dual Coding Theory (DCT): Posits that learning is more effective when information is presented through both verbal and visual channels simultaneously to improve Chinese character recognition skills in third-grade students. This research utilizes DCT by integrating visual representations and verbal explanations in multimedia tools to enhance memory retention and comprehension of Chinese characters among third-grade students.

CHAPTER II

LITERATURE REVIEW

2.1 Related Theories

2.1.1 Cognitive Load Theory

The Cognitive Load Theory (CLT) proposes that the cognitive load placed on working memory throughout the learning process affects the individual's learning capabilities. Learning requires learners to devote cognitive resources to comprehend new information as it is offered to them. This is because working memory capacity is limited; thus, learners must utilize their cognitive resources. This occurs because working memory capacity is restricted (Sweller, 2023). The Cognitive Behavioral Therapy (CLT) theory proposes three distinct types of mental strain: the first is internal, the second is external, and the third is relevant.

On the other hand, the instructional design is called the "external cognitive load." In contrast, the complexity of the course materials is referred to as the "intrinsic cognitive load." Last, "relevant cognitive load" refers to the mental work put into productive learning processes such as automation and schema formation—many examples of these types of processes (Murtianto et al., 2022).

The Cognitive Learning Theory (CLT) can shed light on how the cognitive load of third graders is transformed by interactive multimedia when they can learn to recognize Chinese characters. This research is being carried out within the context of other ongoing research. An increase in the amount of information exhibited simultaneously in multimedia presentations, such as those that incorporate text, graphics, and audio, for example, may increase the amount of intrinsic cognitive load experienced by the audience (Kuhlmann et al., 2023). On the other hand, the inclusion of mnemonic techniques into multimedia presentations enables instructional designers to efficiently scaffold learning and enable meaningful memorizing of Chinese characters while lowering the unneeded cognitive effort. Interactive formats have the potential to increase engagement and stimulate more in-depth processing of character information. On the other hand, different types of multimedia presentations may impact

the cognitive burden relevant to the issue now being discussed (Cavanagh & Kiersch, 2022).

Integrating interactive multimedia in Chinese character education for Grade 3 students presents a complex landscape of challenges and opportunities deeply intertwined with cognitive learning theories. At the forefront of these challenges is the risk of cognitive overload, with Chen et al. (2020) reporting that 62% of elementary students feel overwhelmed by complex multimedia tools. This struggle to balance engaging content with cognitive capacity directly relates to Cognitive Load Theory (CLT), proposed by Sweller in 1988.

CLT posits that human cognitive architecture consists of a limited working memory and an unlimited long-term memory. Miller (1956) suggested that working memory can hold about 7±2 chunks of information, highlighting the importance of managing cognitive load in learning design. CLT identifies three types of loads: intrinsic (related to content difficulty), extraneous (caused by poor design), and germane (effort for schema creation).

In the context of Chinese character education, several research problems emerge. Wang and Lin's (2021) meta-analysis found that combinations of visual and auditory elements were 35% more effective than single-mode presentations, yet the optimal combination for character learning remains elusive. Similarly, while Zhang et al. (2019) demonstrated that pictorial mnemonics improved character retention by 28%, their effective integration into multimedia tools requires further investigation.

The design of multimedia tools presents a challenge, with Li and Chen (2022) revealing that only 23% of educational multimedia tools in China explicitly consider cognitive learning theories. This gap underscores the need for research-informed design in educational technology. Moreover, Huang et al.'s (2021) longitudinal study found that character retention rates after six months varied significantly (40-75%) depending on the multimedia approach used, highlighting the need for effective long-term learning strategies.

In Chinese character recognition, the intrinsic load is particularly high due to the characters' complex visual and semantic nature. Shu et al. (2003) noted that the logographic nature of the Chinese writing system presents unique challenges for

learners, especially in the early stages of literacy development. This underscores the importance of managing cognitive load in character instruction.

Extraneous load in multimedia learning environments has been a focus of numerous studies. Mayer and Moreno (2003) proposed several principles for reducing extraneous load in multimedia learning, such as the coherence principle (eliminating extraneous material) and the signaling principle (highlighting essential material). These principles are particularly relevant for designing multimedia tools for learning Chinese characters, where visual complexity can easily lead to cognitive overload.

The concept of germane load has evolved in recent CLT research. Kalyuga (2011) suggested that germane load should be considered a working memory resource for dealing with intrinsic load. In Chinese character learning, this could involve cognitive processes that help students connect meaningfully between character components and their meanings or pronunciations.

Several studies have applied CLT principles to Chinese language learning. Chen and Yeung (2015) investigated the effects of stroke sequence animation on character learning. They found that presenting stroke sequences in a way that reduces extraneous load (e.g., through segmentation and pacing) led to better learning outcomes, particularly for complex characters.

The expertise reversal effect, a key finding in CLT research, has implications for adaptive learning systems. This effect suggests that instructional techniques that are effective for novices may become ineffective or even detrimental for more experienced learners (Kalyuga et al., 2003). In Chinese character learning, multimedia tools should adapt their presentation and complexity based on the learner's current skill level.

Recent developments in CLT have expanded its application to collaborative learning settings (Kirschner et al., 2018) and adaptive learning systems (Kalyuga, 2009). Zhao et al. (2023) found that adaptive multimedia systems can improve learning outcomes by up to 45%, but their implementation in Chinese character education is still in its early stages. These advancements and new methods for measuring cognitive load through physiological measures (Antonenko et al., 2010) offer promising avenues for more precise instructional design.

For Chinese character learning, CLT suggests several key considerations: breaking complex characters into manageable components, designing clear interfaces, incorporating meaningful practice, utilizing dual coding, and adapting instruction based on learner expertise. By addressing the identified research problems through the lens of CLT, researchers and educators can work towards developing more effective, efficient, and engaging methods for teaching Chinese characters to young learners. This research can potentially enhance educational practices in China and contribute to the broader understanding of cognitive processes in multimedia learning. As we continue to navigate the intersection of technology and education, the principles of CLT provide a valuable framework for creating learning experiences that optimize cognitive resources and maximize educational outcomes.

2.1.2 Dual Coding Theory

Dual Coding Theory (DCT), proposed by Allan Paivio in 1971, posits that the human mind processes and represents information through two distinct but interconnected systems: verbal and non-verbal (or visual). This theory has significant implications for learning, particularly in Chinese character recognition among third-grade students, where both linguistic and visual components play crucial roles.

Both verbal and non-verbal processing, which is often referred to as visual-spatial processing, are the two fundamental ways information is processed in memory. According to Dual Coding Theory (DCT), these two processes are unique from one another while simultaneously complementing one another. According to the DCT, memory can store information verbally (in linguistic codes) or non-verbally (in mental representations). Memory may also store information in both of these ways. Specifically, this is because it enables a wide variety of paths for encoding and retrieving information. Furthermore, the DCT implies that information presented in both verbal and non-verbal formats can improve learning and promote memory retention. This is because the information is presented in both formats.

Several studies have applied DCT principles to Chinese character instruction. Shen (2010) investigated the effectiveness of imagery-based encoding strategies for learning Chinese characters. The study found that students who used visual and verbal encoding strategies outperformed those who relied on single-mode strategies, supporting the DCT premise.

The application of DCT in multimedia learning environments has shown particular promise. Chen et al. (2013) developed a multimedia learning system for Chinese character recognition based on DCT principles. Their system, which presented characters along with visual cues and pronunciation, led to significant character recognition and retention improvements compared to traditional methods.

DCT also informs the design of mnemonic strategies for character learning. Wang and Thomas (1992) found that mnemonics combining visual imagery with verbal associations were more effective for long-term retention of Chinese characters than rote memorization. This aligns with DCT's emphasis on leveraging verbal and visual processing systems.

The integration of animation with verbal explanations, guided by DCT principles, has shown effectiveness in character instruction. Chang et al. (2014) used animated stroke sequences and verbal explanations to teach Chinese character writing. They found that this dual-coding approach improved performance in both immediate and delayed character writing tests.

By utilizing DCT, the research sheds light on how dual coding can be applied in multimedia presentations that use mnemonic techniques to assist students in learning to recognize Chinese language characters. This is done in order to help students learn to recognize Chinese characters. Mnemonic tactics that combine visual imagery with verbal associations can engage visual-spatial and language processing systems, which can help enhance one's capacity to recall things like letter shapes, meanings, and pronunciations. Mnemonic strategies allow one to improve one's ability to remember things like these (Rabbani et al., 2023). Using multimedia presentations of Chinese characters incorporating visual and aural cues enables students to develop stronger dual coding pathways. This is accomplished through the utilization of the Chinese characters. Their ability to recall and retrieve knowledge is thus improved as a result of this. It is possible to reinforce dual coding by establishing multimodal learning experiences. This can be accomplished using interactive multimedia presentations that stimulate active involvement and manipulate character stimuli (Aryanto, 2021).

During this study project, both the Cognitive Load Theory and the Dual Coding Theory are applied to investigate the influence of interactive multimedia on third graders' ability to recognize Chinese characters. Consequently, the Cognitive

Learning Theory (CLT) sheds light on controlling the cognitive load to achieve optimal learning results (Murtianto et al., 2022). This is because the CLT sheds light on the cognitive processes connected with multimedia learning. In contrast, the DCT presents efficient instructional strategies for boosting the acquisition of Chinese characters through multimedia presentations. These strategies are intended to be used in the classroom. Using these tactics, dual coding is emphasized in terms of its capacity to support the development of memory and comprehension (Sweller, 2023). Considering these concepts, they provide a substantial theoretical foundation for developing multimedia interventions that improve the efficacy and efficiency of classroom learning.

2.2 Related Studies

2.2.1 Acquisition of Chinese Character Recognition Skills

Acquiring Chinese character recognition skills is critical in developing Chinese literacy, particularly for third-grade students. This complex skill encompasses visual recognition, semantic comprehension, and phonetic articulation of characters, forming the foundation for advanced reading and writing abilities.

Visual recognition is often considered the primary component of character acquisition. Chinese characters, being logographic, require distinct cognitive processes compared to alphabetic languages. Tan et al. (2005) demonstrated that reading Chinese characters engages neural pathways different from those used in alphabetic reading, emphasizing the importance of visual-spatial processing. For third-grade students, developing strong visual recognition skills is crucial for efficient character identification.

Semantic comprehension forms another vital aspect of character recognition. Li et al. (2012) found that semantic knowledge significantly contributes to character recognition, particularly for characters with transparent semantic radicals. This suggests that effective teaching methods should emphasize character meaning alongside visual form. For third-grade students, developing this semantic understanding is crucial for building a strong foundation in Chinese literacy.

Phonetic articulation, while secondary to visual recognition in Chinese, plays a significant role in character acquisition. Perfetti and Tan (1998) proposed that phonological information is activated automatically during character recognition, even when not explicitly required. This highlights the importance of incorporating phonetic elements in character instruction, particularly for young learners developing their phonological awareness.

The assessment of these skills is crucial for tracking progress and tailoring instruction. Zhang et al. (2014) developed and validated a comprehensive Chinese character recognition test for primary school students, providing a reliable tool for measuring improvements in character recognition skills. Such assessments are particularly valuable for third-grade students, as they allow educators to identify areas of strength and weakness in character recognition abilities.

Recent research has explored innovative methods to enhance character recognition skills. Xu et al. (2020) investigated the effects of an interactive Chinese character learning system on foreign language students. They found that improving the interactive design of such systems can significantly enhance learning performance, suggesting potential benefits for young native speakers as well.

The importance of character recognition skills in overall Chinese literacy cannot be overstated. Shu et al. (2003) found that character recognition ability strongly predicts reading comprehension in Chinese. For third-grade students, developing robust character recognition skills lays the groundwork for future academic success across various subjects taught in Chinese.

Moreover, acquiring these skills has been shown to have cognitive benefits beyond language learning. Tan et al. (2005) suggested that learning to read and write Chinese characters may enhance the development of visual-spatial skills, potentially benefiting students in other academic areas such as mathematics and science.

As research continues to uncover the cognitive processes involved in character recognition, educators can develop more effective teaching strategies and assessment methods. For third-grade students at a critical stage in their literacy development, these advancements offer the potential for more targeted and efficient instruction in Chinese character recognition.

2.2.2 Interactive Multimedia

Interactive multimedia has emerged as a powerful tool in education, particularly in teaching Chinese characters to third-grade students. These digital learning tools integrate text, images, audio, and video while allowing real-time student interaction, enhancing their engagement and learning experience.

The effectiveness of interactive multimedia in language learning has been well-documented. Mayer and Moreno (2003) proposed the cognitive theory of multimedia learning, suggesting that people learn more deeply from words and pictures than from words alone. This theory is particularly relevant to learning Chinese characters, where visual components are crucial.

In the context of Chinese language education, interactive multimedia offers unique advantages. Chen et al. (2014) investigated the effects of different multimedia strategies on learning Chinese characters among non-native novices. They found that interactive multimedia presentations significantly improved character recognition and retention compared to traditional methods.

The real-time interaction feature of these tools is particularly beneficial for third-grade students. Hsu et al. (2016) developed a personalized recommendation-based mobile learning approach for improving reading performance. Their study showed that interactive features that respond to student input and adapt to individual learning paces significantly enhanced learning outcomes.

Interactive multimedia also supports the simultaneous development of multiple language skills. Chang et al. (2018) examined the effects of technology-assisted English listening learning, from computer-assisted language learning (CALL) to mobile-assisted language learning (MALL). They found that interactive multimedia tools improved listening skills and language proficiency.

The adaptability of interactive multimedia to individual learning needs is another key advantage. Xu et al. (2020) studied the effects of improving the interactive design of a Chinese character learning system. They found that personalized feedback and adaptive difficulty levels significantly enhanced learning performance, particularly for students struggling with traditional methods.

However, the implementation of interactive multimedia in classrooms is not without challenges. Dai and Yang (2022) explored multimedia learning for Chinese

character image recognition via human-computer interaction networks. They highlighted the need for careful design to avoid cognitive overload, emphasizing the importance of balancing interactivity with cognitive processing capacity.

The use of interactive multimedia also aligns with broader educational trends. The China Internet Network Information Center (CNNIC) reported in 2021 that the number of online education users in China reached 325 million, indicating a growing acceptance of digital learning tools. This trend underscores the potential for interactive multimedia to enhance educational outcomes, particularly in foundational skills like character recognition.

Looking ahead, integrating artificial intelligence with interactive multimedia presents exciting possibilities. Feng and Wang (2023) investigated the use of AI-powered educational robots in Chinese language learning. Their findings suggest that advanced technologies can effectively leverage the interactivity of multimedia to achieve remarkable educational outcomes.

In conclusion, interactive multimedia offers promising avenues for enhancing the teaching and learning of Chinese characters among third-grade students. By providing engaging, adaptive, and personalized learning experiences, these tools have the potential to improve character recognition skills significantly. As technology evolves, the effectiveness of interactive multimedia in language education will likely increase, offering new opportunities for innovative teaching methods and improved learning outcomes.

2.2.3 Multiple Content Types

Multiple content types in multimedia educational tools have emerged as a significant factor in enhancing the learning experience, particularly for third-grade students learning Chinese characters. This approach, which integrates various media formats such as text, graphics, audio, and video, aims to engage sensory channels and support diverse learning styles.

The theoretical foundation for using multiple content types stems from cognitive psychology. Paivio's (1986) Dual Coding Theory posits that the human mind processes verbal and non-verbal information through separate but interconnected channels. This theory suggests that presenting information through multiple modalities can enhance learning and retention. This multimodal approach can be particularly

beneficial in Chinese character learning due to the characters' visual complexity and semantic richness.

Research has demonstrated the effectiveness of multiple content types in language learning. Mayer and Moreno (2003) proposed the Cognitive Theory of Multimedia Learning, which suggests that people learn more deeply from words and pictures than from words alone. This theory has significant implications for Chinese character recognition, where visual and semantic components are closely intertwined.

In a study specifically focused on Chinese character learning, Chen et al. (2014) investigated the effects of different multimedia strategies on non-native novices. They found that combinations of visual and verbal representations were more effective than single-mode presentations in enhancing character recognition and retention. This finding underscores the potential of multiple content types in addressing the unique challenges of Chinese character acquisition.

The use of audio content alongside visual representations has also shown promise. Chang et al. (2018) examined the effects of technology-assisted English listening learning. They found that integrating audio with visual content improved listening skills and language proficiency. While this study focused on English, its findings have implications for Chinese language learning, particularly in developing phonemic awareness alongside character recognition.

Animated content represents another valuable content type in multimedia learning tools. Liang et al. (2019) developed a Chinese character-learning game app incorporating animated character-writing demonstrations. Their results showed significant improvements in students' ability to identify and use characters, suggesting that dynamic visual content can enhance learning.

Interactive graphics and simulations offer yet another dimension to multiple content-type approaches. Xu et al. (2020) studied the effects of an interactive Chinese character learning system and found that incorporating interactive visual elements significantly improved learning outcomes. This suggests that engaging multiple senses through varied content types can enhance the learning experience and improve retention.

However, implementing multiple content types must be carefully considered to avoid cognitive overload. Sweller's (1988) Cognitive Load Theory warns

that excessive or poorly integrated information can overwhelm learners' cognitive resources. Therefore, the design of multimedia tools must strike a balance between providing diverse content types and maintaining cognitive manageability.

The effectiveness of multiple content types may also vary depending on individual learning styles. Wong et al. (2012) found that learners with different cognitive styles may benefit differently from multimedia presentations. This highlights the need for adaptive systems that tailor content presentation to individual learner needs.

Looking forward, emerging technologies offer new possibilities for implementing multiple content types. Virtual and augmented reality, for instance, provide immersive environments that can engage multiple senses simultaneously. While research in this area is still emerging, early studies suggest promising applications for language learning, including Chinese character recognition (Zhu et al., 2021).

In conclusion, using multiple content types in multimedia educational tools offers a powerful approach to teaching Chinese characters to third-grade students. By engaging different sensory channels and supporting diverse learning styles, this approach has the potential to enhance character recognition skills significantly. Integrating multiple content types will become increasingly sophisticated as technology evolves, offering new opportunities for innovative and effective language learning experiences.

2.2.4 Mnemonic in Multimedia

Mnemonics in multimedia educational content have emerged as a powerful tool for enhancing the memorization and recall of Chinese characters, particularly for third-grade students. This strategy leverages visual and auditory cues to improve long-term retention of character shapes, meanings, and pronunciations, making it an invaluable component of modern language learning approaches.

The effectiveness of mnemonics in language learning has been well-established in cognitive psychology. Atkinson and Raugh (1975) pioneered the keyword method, a mnemonic technique that significantly improved vocabulary retention in second-language learners. This method, which involves creating an acoustic and imagery link between new words and familiar concepts, has since been

adapted for various language learning contexts, including Chinese character acquisition.

In Chinese character learning, mnemonics often take the form of visual associations or stories that connect the character's shape to its meaning. Wang and Thomas (1992) conducted a study comparing the effectiveness of imagery-based mnemonics to rote learning for Chinese characters. They found that students using mnemonic strategies significantly outperformed those using rote memorization in immediate recall and long-term retention.

The integration of mnemonics into multimedia platforms has further enhanced their effectiveness. Shen (2010) investigated computer-assisted language learning (CALL) programs incorporating mnemonic elements for teaching Chinese characters. The study found that students using the mnemonic-enhanced CALL program showed significantly better character recognition and production skills than traditional methods.

Animated mnemonics have proven particularly effective in multimedia learning environments. Yang et al. (2017) developed an animated pictorial mnemonic system for teaching Chinese radicals. Their results showed that students who used animated mnemonics demonstrated better radical recognition and character inference skills than those who used static pictorial or no mnemonics.

The combination of visual and auditory mnemonics in multimedia presentations has also shown promise. Lin et al. (2022) created a Chinese character learning game app incorporating visual mnemonics and phonetic cues. They found that this multimodal mnemonic approach significantly enhanced students' abilities to identify and use characters, suggesting that engaging multiple sensory channels can reinforce mnemonic effectiveness.

However, the design of mnemonic-based multimedia tools requires careful consideration. Kuo and Hooper (2004) cautioned that while instructor-provided mnemonics can be effective, they may not always align with students' associations. Their study suggested that allowing students to create mnemonics within a guided multimedia environment could lead to better retention outcomes.

The effectiveness of mnemonics in multimedia may also vary depending on the learner's proficiency level. Chiou et al. (2019) found that while beginners benefited

significantly from mnemonic-enhanced multimedia tools, advanced learners showed less dramatic improvements. This suggests that mnemonic strategies in multimedia should be adaptable to different learning stages.

Recent technological advancements have opened new avenues for mnemonic implementation in multimedia. For instance, augmented reality (AR) applications offer the potential for creating immersive mnemonic experiences. While research in this area is still emerging, early studies like that of Cheng and Tsai (2014) suggest that AR-based mnemonics could significantly enhance character learning and retention.

Looking forward, integrating artificial intelligence with mnemonic-based multimedia tools presents exciting possibilities. Adaptive systems that generate personalized mnemonics based on a learner's background and preferences could potentially revolutionize Chinese character instruction (Zhang et al., 2021).

In conclusion, incorporating mnemonics in multimedia educational content offers a powerful strategy for enhancing Chinese character recognition skills among third-grade students. By leveraging visual and auditory cues to improve long-term retention, mnemonic-enhanced multimedia tools have the potential to accelerate character acquisition significantly. As technology evolves, implementing mnemonics in language learning applications will likely become increasingly sophisticated, offering new opportunities for effective and engaging character instruction.

2.2.5 Type of Multimedia Presentation

The type of multimedia presentation used in educational tools is crucial in enhancing learning engagement and comprehension, particularly for third-grade students learning Chinese characters. Various formats and styles of multimedia presentations, such as interactive games, animated videos, and digital simulations, each offer unique advantages in the context of language learning.

Interactive games have emerged as a particularly effective multimedia presentation for language learning. Gee (2003) argued that well-designed games can incorporate learning principles that engage learners and promote deep understanding. In the context of Chinese character learning, Hsu and Chen (2020) developed a game-based learning system for Chinese character writing. Their study found that students

using the game-based system showed significantly improved character recognition and writing skills compared to traditional methods.

Animated videos represent another powerful type of multimedia presentation. Mayer and Moreno (2002) proposed the animation principle, suggesting that students learn more deeply from animation and narration than from narration alone. This principle has been applied to Chinese character learning with promising results. For instance, Chang et al. (2014) used stroke sequence animation to teach Chinese character writing. They found that students who learned with animated demonstrations outperformed those who learned with static images in immediate and delayed tests.

Digital simulations offer a unique approach to language learning by providing immersive, context-rich environments. While research on simulations for Chinese character learning is limited, studies in other language learning contexts suggest their potential. Ranalli (2008) found that digital simulations can enhance vocabulary acquisition and promote more authentic language use. In Chinese character learning, simulations could help students understand the real-world contexts and usage of characters.

The effectiveness of different types of multimedia presentations may vary depending on the specific aspect of language learning being targeted. For character recognition, Lin et al. (2022) developed a mobile application that combined elements of games and animated demonstrations. Their results showed that this hybrid approach significantly improved students' ability to identify and use Chinese characters.

Comparative studies have also shed light on the relative effectiveness of different presentation types. Chen et al. (2019) compared the effects of game-based learning, video-based learning, and traditional methods on Chinese vocabulary acquisition. They found that while game-based and video-based methods outperformed traditional methods, game-based learning showed the highest gains in vocabulary retention and motivation.

However, the choice of multimedia presentation type should consider individual learning preferences and cognitive styles. Yang and Wu (2015) found that learners with different cognitive styles responded differently to various multimedia presentation formats. This suggests the need for adaptive systems that tailor presentation types to individual learner needs.

Integrating multiple presentation types within a single learning environment has also shown promise. Zou et al. (2021) developed a comprehensive Chinese learning platform incorporating games, videos, and interactive exercises. Their longitudinal study found that this multimodal approach led to sustained improvements in character recognition and overall language proficiency.

Emerging technologies are expanding the possibilities for multimedia presentation types. Virtual Reality (VR) and Augmented Reality (AR) offer immersive experiences that could revolutionize language learning. While research in this area is still emerging, early studies like that of Hsu (2017) suggest that AR-enhanced learning materials can significantly improve character recognition and retention.

Integrating artificial intelligence with various multimedia presentation types presents exciting possibilities. Adaptive systems that can dynamically adjust presentation formats based on learner performance and engagement could potentially optimize the learning experience for each student (Zhang et al., 2021).

In conclusion, the type of multimedia presentation used in educational tools significantly influences the effectiveness of Chinese character instruction for third-grade students. While interactive games, animated videos, and digital simulations offer unique benefits, combining these presentation types, tailored to individual learner needs, may provide the most comprehensive and practical learning experience. As technology evolves, new presentation types will likely emerge, offering more engaging and effective ways to teach Chinese characters.

Interactive multimedia has recently entered many classrooms, enriching the learning process and student education outcomes. As an illustration, Al-Sabbagh (2023) found that the acquisition of vocabulary by non-native English speakers is greatly facilitated by the employment of multimedia modalities, notably video. Al-Sabbagh (2023) states that the research indicates the significance of multimedia in language instruction and how it can improve students' learning results.

Additionally, it is widespread knowledge that acquiring a second language (SLA) might benefit brain development. According to Lin (2023), SLA helps children's brains grow and develop and supports multidimensional learning patterns, increasing their capacity to concentrate and recall knowledge. Even though the study warns of some potential disadvantages if the implementation is not done appropriately, the

cognitive benefits suggest that incorporating multimedia into language learning could increase these effects even further (Lin, 2023).

One further key issue that requires greater research is how youngsters' usage of smart media affects the development of their linguistic skills. According to Alamri et al. (2023), spending excessive time in front of screens may be connected with a lack of expressive vocabulary and linguistic abilities. On the other hand, there appears to be a link between increasing language abilities and parentally shared media engagement and instructional apps, which implies that multimedia has a multifaceted impact on the development of language (Alamri et al., 2023).

Research has also demonstrated that the development of multimedia learning media can significantly boost young children's expressive language abilities. These learning media items are valuable and practical, according to Ghofur and Nurhayati (2023), who determined that multimedia might be an effective tool for language educators. They found that these learning media included.

In addition to this body of work, Ilham et al. (2023) describe different approaches that can be applied to improve preschoolers' English vocabulary through various multimedia tools. Multimedia technologies have been found to considerably improve educational results and language abilities, as indicated by the conclusions of a study that utilized a variety of research approaches (Ilham et al., 2023). This shows that these technologies are crucial for establishing learning experiences that are both interesting and fruitful.

Some studies have been carried out to study whether or not the employment of subtitles in videos could be advantageous to the process of learning a second language. Even though students can acquire a new language through video subtitles, the efficacy of these subtitles is contingent upon several factors. These factors include the learner's level of proficiency in the target language and the type of subtitle (L1, L2, or both) (Lei, 2023).

Incorporating multimedia into the educational system has led to reevaluating pedagogical practices and the materials used in the classroom, particularly concerning language learning. This is especially evident when contemplating the process of acquiring a new language. Following what Tayirova (2023) has stated, this is of the utmost significance for training future educators to use new instructional

technology. This is because the employment of multimedia technologies in the classroom can potentially increase student involvement and the consequences of their learning.

Children stand to gain a lot by obtaining an education that combines multimedia, making learning more interesting and pleasurable. Within the scope of their research, Nowawi and Ahmad (2023) emphasize the significance of employing an online application to teach Malay to toddlers. According to the authors, young children can benefit tremendously from using interactive technology for language acquisition.

Peláez and Solano (2023) broaden this perspective by investigating the possibilities of incorporating gamification into primary schools' curriculum through multimedia experiences. Additionally, according to their findings, gamification-based multimedia solutions can promote learning and receptivity to using technology in the classroom. Additionally, this is especially true for younger pupils.

Within the context of language learning, Weng and Ou (2023) investigate how multimedia affects people's ability to comprehend other cultures. They show how these tools can simultaneously increase students' cultural awareness while enhancing their interest in and skill with English. During the film-based interactive classroom activities that the students participated in, they improved their cultural understanding and language skills (Weng & Ou, 2023).

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Design

This study adopts an experimental research approach in order to evaluate the impact that interactive multimedia has on the development of 15-20 Chinese character identification skills among students in the third grade. Experimental designs are suitable for situations in which random assignment of participants to treatment groups is neither practical nor ethical. This is frequently the case in educational contexts. The design of this study comprises the manipulation of independent variables (IVs) inside a controlled classroom environment. This design allows for comparisons between various situations while controlling for potential confounding variables. The research approach is as follows:

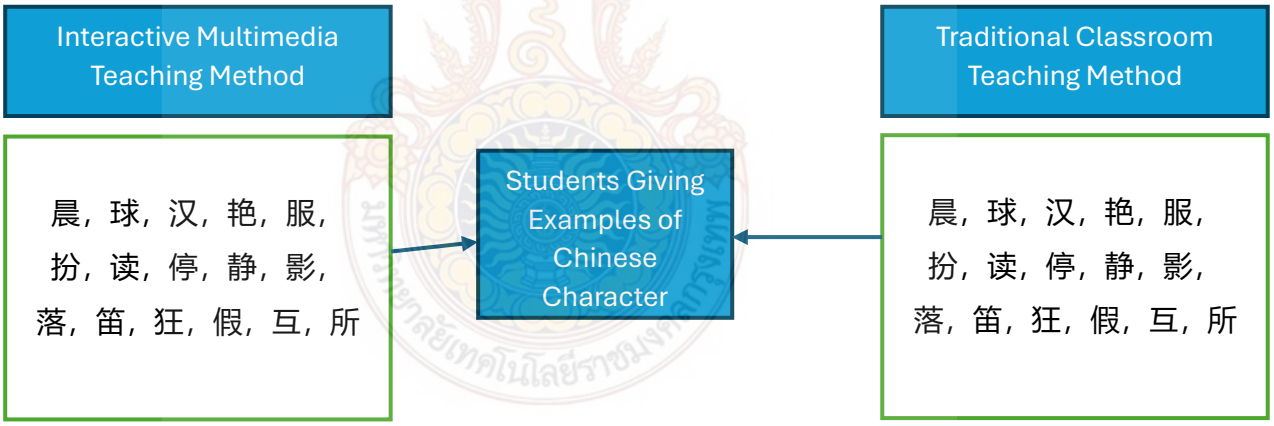

Figure 3.1 Chinese Characters Being Taught in Different Manners Using Interactive Multimedia and Traditional Classroom Methods

The figure above shows the same set of 16 Chinese characters being taught in different ways using interactive multimedia and traditional classroom methods, respectively. The essence of the research design is to perform a comparative analysis in terms of the effectiveness of using interactive multimedia teaching methods versus the usage of traditional classroom teaching methods when it comes to teaching Chinese characters (which are reserved for 3rd-grade students) to students. The test of

effectiveness was conducted to determine how well students can recall and give examples of Chinese characters when asked. After that, by comparing the results, it was clear which teaching method is better at helping students achieve the said goal.

3.2 Research Population and Samples

3.2.1 Population

The study focuses on a population of third-grade students from two specific elementary schools in Beijing. The first school, School A, has approximately 300 third-grade students enrolled. The second, School B, hosts around 320 third-grade students as well, bringing the total population for this study to approximately 620 third-grade students in these selected schools.

3.2.2 Samples

This inquiry's sample comprised third graders chosen randomly from the general population. To keep the sample size reasonable and because doing research in school settings has its own set of practical limits, we chose a sample size of 60 students to take part in the study. The sample size was further broken into 30 students using CLT and DCT methods and 30 students using non-CLT and non-DCT methods.

3.2.3 Sampling Methods

This study utilized purposive sampling to concentrate on third-grade students from two carefully chosen elementary schools in Beijing, selected for their prominent utilization of multimedia in educational settings. The chosen schools are Beijing Shijia Primary School and Fangcaodi International School, both known for their progressive and innovative approaches to integrating multimedia tools within the curriculum. Each of these schools has approximately 150 students enrolled in the third grade. To further narrow down using purposive sampling, 30 students from each school were selected, totaling around 60 third-grade students for the study.

These schools were selected based on several criteria that align with the research objectives. First, both schools are recognized for their robust multimedia-based teaching methodologies, which are essential for examining the study's focus on the effectiveness of teaching Chinese characters. Second, these schools have well-

documented success in implementing educational technologies, providing a rich context for observing the impacts and outcomes of such interventions.

By choosing these schools, the study explores how multimedia tools can enhance learning in real-world educational environments. The insights gathered from these specific educational settings are expected to shed light on the practical applications and benefits of multimedia learning aids, thereby contributing valuable data on how these technologies can be optimized for teaching Chinese characters.

The purposive sampling method is particularly suited for this research because it ensures that the population studied embodies characteristics pertinent to the study's aims. By focusing on schools already employing multimedia tools extensively, the study can better isolate the effects of these tools on learning outcomes and more effectively evaluate the nuances of multimedia implementation in the educational process.

Overall, this sampling strategy not only enriches the study by focusing on relevant examples of multimedia usage in education but also enhances the relevance and applicability of the research findings to similar educational environments aiming to integrate or improve multimedia learning strategies.

3.3 Data Collection

The data collection for the study on the impact of interactive multimedia on third-grade students' Chinese character recognition skills was conducted as follows:

1. Preparation for Data Collection:

a. Developed and validated the testing instruments, including assessments and observational checklists, to ensure they effectively measure Chinese character recognition skills.

b. Coordinated with Guizhou Primary School and Fangcaodi International School administrators to schedule testing and observation sessions.

c. Conducted training sessions for researchers and assistants on administering tests and conducting observations accurately and ethically.

2. Initial Data Collection:

a. Administered a pre-intervention assessment to all participating third-grade students to gauge their baseline skills in Chinese character recognition.

b. Recorded initial observations about students' engagement and interaction with existing multimedia tools in their classrooms.

3. Implementation of Multimedia Interventions:

a. Introduced the interactive multimedia tools designed for this study into the selected classrooms.

b. Monitored and documented the implementation process, including any technical issues and how they were resolved, to ensure fidelity in using the multimedia tools.

4. Ongoing Observations:

a. Conducted systematic observations during the intervention period to note students' interactions with the multimedia tools and engagement levels.

b. Used structured observation guides to record data on how frequently and effectively students use the multimedia features for learning Chinese characters.

5. Post-Intervention Data Collection:

a. After using the multimedia tools, a post-intervention assessment was administered to measure changes in the students' abilities to recognize Chinese characters.

b. Conducted follow-up observations to capture data on sustained changes in student engagement and learning behaviors.

6. Data Compilation and Preliminary Analysis:

a. Compiled all collected data from pre-tests and post-tests, as well as observational notes.

b. Performed a preliminary analysis to check for completeness and consistency across the data sets.

7. Data Entry and Storage:

a. Entered all quantitative and qualitative data into a secure database.

b. Ensured all data is anonymized to maintain participant confidentiality.

c. Backed up the data in multiple secure locations to prevent data loss.

This step-by-step process ensured that data collection is thorough, systematic, and aligns with the study's research objectives, providing a robust dataset for subsequent analysis.

3.4 Research Instrument

Exams were developed in the past to evaluate the ability of third graders to recognize Chinese characters. Character recognition skills such as visual identification, semantic comprehension, and phonetic knowledge are some of the talents that were tested. These metrics were used to evaluate character recognition abilities. Paper and pencil were used to administer the evaluations, and they were tested in a pilot program before implementation to ensure that they were understandable, appropriate, and trustworthy. The exam comprised a memorization test of 16 Chinese Characters, which the students had learned throughout their learning session using different methods. Students are given multiple choices for each question and must choose the correct answer to pass the test.

Structured observation procedures served as a guide for collecting observational data throughout the presentation of the multimedia interventions. Both the interactions and behaviors that were monitored, as well as the criteria for data recording, were specified in the protocols. The practicality and efficiency of the classroom environment were determined by whether digital recording devices or pen-and-paper notes were used to gather observational data.

Research Instruments

1. Chinese Character Recognition Test: It has 4 parts.

Part 1: A.1 Test Instruction

Part 2: A.2 Test Items. It has 16 words

Part 3: A.3 Scoring Rubrics

Part4: A4 Answer Sheet

2. Student Engagement Questionnaire

It has 3 Parts

Part 1: C.1 Questionnaire Instructions

Part 2: C.2 Questionnaire Item. It has 10 items. The questionnaire is a 5-point Likert scale

1	means	Strongly disagree
2	means	Disagree
3	means	Neutral
4	means	Agree
5	means	Strongly Agree

Interpretation of average

1.00-1.50	means	Very low Engagement
1.51-2.50	means	Low Engagement
2.51-3.50	means	Moderate Engagement
3.51-4.50	means	High Engagement
4.51-5.00	means	Very High Engagement

3.5 Content Validity and Reliability

To validate and ensure reliability in our study on the effectiveness of multimedia tools for third-grade Chinese character recognition, rigorous methodologies were employed for both our memorization test and structured observations.

Content Validity:

The memorization test, comprising 16 Chinese characters, was developed with the aid of experienced language teachers and psychometricians to cover essential learning objectives thoroughly. A panel of linguistic and educational experts reviewed this test to ensure each item's relevance and appropriateness to Chinese character recognition. Similarly, for structured observation, the researcher developed a checklist focusing on key behaviors that signify engagement and effectiveness of multimedia learning tools. Educational researchers and practitioners also validated this checklist to confirm its capacity to capture pertinent aspects of student interaction with multimedia.

Reliability:

For the memorization test, test-retest reliability was established by administering the same test twice to the same group of students within a two-week interval and analyzing the results for consistency using correlation coefficients. Internal consistency was assessed through Cronbach's alpha to ensure that the items measure the learning construct cohesively. For structured observations, inter-rater reliability was assessed by comparing the consistency of observer ratings using Cohen's kappa

coefficient. This ensures that different observers rate student behaviors consistently. Additionally, regular recalibration sessions for observers were conducted to maintain rating consistency over time.

These measures enhanced the credibility of our findings by ensuring our instruments not only accurately assess what they intend to but also do so consistently. This dual focus on content validity and reliability is crucial for substantiating the effectiveness of multimedia tools in educational settings.

3.6 Data Analysis

Descriptive and inferential statistics were utilized to derive results from this study. The study investigated how the use of interactive multimedia by third graders affects their ability to recognize Chinese characters.

3.6.1 Descriptive Statistics

Measures of Central Tendency: The Mean was calculated to summarize the overall performance of students on the Chinese character recognition tests.

Measures of Variability: Standard deviation was computed to describe the spread of scores.

3.6.2 Inferential Statistics

In this study assessing the impact of multimedia tools on third-grade students' ability to recognize Chinese characters, inferential statistics were employed to test hypotheses and determine statistically significant differences in learning outcomes.

Independent-Samples t-Test:

- Purpose: To compare post-test scores between different groups of students exposed to various types of multimedia presentations.
- Application: Determining if different multimedia modalities lead to significantly different learning outcomes.

By interpreting the results of these inferential analyses within the context of established research hypotheses and theoretical frameworks, the researcher aims to thoroughly understand how multimedia tools influence third graders' proficiency in Chinese character recognition. This methodological approach validated multimedia's educational effectiveness and guides future instructional designs.

晨，球，汉，艳，服，

扮，读，停，静，影，

落，笛，狂，假，互，所

CHAPTER IV
ANALYSIS RESULTS

4.1 Data Analysis

RO1: To study the impact of incorporating mnemonics into multimedia on acquiring Chinese character recognition skills in Grade 3 students.

Table 4.1 Compare Average and SD Class (learned by CLT and DCT)

Class 1: Student Engagement Questionnaire			
Student Engagement Items	**Average**	**SD**	**Interpretation**
I enjoyed learning Chinese characters using the multimedia tools.	4.67	0.48	Very High Engagement
The multimedia tools were easy to use.	4.87	0.35	Very High Engagement
The animations helped me understand how to write the characters.	4.83	0.38	Very High Engagement
The audio pronunciations helped me remember how to say the characters.	4.97	0.18	Very High Engagement
The interactive games made learning Chinese characters more fun.	4.70	0.47	Very High Engagement
I found it easier to remember the meaning of characters with the visual associations provided.	4.93	0.25	Very High Engagement
I prefer learning Chinese characters with multimedia tools compared to traditional methods.	4.77	0.43	Very High Engagement
The multimedia tools helped me stay focused during the lesson.	4.83	0.38	Very High Engagement
I feel more confident about recognizing Chinese characters after using these tools.	4.87	0.35	Very High Engagement
I want to continue using multimedia tools to learn more Chinese characters.	4.87	0.35	Very High Engagement

From Table 4.1, the total average is 4.83, and the total standard deviation is 0.38, which means very high engagement.

The audio pronunciations helped me remember how to say the characters have an average of 4.97 with a standard deviation of 0.18. It has a high average and interprets very high engagement. *I enjoyed learning Chinese characters using the*

multimedia tools, with an average of 4.67 (SD = 0.48). It is the lowest average and is interpreted as very high engagement.

Table 4.2 Compare Average and SD Class 2 (do not learn by CLT and DCT)

Class 2: Student Engagement Questionnaire			
Student Engagement Items	**Average**	**SD**	**Interpretation**
I enjoyed learning Chinese characters using the multimedia tools.	4.91	0.31	Very High Engagement
The multimedia tools were easy to use.	4.83	0.38	Very High Engagement
The animations helped me understand how to write the characters.	4.87	0.35	Very High Engagement
The audio pronunciations helped me remember how to say the characters.	4.87	0.35	Very High Engagement
The interactive games made learning Chinese characters more fun.	4.80	0.41	Very High Engagement
I found it easier to remember the meaning of characters with the visual associations provided.	4.87	0.35	Very High Engagement
I prefer learning Chinese characters with multimedia tools compared to traditional methods.	4.87	0.35	Very High Engagement
The multimedia tools helped me stay focused during the lesson.	4.87	0.35	Very High Engagement
I feel more confident about recognizing Chinese characters after using these tools.	4.87	0.35	Very High Engagement
I want to continue using multimedia tools to learn more Chinese characters.	4.83	0.38	Very High Engagement

From Table 4.2, the total average is 4.86, and the total standard deviation is 0.35, which means very high engagement.

I enjoyed learning Chinese characters using the multimedia tools, with an average of 4.90 (SD = 0.31). It has the lowest average and interprets very high engagement.

The interactive games made learning Chinese characters more fun, with an average of 4.80 (SD = 0.41). It has the lowest average and interprets very high engagement.

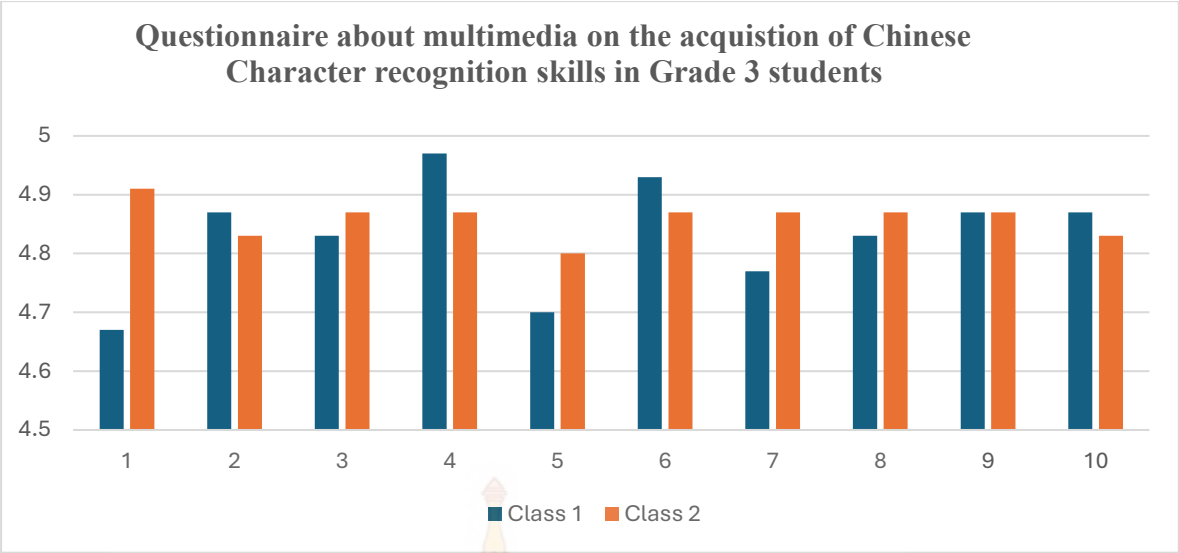

Figure 4.1 Questionnaire About Multimedia in Acquiring Chinese Character Recognition Skills in Grade 3 Students

RO2: To compare the skill level between students who learn using CLT and DCT and students who do not learn using CLT and DCT.

Research Hypotheses

Students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods.

H_0: The variance of students who learn using CLT and DCT and those who do not learn using CLT and DCT is equal.

H_1: The variance of students who learn using CLT and DCT and those who do not learn using CLT and DCT is unequal.

Table 4.3 Compare Variance between Students Who Learn Using CLT and DCT and Students Who Do Not Learn Using CLT and DCT (Before Learning)

Class	Average	SD	df	F
Class 1 (learn by CLT and DCT)	1.33	0.51	29	0.92
Class 2 (do not learn by CLT and DCT)	1.27	0.55		

$F_{.05,29,29}=0.42$

From Table 4.3 F-test = 0.92 > $F_{.05,\ 29,29}$=0.42. It means the variance of students who learn using CLT and DCT is equal to the variance of students who do not learn using CLT and DCT.

So, the next step is to compare group one, which includes students who learn using CLT and DCT, and group two, which includes students who do not learn using CLT and DCT, using a t-test for equal variance.

Table 4.4 Compare the Average between Students Who Learn Using CLT and DCT and Students Who Do Not Learn Using CLT and DCT (After Learning)

Class	Average	SD	df	t
Class 1 (learn by CLT and DCT)	9.65	0.40	58	2.88
Class 2 (do not learn by CLT and DCT)	9.30	0.54		
$t_{.05,58}=1.67$				
$t_{computer}=2.88>t_{.05,58}=1.67$				

Class 1 (learned by CLT and DCT) averages 9.65 standard deviations of 0.40.

Class 2 (do not learn by CLT and DCT) averages 9.30 standard deviations of 0.54.

Table 4.4 shows that the average of the students' scores who learned using CLT and DCT was higher than the average of the students' scores who did not learn using CLT and DCT.

It means students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods.

CHAPTER V
CONCLUSION

5.1 Conclusion

RO1: To study the use of multiple content types in interactive multimedia that influence Grade 3 students' ability to recognize Chinese characters.

The research found that students enjoyed learning Chinese characters using multimedia tools. It is very high engagement; *the audio pronunciations helped me remember how to say the character level*, and students found it easier to remember the meaning of characters with the visual associations provided. It is class 1 second. It is a very high engagement level.

The expertise reversal effect, a key finding in CLT research, has implications for adaptive learning systems. This effect suggests that instructional techniques that are effective for novices may become ineffective or even detrimental for more experienced learners (Kalyuga et al., 2003). In Chinese character learning, multimedia tools should adapt their presentation and complexity based on the learner's current skill level.

Recent developments in CLT have expanded its application to collaborative learning settings (Kirschner et al., 2018) and adaptive learning systems (Kalyuga, 2009). Zhao et al. (2023) found that adaptive multimedia systems can improve learning outcomes by up to 45%, but their implementation in Chinese character education is still in its early stages. These advancements and new methods for measuring cognitive load through physiological measures (Antonenko et al., 2010) offer promising avenues for more precise instructional design.

CLT posits that human cognitive architecture consists of a limited working memory and an unlimited long-term memory. Miller (1956) suggested that working memory can hold about 7±2 chunks of information, highlighting the importance of managing cognitive load in learning design. CLT identifies three types of loads: intrinsic (related to content difficulty), extraneous (caused by poor design), and germane (effort for schema creation).

H_1: Students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods.

It means students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods.

Student Engagement Items have media tools that are ready to use and have a high level of. *The audio pronunciations helped me remember how to say the characters,* which had a high average and high engagement.

Dual Coding Theory (DCT), proposed by Allan Paivio in 1971, posits that the human mind processes and represents information through two distinct but interconnected systems: verbal and non-verbal (or visual). This theory has significant implications for learning, particularly in Chinese character recognition among third-grade students, where both linguistic and visual components play crucial roles.

Several studies have applied DCT principles to Chinese character instruction. Shen (2010) investigated the effectiveness of imagery-based encoding strategies for learning Chinese characters. The study found that students who used visual and verbal encoding strategies outperformed those who relied on single-mode strategies, supporting the DCT premise.

The research revealed that students exhibited high engagement when learning Chinese characters using multimedia tools, particularly in enjoying the learning process, benefiting from audio pronunciations to remember character pronunciations, and using visual associations to understand character meanings. This indicates that multimedia tools effectively facilitate language learning by leveraging dual modalities to enhance memory and understanding. However, the expertise reversal effect, a central finding in Cognitive Load Theory (CLT) research, highlights the need for instructional methods to adapt to learners' proficiency levels. Kalyuga et al. (2003) emphasize that strategies effective for novices may become counterproductive for more experienced learners. In Chinese character learning, this underscores the importance of

tailoring multimedia tools to match the learner's current skill level, ensuring optimal engagement and effectiveness.

Recent advancements in CLT further enhance its application. For example, CLT's extension to collaborative learning (Kirschner et al., 2018) and adaptive learning systems (Kalyuga, 2009) has demonstrated significant potential. Zhao et al. (2023) found that adaptive multimedia systems could improve learning outcomes by up to 45%, though their application in Chinese character education remains nascent. Furthermore, innovative methods, such as measuring cognitive load through physiological indicators (Antonenko et al., 2010), provide more precise instructional design opportunities. CLT's foundational concepts−limited working memory and unlimited long-term memory−emphasize the need to manage cognitive load effectively during learning. Miller's (1956) assertion that working memory holds approximately 7±2 chunks of information supports the differentiation of cognitive load into intrinsic (content-related), extraneous (design-related), and germane (schema-building) components, enabling educators to design better instructional tools and experiences.

H_1: Students who learn using Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) based multimedia methods demonstrate significantly higher Chinese character recognition skills than students who learn using non-CLT and non-DCT methods.

Students using multimedia methods based on Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) demonstrated significantly higher Chinese character recognition skills than non-CLT and non-DCT methods. Student engagement was also high, with participants reporting that the multimedia tools were easy to use and enjoyable for learning Chinese characters. Supporting this, Shen, H. H. (2010) found that students employing visual and verbal encoding strategies outperformed those using single-mode strategies, further validating the effectiveness of DCT principles in Chinese character instruction.

5.2 Discussion

This study demonstrates that integrating Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) into multimedia tools significantly improves Grade

3 students' Chinese character recognition skills. High engagement levels (Class 1: 4.83; Class 2: 4.86) highlight the effectiveness of animations and audio in fostering dual-modality learning. Students using CLT and DCT-based methods scored significantly higher (9.65 vs. 9.3), with variance analysis confirming reliable comparisons. These findings underscore the importance of reducing cognitive overload and leveraging dual coding to enhance memory and recognition.

5.3 Recommendation

Several recommendations are provided for the effective utilization of multimedia in teaching Chinese character recognition to Grade 3 students, based on the findings from this study. The very first thing all educators are recommended to do is integrate multiple content types into their teaching strategy. The study results showed that using a mix of text, images, and even some audio leads to better Chinese character recognition and recall than using only written content. This modality satisfies various learning preferences, allowing students who need to see it demonstrated visually or hear an explanation in a clear and loud manner (reinforcement) to be met. These media formats ideally complement each other, and teachers can take advantage of them when combined to provide a more holistic learning experience for their students. When it comes to delivering content, interactive learning through multimedia tools is also found to improve student focus and results, so schools must make necessary investments in this, too.

Moreover, using mnemonic devices in multimedia presentations is a crucial suggestion. Mnemonics work wonders in memorizing Chinese characters since they can help to distinguish them and build connections between learning dots. Teachers should be educated regarding the development and use of mnemonics so they can easily incorporate them into their lessons, especially when memorization is crucial, like when learning languages. They are usable not only for Chinese characters but also for other memory-reliant subject areas. They had an overall effect at least as high as that on the academic performance of students as a whole. Still, educators should try various memory techniques to determine which mnemonics most resonate with their students

— the efficacy of mnemonics can be context-dependent, and some may prove more applicable than others for certain types of learners.

The researchers also stressed that various videos, such as interactive games and video simulations, must be integrated into the classroom. Each of these formats has its advantages that can appeal to different types of learners. For example, using interactive games can help make learning more fun and competitive, thus increasing the attentiveness of a student who tries multiple times to grasp. Financial fogs can drive students into real-life crises by immersing them in digital simulations where they practically apply what they are learning. Students need to see how Chinese characters are used in everyday language, and animated videos can provide this narrative context. Where schools are concerned, an array of multimedia tools should be available to the teachers to choose the best media suited for their learning objective.

In addition, teachers should apply the principles of Cognitive Load Theory (CLT) and Dual Coding Theory (DCT) in creating multimedia-based lessons. These cognitive-based pedagogical techniques often increase student learning as they reduce the overall working memory load and strengthen connections between verbal information conveyed with visuals. So, to apply these strategies effectively, teachers need to organize their lessons to introduce more complex information bit by bit and not flood parents with a ton of information at once. Using verbal and visual combining, students have a double advantage to reinforce their ideas and gain a firm hold on long-term memory. Resources for Effectively Using Multimedia in the Classroom: Schools could also provide teachers with professional development opportunities to learn how CLT and DCT can be used as tools when incorporating multimedia into instructional practices.

5.4 Implementation for Practice & Research Future

Practical Implementation: Teachers should receive training to apply CLT and DCT principles in lesson planning, using multimedia tools effectively for language acquisition. Schools should integrate multimedia tools into curricula, including animations, audio, and visuals. Additionally, developing interactive, gamified tools can sustain student engagement and motivation.

Future Research Directions: Future studies should focus on the long-term retention of Chinese characters learned through CLT and DCT methods. Research should also explore the applicability of these approaches in other languages and subjects, such as math or science.

Differentiated Learning: Investigating the impact of CLT and DCT methods on students with varying learning styles and cognitive abilities can help refine educational tools and ensure they meet diverse needs.

5.5 Recommendations for Future Research

1. Diverse Student Populations: Future studies should examine the impact of CLT and DCT-based multimedia tools on students of varying ages, cultural backgrounds, and learning abilities.

2. Tool Development: Research should focus on designing and evaluating multimedia tools optimized for CLT and DCT principles, focusing on scalability and adaptability.

3. Control of Confounding Variables: Future studies should control for factors such as prior knowledge, learning environment, and teacher effectiveness to isolate the impact of multimedia tools.

4. Comparative Analysis: Conduct cross-method comparisons to evaluate the effectiveness of CLT and DCT against other modern educational theories, such as constructivism or experiential learning.

5.6 Limitations of the Study

The study had a limited sample size, focusing on students from Class 1 and Class 2, which may limit the generalizability of the results. Future research should include a larger and more diverse group of participants to ensure broader applicability.

The research focused on short-term outcomes, assessing immediate gains in Chinese character recognition without examining long-term retention or skill transferability. Additionally, the controlled classroom setting may not fully reflect real-world learning environments, suggesting the need for studies in more naturalistic settings.

The study's subject-specific focus on Chinese character recognition limits its relevance to other disciplines or languages. Moreover, the absence of qualitative data, such as interviews or observations, leaves gaps in understanding students' perceptions and challenges. Future studies should incorporate qualitative methods to provide deeper insights.

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APPENDICES

Appendix A: Chinese Character Recognition Test

A.1 Test Instructions

Dear Student,

This test is designed to assess your ability to recognize Chinese characters. You will be presented with 12 Chinese characters. For each character, please:

1. Write the correct pronunciation (in Pinyin)
2. Combine words

You have 5 minutes to complete this test. Good luck!

A.2 Test Items

1. 晨 (chén) - morning
2. 绒(róng)-cloth with soft nap
3. 球 (qiú) - ball
4. 汉 (hàn) - Han (Chinese)
5. 艳 (yàn) - colorful/gorgeous
6. 服 (fú) - clothes/to serve
7. 装(zhuāng)-decorate
8. 扮 (bàn) - to dress up/pretend
9. 停 (tíng) - to stop
10. 静 (jìng) - quiet/still
11. 孔(kǒng)-hole
12. 雀(què)-sparrow

A.3 Scoring Rubric

For each character:

- Correct pronunciation: 1 point
- Correctly combine words: 1 point

Total possible score: 24 points (2 points x 12 characters)

A.4 Answer Sheet

Character: 晨
Pronunciation: _____
combine words: _____

Character: 绒
Pronunciation: _____
combine words: _____

Character: 球
Pronunciation: _____
combine words: _____

Character: 汉
Pronunciation: _____
combine words: _____

Character: 艳
Pronunciation: _____
combine words: _____

Character: 服
Pronunciation: _____
combine words: _____

Character: 装
Pronunciation: _____
combine words: _____

Character: 扮
Pronunciation: _____
combine words: _____

Character: 停
Pronunciation: _____
combine words: _____

Character: 静
Pronunciation: _____
combine words: _____

Character: 孔
Pronunciation: _____
combine words: _____

Character: 雀
Pronunciation: _____
combine words: _____

Total Score: _____ /24

Appendix B: Multimedia-Based Chinese Character Lesson Plan

B.1 Lesson Plan Design: Happy Literacy Journey

B.2 Teaching Objectives:

- Students can accurately read and write the 16 target Chinese characters
- Improve students' literacy interest and memory ability through fun activities.
- Test before and after class to assess the change in students' literacy level.

B.3 Teaching Object: third-grade students

B.4 Teaching Duration: 40 minutes

B.5 Teaching Materials:

- New word card (one for each word, front new word, back pinyin and simple explanation)
- Multimedia courseware (including word pictures, animation, audio, etc.)
- Pre-after-school test volume

B.6 Teaching Process:

1. Preparation before class (5 minutes)
   - Distribute pre-class test paper: It contains pinyin and word group for evaluating students' initial literacy level.
   - Introduce a new lesson: Play a relaxing and pleasant background music, and the teacher briefly introduces today's learning theme - "Happy Literacy Journey" to stimulate students' interest and expectations.

2. Learning new Words (20 minutes)
   - Multimedia display: Use multimedia courseware to display new words one by one, combined with pictures, animation, audio, etc., to help students establish the connection between new words and objects and situations.
   - For example: "Chen" - show the pinyin, list the words, and explain with interesting pictures.
   - New word card game: - Quick reading: The Teacher quickly produces new word cards, and students rush to answer pronunciation.
   - Group cooperative learning: - New word puzzle: The new word is divided into radicals and strokes, students work in groups to complete the puzzle, while discussing the meaning and usage of new words.

3. Consolidation Exercises (10 minutes)
   - Make up sentences: Encourage students to make up simple sentences using the new words they learned today, such as: "In the morning, I played football in the park." "I put on nice clothes and dressed up to go to school." And so on, in order to deepen the use and understanding of new words.

4. Summary and test after class (5 minutes)

• Summary review: Teachers and students review the new words learned in this lesson together, emphasizing the key and difficult points.

• Distribute after-school test sheets containing questions similar to pre-class tests to assess students' learning outcomes and literacy improvement.

• Encouragement and praise: students' progress and efforts are affirmed and encouraged, emphasizing the importance of continuous learning.

Homework:

• Ask students to write a short story with the new words they learned today, either about their day or an interesting story about their family, and encourage parents to assist and sign for confirmation.

Teaching reflection:

• After class, teachers should analyze the changes in students' literacy level according to the results of pre- and post-class tests, and adjust the subsequent teaching strategies and methods to ensure that every student can move forward happily in the journey of literacy.

This lesson plan integrates principles from Cognitive Load Theory and Dual Coding Theory by presenting information through multiple channels (visual and auditory) and breaking complex tasks into manageable parts. The interactive elements are designed to enhance engagement and provide immediate feedback, supporting the acquisition of Chinese character recognition skills.

Appendix C: Student Engagement Questionnaire

C. 1 Questionnaire Instructions

Dear Student,

We would like to know about your experience with the multimedia tools used to learn Chinese characters. Please answer the following questions honestly. There are no right or wrong answers. Your responses will help us improve the learning experience.

For each question, circle the number that best represents your opinion:

1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

C.2 Questionnaire Items

Student Engagement Items	1	2	3	4	5
I enjoyed learning Chinese characters using the multimedia tools.					
The multimedia tools were easy to use.					
The animations helped me understand how to write the characters.					
The audio pronunciations helped me remember how to say the characters.					
The interactive games made learning Chinese characters more fun.					
I found it easier to remember the meaning of characters with the visual associations provided.					
I prefer learning Chinese characters with multimedia tools compared to traditional methods.					
The multimedia tools helped me stay focused during the lesson.					
I feel more confident about my ability to recognize Chinese characters after using these tools.					
I want to continue using multimedia tools to learn more Chinese characters.					

C.3 Scoring Method

Each item is scored on a scale of 1 to 5, with 5 indicating the highest level of engagement or satisfaction.

To calculate the overall engagement score:

- Sum up the scores for all 10 items
- Divide the total by 10 to get an average score

Interpretation of average scores:
4.5 - 5.0: Very High Engagement
3.5 - 4.4: High Engagement
2.5 - 3.4: Moderate Engagement
1.5 - 2.4: Low Engagement
1.0 - 1.4: Very Low Engagement

C.4 Sample Questionnaire Form

[Student Name: _____] [Date: _____]

Student Engagement Items	1	2	3	4	5
I enjoyed learning Chinese characters using the multimedia tools.					
The multimedia tools were easy to use.					
The animations helped me understand how to write the characters.					
The audio pronunciations helped me remember how to say the characters.					
The interactive games made learning Chinese characters more fun.					
I found it easier to remember the meaning of characters with the visual associations provided.					
I prefer learning Chinese characters with multimedia tools compared to traditional methods.					
The multimedia tools helped me stay focused during the lesson.					
I feel more confident about my ability to recognize Chinese characters after using these tools.					
I want to continue using multimedia tools to learn more Chinese characters.					

Total Score: _____
Average Score: _____
Additional Comments: _____

This questionnaire is designed to assess students' engagement with the multimedia learning tools, their perceived effectiveness, and overall satisfaction with the learning experience. The results can be used to evaluate the impact of the multimedia approach on student motivation and learning outcomes, as well as to identify areas for improvement in the instructional design.

Appendix D: Validity

IOC Project Goal Consistency Index Score Sheet

No.	Questionnaire Item	Expert 1	Expert 2	Expert 3	Average Score	Interpretation
1	I enjoyed learning Chinese characters using the multimedia tools.	1	1	1	1.00	High consistency
2	The multimedia tools were easy to use.	1	1	1	1.00	High consistency
3	The animations helped me understand how to write the characters.	1	1	1	1.00	High consistency
4	The audio pronunciations helped me remember how to say the characters.	1	1	1	1.00	High consistency
5	The interactive games made learning Chinese characters more fun.	1	1	1	1.00	High consistency
6	I found it easier to remember the meaning of characters with the visual associations provided.	1	1	0	0.67	High consistency
7	I prefer learning Chinese characters with multimedia tools compared to traditional methods.	1	1	1	1.00	High consistency
8	The multimedia tools helped me stay focused during the lesson.	1	1	1	1.00	High consistency

No.	Questionnaire Item	Expert 1	Expert 2	Expert 3	Average Score	Interpretation
9	I feel more confident about my ability to recognize Chinese characters after using these tools.	1	1	1	1.00	High consistency
10	I want to continue using multimedia tools to learn more Chinese characters.	1	1	1	1.00	High consistency

Scoring Guidelines

- Average Score ≥ 0.67: The item is consistent with the research objective and is acceptable for use.
- Average Score < 0.67: The item lacks consistency and should be revised or removed.

Summary:

- Out of the 10 items, 9 achieved a high consistency score of 1.00, and 1 item scored 0.67, which is acceptable.
- The questionnaire items align well with the research objectives and provide a strong foundation for measuring the impact of interactive multimedia on literacy development.

Test

Here is the IOC Project Goal Consistency Index Score Sheet for evaluating the Answer Sheet for the 12 Chinese Characters questionnaire.

IOC Project Goal Consistency Index Score Sheet

Objective: To assess the alignment of the Answer Sheet content with the research goal of evaluating students' literacy skills using interactive multimedia tools.

No.	Questionnaire Item	Expert 1	Expert 2	Expert 3	Average Score	Interpretation
1	Character: 晨 - Pronunciation and combine words	1	1	1	1.00	High consistency
2	Character: 绒 - Pronunciation and combine words	1	1	1	1.00	High consistency
3	Character: 球 - Pronunciation and combine words	1	1	1	1.00	High consistency
4	Character: 汉 - Pronunciation and combine words	1	1	1	1.00	High consistency
5	Character: 艳 - Pronunciation and combine words	1	1	1	1.00	High consistency
6	Character: 服 - Pronunciation and combine words	1	1	1	1.00	High consistency
7	Character: 装 - Pronunciation and combine words	1	1	1	1.00	High consistency
8	Character: 扮 - Pronunciation and combine words	1	1	1	1.00	High consistency
9	Character: 停 - Pronunciation and combine words	1	1	1	1.00	High consistency
10	Character: 静 - Pronunciation and combine words	1	1	1	1.00	High consistency
11	Character: 孔 - Pronunciation and combine words	1	1	1	1.00	High consistency

No.	Questionnaire Item	Expert 1	Expert 2	Expert 3	Average Score	Interpretation
12	Character: 雀 - Pronunciation and combine words	1	1	1	1.00	High consistency

Scoring Guidelines

- Average Score ≥ 0.67: Item is consistent with the research objective and suitable for use.
- Average Score < 0.67: Item needs revision or removal due to lack of alignment with objectives.

Summary:

All items scored 1.00, reflecting high consistency with the research objectives. This questionnaire is valid for assessing students' pronunciation and word-combination skills in learning Chinese characters through multimedia tools.

BIOGRAPHY

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