IMPACT OF INTERACTIVE LEARNING TOOLS ON THE COGNITIVE DEVELOPMENT AND DANCE CREATIVITY OF SIXTH-GRADE SCHOOL LEARNERS

ATAO XU

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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Author Atao XU
Major Master of Arts (Education and Society)
Advisor Assistant Professor Dr. Phadet Kakham

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(Assistant Professor Dr. Phadet Kakham)

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(Associate Professor Dr. Tassanee Laknapichonchat)

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……
(Assistant Professor Dr. Yaoping LIU)
Director of the Institute of Science Innovation and Culture
Date……Month……..Year…..…

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ABSTRACT

This study aims to investigate interactive learning tools to enhance the cognitive development and creative skills of primary school learners in dance education and to examine whether primary school learners are satisfied with these tools. This study adopted the quantitative research method. Employing a quantitative approach, data were collected through questionnaires, lesson plans, and tests. The sample consisted of 159 sixth-grade students from Hope Primary School in Hubei Province, with 45 students in the experimental group using interactive learning tools and 45 in the control group receiving traditional instruction. The findings revealed that interactive learning tools significantly improved cognitive development and creative skills, with the experimental group outperforming the control group in post-test assessments. Furthermore, students generally perceived interactive learning tools positively, particularly regarding their satisfaction with course content. The conclusion emphasizes the potential of interactive learning tools to markedly enhance cognitive development and creativity in dance education while increasing student satisfaction. Future research is recommended to expand the sample size, conduct longitudinal studies, and explore the application of interactive learning tools across other artistic disciplines. The study's limitations include a restricted sample of sixth-grade students from a single school, a short study duration, and a primary focus on cognitive and creative development, omitting other significant areas such as emotional engagement, self-directed learning, and collaboration.

Keywords: Interactive Learning Tools, Cognitive Development, Dance Creativity, Primary School

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Atao XU

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CHAPTER I

INTRODUCTION

This chapter provides a comprehensive overview of the research study, outlining its context, purpose, and structure. It sets the stage for the entire research project, introducing the key concepts, research questions, and methodological approach that guided the investigation into the impact of interactive learning tools on cognitive development in dance creativity among primary school learners.

1.1 Background and Rationale

In the rapidly evolving landscape of primary education, interactive learning tools have emerged as powerful instruments for enhancing cognitive development across various subjects. Dance education, particularly in the realm of creativity, offers a unique opportunity to leverage these tools to foster cognitive growth in young learners. As dance combines physical movement with creative expression, it offers a rich environment for cognitive development, including spatial awareness, problem-solving, and abstract thinking (Koff, 2000).

Technology integration in education has been a growing trend over the past few decades, with interactive learning tools becoming increasingly sophisticated and accessible. These tools, which range from simple digital interfaces to complex virtual reality systems, have shown promise in enhancing engagement, motivation, and learning outcomes across various subjects (Mayer, 2019). However, their application in dance education, particularly in fostering creativity among primary school students, remains relatively unexplored.

Dance creativity develops students' ability to generate, refine, and express original movement ideas (Amalia, 2024; Koff, 2000). This process involves complex

cognitive skills, including divergent thinking, spatial reasoning, and kinesthetic awareness (Torrents et al., 2015). The potential for interactive learning tools to support and enhance these cognitive processes in the context of dance creativity is significant and warrants in-depth investigation.

In primary schools, integrating interactive learning tools into dance creativity education has the potential to revolutionize how students engage with and understand creative movement. These tools, ranging from digital visualization software to motion-sensing technology, provide new avenues for exploration, composition, and reflection (Calvert et al., 2005). For instance, motion capture technology enables students to visualize their movements in real-time, providing immediate feedback and encouraging them to experiment with their movements. Similarly, digital composition tools can enable students to manipulate and combine movement phrases in ways that might be physically challenging, thereby expanding their creative possibilities.

Moreover, integrating learning tools aligns with the broader educational goal of developing 21st-century skills. As students engage with these tools in their dance creativity classes, they develop skills, problem-solving abilities, and collaborative skills that are increasingly valued in today's technology-driven world (Partnership for 21st Century Skills, 2019).

This research investigates the impact of interactive learning tools on the cognitive development of learners in primary schools engaged in dance creativity. By examining factors such as tool type, frequency of use, and mode of implementation, this study aims to provide insights into the effectiveness of these tools in enhancing cognitive aspects of dance creativity, including dance fluency, originality, and choreographic problem-solving. The findings of this research will not only benefit primary schools in refining their approach to dance creativity education but also contribute to the broader understanding of technology integration in arts education. As more institutions globally consider incorporating interactive tools into their curricula, this study will provide valuable insights into the challenges, best practices, and potential

outcomes of such initiatives in the context of dance creativity and cognitive development.

Furthermore, this research has the potential to bridge the gap between dance education and cognitive science, providing empirical evidence on how creative movement, supported by interactive technology, can foster cognitive development in young learners. This interdisciplinary approach could pave the way for more integrated and holistic educational strategies that recognize the value of embodied learning experiences in the development process.

1.2 Research Questions

These research questions are designed to provide a comprehensive understanding of how interactive learning tools impact cognitive development in dance creativity education. They address various aspects of tool usage and cognitive outcomes, allowing for a nuanced exploration of the relationship between technology and dance creativity learning in primary education. With that, the research questions are formulated as follows:

1. How do interactive learning tools enhance the cognitive development of primary school learners in dance education?

2. How do interactive learning tools enhance the creative skills of primary school learners in dance education?

3. How do primary school learners feel about the interactive learning tools in dance education?

1.3 Research Hypotheses

Hypothesis 1: Interactive learning tools enhance the cognitive development of primary school learners in dance education.

Hypothesis 2: Interactive learning tools enhance primary school learners'

creative skills in dance education.

Hypothesis 3: The primary school learners are satisfied with the interactive learning tools in dance education.

1.4 Research Objectives

1.4.1 To investigate interactive learning tools to enhance the cognitive development of primary school learners in dance education.

1.4.2 To investigate interactive learning tools to enhance the creative skills of primary school learners in dance education.

1.4.3 To study whether primary school learners are satisfied with the interactive learning tools in dance education.

1.5 Scope of the Research

1.5.1 Scope of the Research

The scope of this study encompasses sixth-grade students participating in comprehensive dance courses at Hope Primary Schools in Hubei Province. With this specific group as the target, the research aims to explore the impact of interactive learning tools on their cognitive development and dance creativity. The geographical focus is on Hope Primary Schools in Hubei Province. As a vital component of regional education, students at Hope Primary Schools exhibit differences in learning resources and conditions of arts education compared to other schools, providing a typical sample for investigating the adaptability and effectiveness of interactive learning tools in this setting. The research subjects are sixth-grade primary school students enrolled in comprehensive dance courses. Students at this stage are in a crucial period of cognitive development, experiencing rapid advancements in logical thinking, imagination, and creativity. Through the comprehensive dance course, they gain access to arts education that stimulates their innovative consciousness and expressive abilities through

interactive learning tools. The study primarily delved into the facilitating role of these tools in enhancing cognitive and fostering creative expression in dance.

1.5.2 Contents

This study focuses on the integration and impact of interactive learning tools in dance creativity education at the primary school level. The study examined aspects of integrating interactive tools. The research did not delve into the technical interactive tools themselves, nor did it address the broader impact of technology in education outside the context of dance creativity.

The study involved 12-year-old primary school students engaged in dance creativity courses that use interactive learning tools. The research also included their dance educators, who provided valuable insights into tools and their perceived impact on students' cognitive development. During the research process, participants' information was kept confidential and protected. The sample selection adheres to the principle of voluntariness, with students' willingness to participate determining their inclusion in the study. Given the students' young age, this research sought parental guidance and obtained consent from their guardians before conducting the survey.

1.5.3 Research Method

This study employed a quantitative approach to examine the effects of interactive learning tools on the cognitive development and creative skills of grade 6 learners in dance education. This design allows for a comprehensive investigation of both measurable cognitive progress and the more subjective aspects of creativity in dance education.

In the study, tests measure the impact of interactive learning tools on the cognitive development and dance creativity of sixth-grade students. Pre- and post-tests assess the changes in these aspects resulting from the interactive learning tools. The combination of surveys, pre-tests, and post-tests ensured the rigor of the experiment, allowing for a robust analysis of the influence of interactive learning tools on the cognitive development and dance creativity of sixth-grade students. The survey

questionnaires investigate the satisfaction levels of primary school students with interactive learning tools in dance education. Students' evaluations determined the satisfaction.

This study aims to provide a holistic understanding of how interactive learning tools impact both cognitive growth and creativity in dance education. The quantitative data will offer measurable outcomes, ultimately contributing to a more comprehensive analysis of the effectiveness of interactive learning tools in dance education.

1.5.4 Duration

The research was conducted over 3-4 months, allowing for the observation of interactive tool integration across different stages of the dance creativity curriculum. This timeframe enabled the collection of data, providing insights into:

The initial implementation and adaptation phase of using interactive tools.

The development of students' proficiency with the tools over time.

The progressive impact on cognitive development throughout the academic year.

However, this duration may not capture long-term trends or the full impact of curriculum changes implemented during the study period. It also does not account for potential seasonal variations in student performance or engagement. These scopes and limitations define the boundaries of the research, ensuring that the study remains focused and manageable while acknowledging the constraints that may affect the generalizability and interpretation of the findings.

1.6 Research Framework

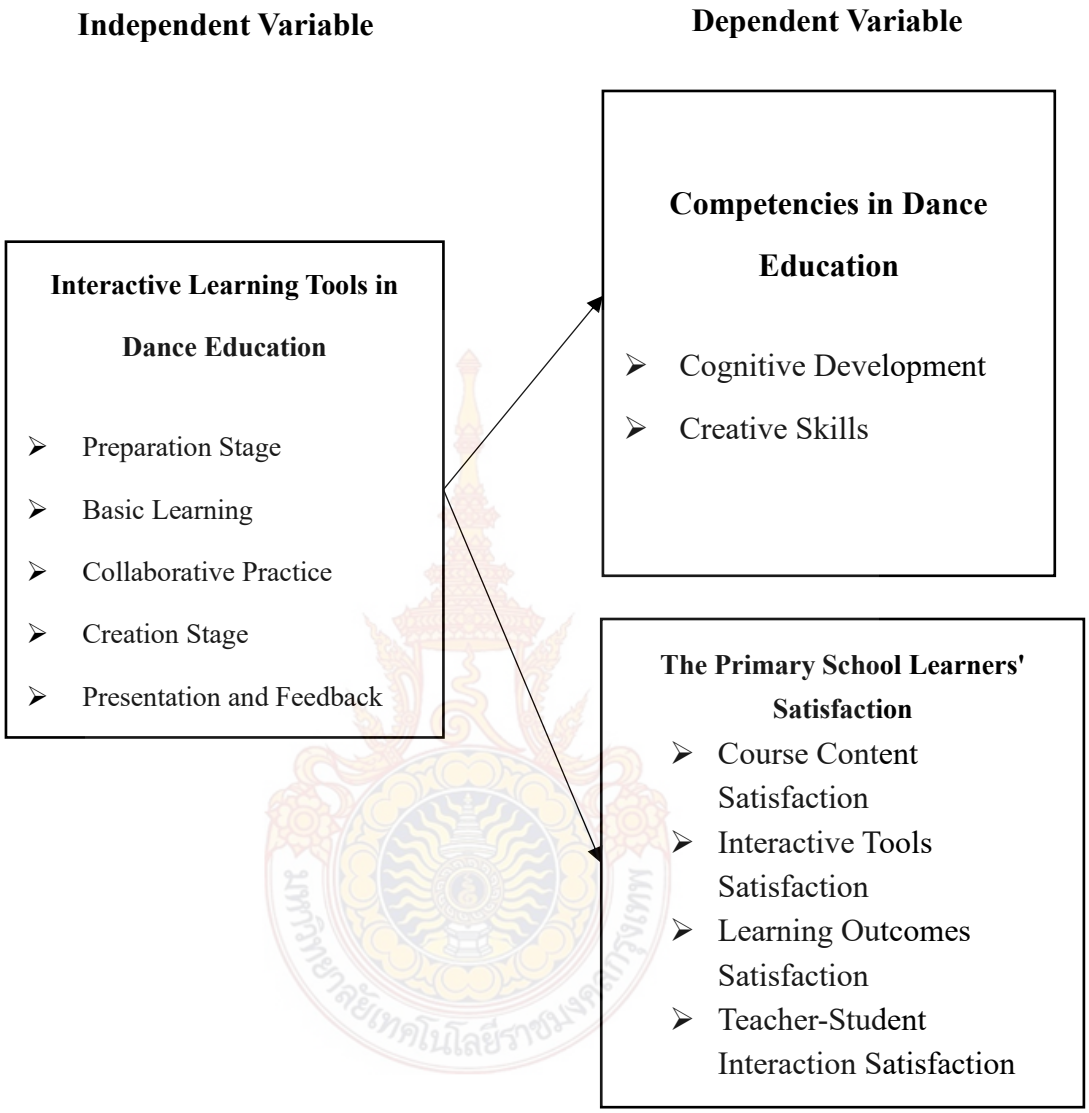

Figure 1.2 Research Framework

The research framework is structured around two key variables. The independent variable is the use of interactive learning tools in dance education, and the primary intervention being analyzed. The dependent variable is the competencies in dance education, encompassing students' cognitive development, creative skills, and overall dance performance. This framework explores how the application of interactive learning tools influences the development of these competencies in dance education.

1.7 Definition of Key Terms

1.7.1 Interactive Learning Tools in Dance Education

The interactive learning tools in dance education refer to the interactive tools to facilitate the learning process of sixth-grade students at Hubei Province's Hope Primary School in their integrated dance curriculum. The process encompasses stages such as preparation, learning, collaborative practice, creation, presentation, feedback, summation, and enhancement. These tools comprehensively support students' cognitive development and dance creativity by breaking down movements, providing real-time corrections, fostering creative design, offering data-driven feedback, and helping them achieve the course objective more effectively.

Go Noodle: an interactive platform tailored for children. It promotes physical activity and learning through engaging videos and activities. Its features encompass guided dances, fitness exercises, and educational content, making it suitable for use in school classrooms or at home. It helps enhance children's concentration, coordination, and overall health.

Choreo Maker: an application designed explicitly for choreographers and dancers, aiming to assist users in visualizing, integrating, and rehearsing their works on tablets and smartphones. The app supports solo, duo, and group choreographies of up to 100 dancers, catering to various dance forms including jazz, ballet, modern dance, Latin dance, street dance, and more. Choreo Maker is designed to enable choreographers to match dance moves to specific moments in music, resulting in seamless performances.

1.7.2 Cognitive Development

It refers to the enhancement of students' thinking abilities, memory, comprehension, analytical skills, and related aspects during dance education. In dance learning, students develop their cognitive and control abilities through understanding the structure, rhythm, and expression of dance movements. Gradually, they acquire critical thinking and problem-solving skills.

1.7.3 Creative Skills

It denotes innovative thinking, artistic expression, and autonomous creative abilities during dance creation and performance. With interactive tools, students can freely design and adjust dance movements, engage in personalized creation, embody their artistic styles, and promote diversity and uniqueness in dance expression.

1.7.4 Primary School Learners' Satisfaction

Primary school learners' satisfaction refers to their satisfaction with various aspects of their learning experiences during the elementary school phase, including course content, teaching methods, learning tools, teacher-student interaction, and other factors. Satisfaction measures learners' evaluations of their classroom experiences, reflecting the pleasure, engagement, and sense of accomplishment they gain during the learning process. By assessing learners' satisfaction across the following four key dimensions, we can gain a comprehensive understanding of their perceptions and feelings towards their learning experiences:

Course Content Satisfaction: Learners' satisfaction with the interest, difficulty, and richness of dance course content, and its ability to stimulate their learning interest.

Interactive Tools Satisfaction: Learners' evaluations of the operability, interactivity, effectiveness, and extent to which the interactive learning tools (such as videos, applications, etc.) aid their learning.

Learning Outcomes Satisfaction: Learners' satisfaction with their perceived progress in cognitive abilities and dance skills reflects their satisfaction with learning effects and personal sense of accomplishment.

Teacher-Student Interaction Satisfaction: Learners' satisfaction with teachers' guidance methods, communication and interaction, care and support, and how teachers use interactive tools to help students improve.

CHAPTER II

LITERATURE REVIEW

This chapter provides an overview of the relevant literature and key concepts related to the research topic. The following concepts and contents will be introduced：

2.1 Related Theories

2.1.1 Constructivism Theory

A related perspective, constructivism, based on the writings of Jean Piaget and Lev Vygotsky, posits that knowledge develops from experiences arising from an individual's interaction with their environment. For example, constructivism provides substantial theoretical grounds for believing that interactive learning tools should have a positive impact on students' learning in primary schools. It emphasizes the learner being an active participant in the learning process, engaging with content, experimenting, and thereby gaining understanding through working and reflecting (Korucu-Kış, 2021). The remainder of what is typically referred to as constructivist learning involves interactive designs, such as digital apps, virtual reality (VR), or instructional software, that provide students with a vehicle for interacting with content in dynamic and meaningful ways.

Interactive learning tools are designed to be appealing and engaging, but they should also encourage active participation from learners. Constructivist theory posits that this engagement is essential for understanding learning (Lombardi, 2008; Strommen et al.). Interactive tools, when used in dance education for primary school children, encourage learners to participate actively and are no longer just receivers. Digital tools, such as students orchestrating their choreographic combinations on a screen or manipulating movement through dance interfaces, evoke Piagetian cognitive

development theories through active discovery (Vogelstein, 2022). These tools support learners through a trial-and-error approach, which is essential for grasping concepts.

Additionally, his theory of the Zone of Proximal Development (ZPD) is particularly relevant to interactive learning tools. ZPD refers to the tasks one can accomplish with the guidance of another individual, such as a teacher, peer, or interactive tool (Alghamdy, 2024). For example, interactive resources provide guided feedback, hints, and scaffolding to help learners overcome challenges that they may not be able to accomplish independently. Such tools, which assist with posture, rhythm, and movement, provide timely feedback to the student, ensuring focus on activities outside one's current ability range to stimulate cognitive development within their ZPD.

Interactive learning tools can also be seen as tools for constructivists who emphasize the integration of social processes. Most of these tools come with collaborative features that enable students to work together, share their progress, and learn from one another. This partnership is not only inspirational but also enriches the educational process by providing students with diverse perspectives and concepts. Perhaps in a dance class, students use an app to collaborate on creating choreography, each bringing their steps (Hsia & Hwang, 2021). This social component fosters a deeper understanding of dance as an art form and challenges students to think critically about how steps flow seamlessly into one another in performance.

Constructivism also encourages context-based learning, which involves connecting new knowledge to the learners' prior understanding and experiences (Jasper-Abowei & Victor-Ishikaku, 2023). Some interactive teaching elements provide lessons accompanied by contextualized content, such as dance routines from other cultures or dances that students may encounter in the future. Here, these tools connect new information to what students already know, so that understanding is genuine and learning progresses from abstract to concrete. This is especially relevant in primary school, where students are acquiring many foundational cognitive skills that will help them progress in their future schooling.

2.1.2 Multiple Intelligences Theory

The theory of Multiple Intelligences was first formulated over 20 years ago by Howard Gardner in his groundbreaking book, which frames intelligence primarily as cognitive, emphasizing the range of how quickly or slowly one is in studies. Different types of intelligence are distinct and relatively independent of one another. Regarding the cognitive development of dance-creativity learners, Gardner's theory provides insight into how these varying intelligences are relevant to primary-aged children during their creative and intellectual growth as they engage in a Dance educational program at school. The theory, in particular, pointed to bodily-kinesthetic, musical, and spatial intelligences as fostering dance creativity (Kassing & Jay, 2020).

When considering dance, given its apparent connection with body movement and manipulation (bodily-kinesthetic intelligence), children with high bodily-kinesthetic intelligence in primary school are often gifted in activities that require physical movement, bodily coordination, and balance. As dance is a collection of body expressions, it activates this intelligence in students by engaging them and encouraging maximum physical activity (Vancea, 2020). In the concept of Dance creativity learners, cognitive development is evident through bodily-kinesthetic intelligence (the ability to translate abstract ideas and emotions into physical movements). The translation process for words, etc., is a much more cognitively demanding task, involving activities such as planning, problem-solving, and memory, which can also be enhanced through dance practice.

Besides bodily-kinesthetic intelligence, musical-rhythmic intelligence adds to dance creativity. Musical intelligence refers to the ability to discern pitch, rhythm, timbre, and tone. This intelligence is essential for understanding time, rhythm, and, therefore, for musical interpretation in dance. Primary school children with good musical intelligence. These activities also promote the cognitive development of these learners as they need to move in time with music, follow musical cues, and choreograph movements that represent the emotional element of a piece.

Dance creativity also requires spatial intelligence, which involves mentally visualizing and manipulating objects within a specific spatial context. Dance is performed with an awareness of space, encompassing the spatial relationships among different parts of the body, how one moves in relation to other dancers (if any are present), and how movement patterns form a cohesive composition. It is this knack for understanding spatial relationships that facilitates their entrance into more complex choreographies and the thoughtful, well-crafted dance routines seen here in younger dancers (if not necessarily as precise). The mental imagery of dance sequences itself contributes to their cognitive development, as it forms an understanding of the spatial component through a process in which learners anticipate and adjust to any changes in the overall context (Zardi et al., 2021).

Gardner's theory also holds that multiple intelligences interact in complex ways, and that movement plays a crucial role in creative activities such as dance. For example, a student of dance creativity would use bodily-kinesthetic intelligence to enact movements and musical intelligence to keep time with the music, in addition to their spatial intelligence, as they navigate through space during a performance. The combination of different types of intelligence is a significant component of cognitive development among dance creativity learners, as it characterizes the holistic context within which creative thought and problem-solving occur in a dance setting (Gao et al., 2021).

2.2 Interactive Learning Tools

2.2.1 The Definition and Steps of Interactive Learning Tools

In dance education, the application of interactive learning tools is gradually becoming a vital means of enhancing students' learning outcomes (Lykesas et al., 2020). These tools help stimulate students' interest in learning, enhance classroom interaction, and foster the development of their cognitive and creative abilities. Interactive learning tools in dance education are instruments that facilitate students' learning in

comprehensive dance curricula, spanning stages such as preparation, learning, collaborative practice, creation, presentation, feedback, and reflection and improvement (Carmona, 2021). Through methods such as motion decomposition, real-time correction, creative design, and data feedback, these tools comprehensively support students' cognitive development and dance creativity, enabling them to achieve course objectives more effectively (Washbrooke, 2023).

Step 1 Preparation Stage

During the preparation stage, interactive learning tools typically introduce multimedia resources, video demonstrations, or virtual character displays of dance movements to help students engage with the course content and establish learning goals (Zardi et al., 2021). According to existing research, many educators have found that visual and audio resources can effectively attract students' attention and provide intuitive learning materials (Bojner Horwitz et al., 2022). Virtual dance tutors and simulated environments allow students to preview dance movements and rhythms before entering the classroom (Angelov, 2023).

Step 2 Basic Learning

In the bare learning stage, interactive learning tools help students break down dance movements and gradually master techniques. Studies show that, through virtual environments and motion capture technology, students can gain a clearer understanding of the composition of complex dance movements and adjust their movements in real time (Vancea, 2020). This technological support enables students to receive personalized guidance during independent learning, thereby effectively improving the accuracy of their movements (Li, 2021).

Step 3 Collaborative Practice

During the collaborative practice stage, interactive learning tools provide a platform for students to engage in teamwork and practice within groups. Recent educational research has found that online collaboration tools, interactive platforms, and virtual stages can promote teamwork and interaction (Kirakosian et al., 2021),

especially in dance performances. Real-time feedback and collective practice help students coordinate and perform in unison. These tools enhance team member collaboration, strengthening their awareness of collaboration and collective performance (Kirakosian et al., 2021).

Step 4 Creation Stage

In the creation stage, students can utilize interactive learning tools to compose dance movements, set movements, and arrange dance sections, thereby expressing their creativity. Multiple studies indicate that when using interactive design tools, students can more freely express personalized creativity and create their dance works through virtual editors or applications (Li, 2021). The flexibility and creative support provided by these tools foster students' innovative thinking and artistic expression (Multazam et al., 2023).

Step 5 Presentation and Feedback

The presentation stage is a critical application scenario for interactive learning tools. Students showcase their dance works on virtual stages and video platforms (Bojner Horwitz et al., 2022). Feedback and evaluation are crucial to effectiveness. Research has shown that students receive feedback through interactive tools such as recording and playback functions, which help them identify deficiencies in their movements and make self-adjustments. This instant feedback mechanism significantly enhances students' reflective abilities and self-correction capabilities (Multazam et al., 2023).

Step 6 Reflection and Improvement

Interactive learning tools also help students review and improve their learning process during the reflection and improvement stage. Through data feedback, motion analysis, and learning records, students can make progress and build upon this foundation for self-improvement (Li, 2021). Some advanced interactive tools can even analyze students' movements through artificial intelligence to provide specific improvement suggestions, further enhancing their skills (Chan et al., 2019).

The application of interactive learning tools in dance education spans multiple stages, from preparation to reflection and improvement, comprehensively supporting students' cognitive development and dance creativity through motion decomposition, real-time correction, creative design, and data feedback (Kirakosian et al., 2021). Literature suggests that these tools increase students' motivation and provide an efficient learning experience (Lykesas et al., 2020). As technology continues to advance, interactive learning tools in dance education will become increasingly widespread, serving as an essential resource for promoting students' comprehensive development (Angelov, 2023).

2.2.2 The Importance of Interactive Learning Tools

The invention of these interactive learning tools has completely revolutionized the way dance is taught and learned, making it more relatable to everyone. Some are mobile apps meant to safely try with you a new “trial-and-error” method, coupled with the learning styles, and a few others for more intermediate dancers who want perfect moves from around the world that have been previously taught. This personalization element is a significant advantage of interactive learning tools in dance. In dance, you rely on your instructors to correct posture and timing as well as technique. Now, thanks to AI-powered apps and video analysis software, dancers can get real-time feedback on their movements. These tools take a dancer performing in real time and identify the parts of their movement that are ineffective, then suggest ways to improve them. Providing dancers with immediate, personalized feedback helps expedite the learning process and gives them those little twinges that we discussed in class right away, rather than waiting until next time (Danesh et al., 2021).

Furthermore, interactive learning tools take one step closer to making dance accessible to even those who cannot afford traditional dance classes. The online platform offers a diverse range of dance forms, including classical ballet, modern contemporary, and hip-hop, allowing enthusiasts to explore different styles from the

comfort of their own homes. They typically employ tutorial-based learning, incorporating video demonstrations, interactive code exercises, and personal tutors to facilitate learning (Multazam et al., 2023). The kind of democratization that dance education makes possible is that — regardless of your background, where you live, or your financial situation (or lack thereof)— everyone has the opportunity for quality instruction in dance.

The interactive learning tool creates a community of students. Dance apps and online platforms also offer social features that enable dancers to connect, track their progress, and even co-create choreographies (Li, 2021). This community-style feeling is one of dancers being excited and motivated, stoking each other's fires, and learning something new from those walking a similar path. In addition, these websites host online competitions and workshops, where budding dancers can use the platform to refine their skills by learning from the crème de la crème of the dance industry.

The traditional world of dance education is no exception to this change, as virtual reality (VR) and augmented reality (AR) are emerging technologies (Kirakosian et al., 2021). Through VR, a dancer can be transported to virtual dance studios to follow along with instructors or even attend performances. On the other hand, using AR allows a dancer to have instruction steps or visual cues overlaid onto their real-life surroundings, making it easier for them to learn. Gladly, new technologies are introducing an interactive, immersive way of learning into the educational process.

The integration of Virtual Reality (VR) and Augmented Reality (AR) technologies has further transformed the landscape of dance education. VR allows dancers to immerse themselves in virtual dance studios, where they can follow along with instructors or participate in virtual performances. This technology offers a highly immersive learning experience that simulates real-world dance environments (Kirakosian et al., 2021). AR, on the other hand, overlays instructional steps or visual cues onto the dancer's real-world environment, enhancing the learning process by providing immediate visual guidance (Chan et al., 2019).

Recent studies have shown that VR and AR technologies can significantly enhance spatial awareness and movement precision in dance training. For instance, Hsieh and Lee (2018) found that VR-based dance training improved participants' ability to perceive and replicate complex spatial patterns in choreography. Similarly, Yan et al. (2020) demonstrated that AR-based feedback systems can enhance dancers' proprioception and movement accuracy, particularly during the learning of intricate gestures and poses.

These technological advancements are introducing more interactive and immersive ways of learning, bringing unprecedented dynamism to the dance education process. As these tools continue to evolve, they promise to revolutionize dance education further, making it more engaging, personalized, and effective.

2.3 Cognitive Development

Research on the cognitive basis of dance is fragile. However, several findings can be noted: The most critical instrument for ballet choreography appears to be a lead limb that indicates an approximately in-phase relationship with two co-choreographed limbs; different kinds of inhibition tend not to be translatable between verbalizing and executing balance-steering or walking plans. Dance as an art form is not just about physical ability; it also involves cognitive processes that foster creativity and innovation (Lykesas et al., 2020). The relationship between cognitive development and dance creativity: problem-solving, memory recall, relation to space around us (spatiality), and affective expressions.

Cognitive Development: One of the primary functions of dance creativity is to improve problem-solving skills, which are an integral part of our daily lives. Dancing frequently involves choreography, in which dancers learn to think critically about a series of movements, transitions, and the story they want to tell (Walton & Mackay, 2022). This approach to choreographic invention involves identifying a problem or idea and exploring multiple solutions through movement to communicate

effectively. When rehearsing for any performance, dancers are trained in divergent thinking; they are rarely taught that there might be only a single “correct” answer to a dilemma, but instead must generate many creative solutions to overcome just one hurdle. These problem-solving skills extend beyond dance, which is what makes dancers so cognitively flexible and easily adaptable in life.

Memory also significantly contributes to dance creativity by enabling the recall of complex movement sequences. Development in this area of cognition will enhance a dancer's ability to memorize and perform choreography with accuracy, as well as to integrate movement into more informed and expressive movements. Learning the choreography requires a mix of short- and long-term memory as you practice the sequence, as well as unfamiliar, more complex dance moves (Carmona, 2021). Regularly working on memory exercises develops dancers' memory skills and enhances their capacity to think creatively by allowing them to interpret and create artistic impressions while executing choreography. Creative memory and re-creative resilience reflect a level of cognitive dexterity characteristic of the accomplished dancer, a testament to the synergy between cognition and creative output that occurs in dance.

Spatial awareness is another critical cognitive skill for a dancer to develop to generate creative dance ideas. Dance Scape, amidst so much skill on display, requires dancers to always keep in mind their position within the space, the proximity of other dancers, and how their moves affect others (Washbrooke, 2023). This spatial awareness is not just about where people are in space, but also about the abstract plane of a dancing performance — how we create visual patterns or emotions through our movements. This section of cognitive development enables dancers to experiment more creatively with space, exploring a range of possibilities for movement in the air and occupying and defining the area around them. This visual ban plays a significant role in creating fresh, eye-catching dance pieces.

Dancing emotions are integral to cognitive developmental processes and play a crucial role in the creative dance experience. Dance has the power to

communicate intricate emotions and narratives without a single word. Dancing also helps significantly, as it requires one to develop the cognitive ability to connect with and express emotions through movement (Bojner Horwitz et al., 2022). This involves recognizing the music, movements, and emotions to be portrayed in a performance.

2.4 Creative Skills

Dance artists are the people who enjoy and are capable of creating Dance Expression. With everyone, from beginner-level dancers to professionals, bringing their inimitable focus and ability into their part of the creative energy. Dance creativity students are lifelong learners who engage in a creative process journey heavily weighted toward learning for autonomy, experiential discovery, and novelty in movement-making (Coogan, 2021).

The early stages of dance creativity, after all, must be preceded by solid training in dance technique. This foundation is important as it provides the tools necessary for a creative outlet. As novices gain a better understanding of fundamental moves, they are more able to experiment with twisting them or combining and transforming pieces into something entirely new (Gray & Banerjee, 2021). That kind of experimentation lies at the core of dance creativity, and students are encouraged to drill through conventional techniques in order to find their voice. Experimentation clearly encourages curiosity, but more importantly, it brings learners into the open where they can access their creative voice.

Another vital aspect of dance creativity learning is imaginative exploration. This is when people draw on their secrets, feelings, and past experiences to inspire movement. Students studying dance creativity are frequently led in exercises that foster divergent thinking, such as improvisation, responding to and interpreting music or other art forms (visual arts, poetry), and creating narratives using movement vocabularies (Crow & Tlhpe, 2020). We can start to see how the inner runs deeper into expression, and this is where more untainted original dance moves will come from in student

choreography. It also helps learners be more emancipated from the usual ideas of choreography and instead form movements that resonate with themselves.

As dance creativity develops, students gain greater confidence in their creative abilities. This confidence is built through praise, feedback, and having platforms to exhibit their work. Learners gain constructive feedback on how their work is viewed and where it can be improved by presenting creative pieces to peers, teachers, or an audience. Sharing your work and receiving feedback on it is crucial for improvement, as it challenges students to reconsider the conclusions they made during an activity (Carless, 2022). Developing dance confidence also allows students to be more comfortable taking risks, pushing boundaries, and stepping into the unknown (all critical components of the creative process).

Take into account that collaboration is another vital element in learning dance creativity. The act of working with others to share insight, gather another's viewpoint, and create together (Tang et al., 2020). More often than not, teamwork yields innovative outcomes that would be unattainable through solo efforts. In dance, creativity and collaboration foster teamwork and communication, as well as the ability to shift between styles or ideas. It also enhances their adaptability, which is crucial for any dancer, as they are constantly in various environments.

2.5 The Primary School Learners' Satisfaction

Research examining the satisfaction of primary school learners has primarily focused on students' overall satisfaction with dance education, particularly the dimensions of course content, interactive tools, learning outcomes, and teacher-student interaction.

Course Content Satisfaction

Satisfaction with course content involves students' evaluations of their interest in the curriculum, its difficulty, and its richness. Studies reveal that fun, appropriately challenging course content is a pivotal factor influencing student

satisfaction (Bojner Horwitz et al., 2022). When students perceive dance courses as innovative, their engagement and satisfaction with the curriculum significantly increase. Dance courses should be tailored to students' ages and skill levels to ensure that the content is enjoyable and stimulating, effectively enhancing student satisfaction. Additionally, the diversity of course content is a critical factor, as research shows that varied course settings can continuously spark students' interests (Kirakosian et al., 2021).

Interactive Tools Satisfaction

With technological advancements, interactive learning tools in dance education have become an integral part of students' learning experiences. Literature suggests that students' satisfaction with interactive tools is a key determinant of their effectiveness in supporting learning. Interactive tools enhance the learning process, feedback, and personalized learning experiences (Li, 2021). Research indicates that students are more satisfied with interactive tools that are easy to use and provide immediate feedback, particularly regarding precision and rhythm in dance movements (Washbrooke, 2023). However, the effectiveness and interactivity of these tools remain major factors influencing student satisfaction.

Learning Outcomes Satisfaction

Satisfaction with learning outcomes primarily reflects students' perceptions of their cognitive abilities and improvements in dance skills. Numerous studies show that students have high expectations for the learning process and hope to achieve visible results through their efforts (Gray & Banerjee, 2021). In dance education, students often measure their learning effectiveness by evaluating improvements in movement completion, dance fluidity, and creativity. Direct feedback on learning outcomes, such as real-time video playback and movement analysis, helps students recognize progress, thereby enhancing their sense of accomplishment and satisfaction (Crow & Tlhpe, 2020). Research indicates that students' satisfaction is higher when they perceive progress in dance courses.

Teacher-Student Interaction Satisfaction

Teacher-student interaction is one of the factors influencing student satisfaction. Good teacher-student interaction not only helps students better understand and master dance techniques but also increases their motivation to learn and emotional engagement. (Chan et al., 2019) Research indicates that teachers' positive feedback, encouraging words, and personalized guidance help students boost self-confidence and enhance their learning experience (Kirakosian et al., 2021). The way teachers use interactive tools to support teaching also significantly impacts student satisfaction. Research shows that teachers actively utilizing interactive tools for real-time corrections and guidance in class can significantly enhance students' sense of participation and trust in teachers, thereby increasing their overall satisfaction.

The literature on primary school learners' satisfaction reveals the profound impact of course content, interactive tools, learning outcomes, and teacher-student interaction on students' satisfaction. Studies show that enjoyable and challenging course content, user-friendly and highly interactive learning tools (Multazam et al., 2023), clear feedback on learning outcomes, and active and effective teacher-student interaction are all key factors in enhancing student satisfaction. With technological advancements, especially the ongoing development of interactive learning tools (Coogan, 2021), these factors in dance education will continue to strengthen, providing students with more personalized and efficient learning experiences.

2.5.1 Research on the Relationship between Interactive Learning Tools and Cognitive Development and Creative Skills of Primary School Students

Recent years have witnessed an increasing scholarly focus on how technological tools impact cognitive and creative enhancement in dance education for primary school students, particularly interactive learning tools that facilitate cognitive development and creative skills.

Interactive Learning Tools and Cognitive Development

In dance education, cognitive development refers to the student's cognitive

abilities as they learn dance movements, understand dance expressions, and improve body control (Li, 2021). Research has shown that interactive learning tools significantly boost students' cognitive skills, particularly in movement decomposition, rhythm sense, and spatial awareness (Horwitz et al., 2022). Studies indicate that video tutorials and real-time feedback tools help students better understand the structure of complex dance movements. Through these tools, students can repeatedly view and analyze dance movements, deepening their memory and understanding of dance skills (Multazam et al., 2023). Technological tools also enhance students' cognitive engagement through interactivity (Gray & Banerjee, 2021). Scholars have employed Virtual Reality (VR) for dance training, providing an immersive learning experience while helping students develop spatial perception by simulating dance environments (Crow & Tlhpe, 2020). VR technology enables students to understand the structure and movement pathways, leaving a profound cognitive impression and influencing their mastery of dance techniques.

Interactive Learning Tools and Creative Skills

In dance education, creativity refers to the unique artistic expression and innovative thinking when choreographing and performing dances. Numerous studies have shown that interactive learning tools significantly promote students' creative thinking and artistic expression (Multazam et al., 2023). Research about interactive design tools for dance creation can stimulate students' creative potential (Coogan, 2021). These tools provide students with movement options and freedom to create, enabling them to explore their styles and enhance their innovative abilities. Studies also show that during the creative process, students can better demonstrate their creativity through interactive tools such as motion capture technology and dance choreography software (Carmona, 2021). With motion capture technology, students can instantly view changes in movement, and virtual demonstrations help them discover new ideas and possibilities in dance creation (Chan et al., 2019). This highly interactive learning approach fosters students' autonomy in dance creation, stimulates their creativity, and enhances their

understanding of dance expression.

Some studies comprehensively explore the dual impact of interactive learning tools on the cognitive development and creative skills of primary school students. Interactive learning tools not only help students master the basic skills of dance movements but also encourage them to create and express themselves based on these skills (Vancea, 2020). These tools enhance students' cognitive abilities by breaking down complex movements, providing immediate feedback, improving spatial perception, and stimulating their creative potential by granting them freedom and flexibility in creation (Kassing & Jay, 2020). The comprehensive application of interactive learning tools in dance teaching can break the limitations of traditional classrooms and provide personalized learning paths (Washbrooke, 2023). These tools support students in gradually establishing cognitive frameworks during autonomous learning and stimulate their desire to explore creation through modules such as movement analysis, rhythm practice, and choreography design, and undergo cognitive development (Chan et al., 2019).

Interactive learning tools are gradually gaining widespread application in elementary education. These tools actively engage students in learning through gamified scenarios, dynamic videos, task challenges, and other innovative methods. Research has shown that this teaching mode affects cognitive development and innovation capabilities. Interactive learning tools can effectively enhance elementary students' abilities, particularly in attention, memory, and problem-solving skills (Kassing & Jay, 2020). Studies indicate that elementary students have relatively short attention spans, and interactive learning tools, through their engaging and instant feedback mechanisms, can help extend students' focus duration and foster better cognitive habits during the learning process (Gray & Banerjee, 2021). Through dance or fitness activities provided by the platform, students complete complex movement combinations based on-screen instructions. These exercises improve their physical coordination and enhance the efficiency of visual and auditory information processing.

Interactive task designs often include rules and task accomplishment, which help cultivate students' logical thinking and judgment (Crow & Tlhpe, 2020).

Interactive learning tools also positively impact students' innovation capabilities. These tools offer open-ended activities that encourage students to explore and express themselves autonomously. In creative learning dance, students can develop independent thinking and creative expression abilities by freely selecting movements and paths. The collaboration features of interactive tools also provide opportunities for students to work in teams, stimulating more inspiration through discussion and sharing (Multazam et al., 2023). Many researchers believe that a learning environment promotes students' imagination and creative thinking. Some studies indicate that the effectiveness of interactive learning tools depends on their implementation and teachers' guidance strategies. Without a well-designed curriculum and guidance, students may focus solely on game elements, overlooking learning objectives (Coogan, 2021). In the application of interactive learning tools, teachers play a crucial role. They need to guide students in transforming game experiences into knowledge construction and stimulate their deep thinking through timely questioning and feedback.

In summary, interactive learning tools offer new opportunities to cultivate cognitive development and innovation among elementary students. With the further development of educational technology, optimizing tool design, enhancing teaching strategies, and achieving a balance between educational objectives remain important directions for future research.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design

The study adopted a quantitative methodology to provide a comprehensive understanding of the research problem. The purpose is to gain an in-depth, empirical understanding of the impact of interactive learning technologies on the cognitive development and creative expression of primary school students at a specific grade level. This approach demonstrates the statistical significance of effectiveness and provides insight into both learner experiences and educator perspectives (Vancea, 2020). The study employed a quasi-experimental design, recruiting and comparing an experimental group with a control group under pre- and post-test conditions. In all cases, the educational design (dance curriculum) was implemented alongside a set of interactive learning technologies. Consequently, these offered a much broader perspective on students' creativity and cognitive growth.

The research provided learners with pre- and post-tests to measure their cognitive improvement using standardized examinations. Questionnaires were used to measure students' satisfaction with the learning tool. The data collected included videography of the process and interactions with interactive technologies, enabling real-time observation of students' engagement with creative processes. The quasi-experimental design enabled data collection in organic contexts and real-life primary school dance programs where the learning tools are already operational. Standardized data-collection instruments were used in this research design to ensure consistency and reliability across the sample. The overarching perspective was expected to facilitate a more in-depth understanding of the contribution of interactive learning tools to promoting cognitive growth in learners through dance creativity in primary school settings.

3.1.1 Questionnaires

The questionnaire was developed to assess primary school students' satisfaction with interactive learning tools in dance education. The study targeted students enrolled in primary school dance courses, focusing on learners who use interactive learning tools (such as instructional videos, educational applications, or virtual reality) in the classroom. The questionnaire design emphasized subjective experiences and their practical effects on students. The questionnaire covered a range of topics, including course materials, teaching methods, learning tools, and teacher-student interaction. Data collection was conducted anonymously to ensure that students feel comfortable expressing their feelings. The questionnaire design prioritized concise and easy-to-understand language, catering to the cognitive level of primary school students and avoiding complex expressions. The questionnaires were distributed offline and completed after class with teacher assistance to ensure convenience and comprehensive data collection. The satisfaction questionnaire for interactive learning tools in dance education included 5 items per dimension, using a 5-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Course Content Satisfaction: Learners' satisfaction with the fun, difficulty, and richness of the dance course.

Interactive Tools Satisfaction: Students' evaluation of the operability, interactivity, and effectiveness of interactive learning tools, and the extent to which learning is affected.

Learning Outcomes Satisfaction: Learners' satisfaction with their cognitive abilities and skill progress reflects their satisfaction with learning outcomes and their personal sense of achievement.

Teacher-Student Interaction Satisfaction: Learners' satisfaction with teachers' guidance methods, communication, interaction, care, and support, as well as how teachers use interactive tools to support students' improvement.

3.1.2 Lesson Plan and Test

Lesson Plan

The lesson plan focused on the application of interactive learning tools in dance education to enhance the cognitive development and creative abilities of primary school students. It incorporated pre-tests and post-tests to compare the effects of interactive learning tools versus traditional teaching methods. Specifically, Class 1 of Grade 6 at Hubei Hope Primary School was selected as the experimental group, using interactive learning tools, while Class 2 adopted traditional teaching methods. The pre-test aimed to confirm that there are no initial differences in cognitive development and creative abilities in dance learning between Class 1 and Class 2. The post-test then compared the impact of interactive learning tools and traditional teaching methods on these aspects.

The design of this study aimed to explore how interactive learning tools can enhance the cognitive development and creative abilities of primary school students in dance education. Cognitive development focuses on students' understanding, memory, and analysis of dance movements, while creative ability emphasizes their design and expression skills in dance. These two dimensions reflected the learning objectives of dance education and correspond to the core functions of interactive tools. The lesson plan, based on the characteristics of interactive learning tools, constructs a closed-loop teaching process consisting of six stages: preparation, learning, cooperative practice, creation, presentation, feedback, and summary and enhancement. This design integrated the functions of the tools into various teaching links, guided students' creative thinking through creative design modules and data feedback, and ensured that the application of interactive tools was significantly distinguished from traditional teaching methods by aligning them with teaching objectives. To verify the actual effects of the tools, Class 1 of Grade 6 at Hubei Hope Primary School was selected as the experimental group, using interactive learning tools, and Class 2 served as the control group, using traditional teaching methods. With consistent teaching content, duration,

and other conditions, the teaching method was identified as the only variable that ensures the scientific and controllable nature of the experimental design.

Test

The test design combined pre-tests and post-tests, focusing on two core indicators: cognitive development and creative ability. The pre-test aimed to determine whether there were significant differences in the initial levels of these two dimensions between the two student groups. Standardized tests were used to evaluate students' memory, understanding, and analysis of dance movements, as well as their basic abilities in dance creation. The post-test further measured the changes in both groups after the teaching intervention, focusing on assessing the impact of interactive learning tools on these two abilities. In cognitive development, the test involved watching dance videos and answering questions on movement recognition and rhythm analysis. For creative ability, students needed to create dance movements to specified music, with their level of innovation reflected in scores for design, rhythm, and expression.

3.2 Samples and Sample Size

3.2.1 Population

The population for this study consisted of 6th-grade primary school pupils (likely aged 12 or older) currently enrolled in dance-integrated programs across several schools that have incorporated interactive educational aids into their curricula. The study population consisted of 6th-grade primary school pupils, typically aged 12 or older. These students were at a critical stage in their educational journey, transitioning from primary to secondary education. This age group was particularly interesting for studying the impact of interactive learning tools on cognitive development and dance creativity, as they have developed basic motor skills and cognitive abilities but remain highly receptive to new learning methods. The 6th-grade students selected for this study are enrolled in schools that have integrated interactive educational aids into their dance curriculum, ensuring that all participants have had some exposure to these tools.

The survey's research scope covered Hubei Hope Primary School. The research subjects are sixth-grade elementary school students enrolled in a comprehensive dance course, totaling 273 students. For the testing phase, Class 1 (45 students) in sixth grade at Hubei Hope Primary School was selected as the experimental group, with interactive learning tools used. In comparison, Class 2 (also 45 students) adopts traditional teaching methods.

3.2.2 Samples

The sample size for this study was determined using the Krejcie and Morgan (1970) table, which guides researchers in selecting a sample size based on the population of interest and a given confidence level or margin of error. Based on a 273-student population, they would recommend sampling at least 159 students. This sample size was also chosen to account for potential non-response or missing values, ensuring that the final analysis would yield a representative sample. It was randomly divided across schools and grade levels at a ratio consistent with that distribution in the population to ensure adequate representation of each subgroup within our study. Such proportional representation enabled a more comprehensive description of interactive learning tools used across various educational settings, as well as the impacts that can be measured and evaluated. As shown in Table 3.1.

Table 3.1 Population and Samples

No	Class	Population	Samples
1	Grade 6 Class 1	45	26
2	Grade 6 Class 2	45	26
3	Grade 6 Class 3	46	26
4	Grade 6 Class 4	46	28
5	Grade 6 Class 5	45	28
6	Grade 6 Class 6	45	25
	Total	273	159

Class 1 (45 students) in sixth grade at Hubei Hope Primary School was

selected as the experimental group, using interactive learning tools, while Class 2 (also 45 students) adopted traditional teaching methods. Class 1 comprised 23 male and 22 female students, while Class 2 included 20 male and 25 female students. As shown in Table 3.2.

Table 3.2 Test Samples

Class	**Class 1**		**Class 2**	
Gender	Male	Female	Male	Female
Sample	23	22	20	25
Total	45		45	

3.2.3 Sampling Methods

The study employed stratified random sampling with proportional allocation to determine the sample size. The population was stratified into six classes, with each class serving as an independent stratum. The number of samples drawn from each class was determined by its proportion in the total population, ensuring representativeness across classes. The student population of each class ranged from 45 to 46, and the corresponding sample sizes were roughly equal, varying from 26 to 28 students. This proportional allocation reflected the distribution characteristics of the overall population. Within each stratum, researchers likely used random sampling to select samples, ensuring fairness and randomness. This approach ensured the sample's representativeness. It effectively minimized biases arising from non-responses and missing values, enabling a more comprehensive description of the use and impact of interactive learning tools across various educational settings. Each class had an instructor who numbered the student list and randomly selected the required number of students from each class for the sample. Each selected student was administered a survey questionnaire and informed that participation was voluntary and that their privacy would be maintained.

3.3 Data Collection

Online platforms can reach diverse populations from various geographic areas, which may be infeasible to collect data from in person. Given current practices in digital music production, teaching via data collection on online platforms was sensible, as both students and teachers are familiar with readily available instruments. The online survey was created and delivered to the chosen students and educators in this sample. The survey was conducted online using an established platform (e.g., Qualtrics or SurveyMonkey) to facilitate distribution. The researcher measured all main variables in the study across multiple sections of a single survey.

3.3.1 Questionnaire Data Collection

The design of the data collection process aims to ensure the comprehensiveness, accuracy, and reliability of survey questionnaire data, encompassing crucial stages such as questionnaire preparation, distribution, collection, and organization, while laying the foundation for subsequent analysis.

Questionnaire Preparation and Pilot Testing Phase:

Before officially initiating data collection, a five-point Likert-scale questionnaire was used. The encompassing satisfaction focused on course content, interactive tools, learning outcomes, and teacher-student interaction. The questionnaire's internal consistency was analyzed, and adjustments were made to improve the accuracy and clarity of item wording. Additionally, the length and logical rationality of the questionnaire were optimized.

Distribution and Completion Phase of the Official Questionnaire:

Offline distribution methods were used to improve the questionnaire's response rate. Offline distribution provided on-site guidance to ensure completion and prevent misunderstandings of questions. Anonymity was guaranteed throughout the questionnaire completion process to alleviate students' psychological pressure and encourage honest responses. The entire process was completed within 15 minutes to minimize disruptions to teaching time.

Questionnaire Cleaning and Organization Phase after Collection:

The collected questionnaires were screened for invalid answers and incomplete responses. The data are a unified electronic spreadsheet for the organization.

Data Preprocessing and Preliminary Analysis Phase:

Before formal data analysis, preprocessing was conducted on the organized data, including handling missing values and screening for outliers. Descriptive statistics were also generated at this stage, including the number of valid questionnaires and the distribution of students' basic information, among other data, providing a foundation for subsequent comparative analysis of satisfaction differences between the experimental and control groups.

3.3.2 Test Data Collection

Test Preparation

Before the official tests, a scientific and standardized testing scheme was designed. The pre-test and post-test maintain consistent content, including questions that assessed cognitive development and creative abilities, to ensure comparability between the two tests.

Test Organization and Implementation

Pre-test Phase

Before the course began, pre-tests were administered separately to students in the experimental and control groups. The purpose was to understand the initial levels of cognitive development and creative abilities in dance learning groups.

Teaching Experiment Phase

Throughout the teaching cycle, the experimental group utilized interactive learning tools to support instruction, while the control group employed traditional teaching methods. Test data was collected during this phase; however, observations of student participation and performance in both groups were also recorded throughout the learning process to provide contextual support for post-test analysis.

Post-test Phase

After the teaching cycle ended, post-tests were administered to both groups, following the same procedures and standards as the pre-test.

Experimental Group: Cognitive development and creative ability tests were conducted using interactive learning tools that automatically record performance indicators (e.g., movement accuracy and rhythm-matching scores) and generate reports.

Control Group: Students completed the same tests under teacher supervision, with observers and grading teachers recording the data.

Data Recording and Organization

Data recording was conducted separately for the experimental and control groups, with a focus on cognitive development and creative abilities.

Data Cleaning

The data was checked for missing values, outliers, or entry errors. When the interactive tools in the experimental group failed to record data (e.g., a student did not complete a movement), the corresponding scores should be supplemented.

Data Preprocessing and Preliminary Analysis

The data from the experimental and control groups were grouped and organized into a format suitable for statistical analysis (e.g., separating pre-test and post-test data). Descriptive statistics were conducted on item scores to examine the distributions of cognitive development and creative ability scores across groups at pre-test and post-test. Changes in students' scores between the pre-test and post-test were shown, and a preliminary comparison of the magnitude of score improvement between the experimental and control groups lays the foundation for formal statistical analysis.

3.4 Research Instrument

Go Noodle

Go Noodle is an interactive platform designed specifically for children that encourages physical activity and learning through highly engaging videos and activities.

The platform offers a diverse range of content, including dance instruction, fitness training, attention-focusing exercises, and other interactive teaching resources, making it suitable for classroom or home use.

- Educational Value: Go Noodle helps children release excess energy, thereby enhancing their classroom attention and focus.
- Physical Exercise: It promotes physical well-being by guiding children through simple dance moves, stretching exercises, and jumping routines.
- Suitable Scenarios: Brain Breaks during school lessons, after-school entertainment, family bonding activities, and more.
- User Experience: The platform captivates children with vibrant colors, animated characters, and cheerful background music, creating a joyful learning atmosphere.

Choreo Maker

Choreo Maker is a mobile application tailored for choreographers and dancers. It assists users in choreographing, visualizing, and rehearsing various dance works on tablets or smartphones.

- Choreography Function: Supports solo, duo, or group dance choreography for up to 100 dancers, suitable for various styles including jazz, ballet, modern dance, Latin dance, street dance, and more.
- Creative Integration: Users can precisely sync dance moves with specific music, ensuring smoother and more coherent performances.
- Real-time Visualization: Provides features such as dancer position layouts and action design previews, facilitating adjustments to the work structure by choreographers at any time.
- Applicable Scenarios: Dance instruction, professional stage choreography, rehearsal assistance tools, and other related contexts.

Figure 3.1 Go Noodle and Choreo Maker

Part 1 for Answering Research Question 1

Lesson Plan: Focusing on the Application of Interactive Learning Tools in Dance Education

The application of interactive learning tools in dance education, through four progressively advanced teaching units, aimed to promote cognitive development and creative abilities in elementary school students' dance learning. The curriculum design adopted a framework of teaching stages, including "Preparation Phase - Basic Learning - Collaborative Practice - Creation Phase - Presentation and Feedback - Summarization and Enhancement," integrating various interactive tool functions to guide students from movement learning to creative design, progressively deepening

their understanding of dance art and enhancing their creative expression abilities.

Lesson 1: Establishing Basic Cognitive Understanding of Dance

Objective: To help students become familiar with basic dance movements, enhance their movement memory capabilities, and musical rhythm sense.

This lesson primarily utilized the movement decomposition and rhythm-matching functions of interactive tools. Through simple decomposed movement exercises and rhythm coordination training, students grasp the elements of dance at the cognitive level. Meanwhile, under the guidance, students began to understand the relationship between movements and music, laying a foundation for subsequent lessons.

Lesson 2: Enhancing Movement Combination and Analytical Skills

Objective: To build upon basic movements and enhance students' understanding of movement combinations and self-analysis abilities.

This lesson revolved around movement playback and imitation functions. Students learned and imitated dance movements autonomously by observing demonstration videos. Interactive tools help students break down complex movements and track their progress, providing clear performance feedback. The course emphasized the spatial and rhythmic variations in movement, gradually enhancing students' cognitive abilities in dance movement structure through teacher-student interaction and the use of tools.

Lesson 3: Cultivating Group Collaboration and Creative Abilities

Objective: To develop students' collaborative abilities and initial dance creation awareness.

Centered on group cooperation, this lesson guides students to use the creative design and collaborative practice modules in interactive tools to complete team-creation tasks. Within groups, students assume different creative roles (e.g., movement designer, rhythm controller) and collaboratively adjust the movements and rhythms of their works through interactive tools, gradually refining them during practice. The teacher provided real-time guidance and feedback through the tools

during the lesson, helping students complete group creations more effectively.

Lesson 4: Presentation of Creative Achievements and Comprehensive Ability Enhancement

Objective: To comprehensively present students' creative achievements and enhance their dance learning level through reflection.

This lesson culminated the curriculum, in which students combined the content from previous lessons to complete and present a full dance piece to the class. Following the presentation, students reflected individually and as a group, making improvements, and observed their learning progress through the data review function of the interactive tools. They summarized their overall gains from dance learning.

Cognitive Development Test

The design of cognitive development tests aimed to evaluate students' motor memory, rhythm perception, and analytical abilities regarding dance structures during their dance learning process by assessing their memory and comprehension of dance movements. The tests encompassed students' ability to observe dance movement videos and retell or reproduce the actions, thereby evaluating their memory and motor comprehension. The tests further examined students' rhythm perception using various rhythmic music clips, assessing their ability to select appropriate dance movements in response to the rhythm. Additionally, by analyzing dance movements, the tests assessed students' understanding of the relationship between dance movements and musical rhythms. These test items comprehensively reflected students' cognitive progress in dance learning, providing data to support subsequent learning and instructional adjustments.

Part 2 for Answering Research Question 2

Creative Skills Test

The creative skills test was the creative thinking and expressive abilities demonstrated during dance learning—students' independence, flexibility, and creativity in understanding their skill enhancement in dance composition. The test content

included creative movement design, unique dance movements, thematic requirements, and the application of creativity in movement. This section evaluated students' ability to utilize imagination and innovation in dance creation. Subsequently, students participated in collaborative creation within groups, utilizing dance knowledge and interactive tools to jointly design a complete dance work, testing their creative contributions and expressive abilities within a team setting. Students presented their creative outcomes, received feedback from peers and teachers, and engaged in self-reflection and improvement. This stage examined students' dance-expressive abilities and reflected on their evaluation and revision skills during the creative process. By comprehensively assessing students' creative skills across different aspects, the creative skills test reflected their creativity and independent thinking abilities in dance composition.

Part 3: For Answering Research Question 3

Questionnaire

The design and implementation of this research questionnaire focused on elementary school students' satisfaction with interactive learning tools in dance education, aiming to gain a comprehensive understanding of students' evaluations of course content, interactive tools, learning outcomes, and teacher-student interactions during the learning process. The questionnaire used a five-point Likert scale to assess students' learning experiences across multiple dimensions, providing crucial data for studying the actual teaching effects of interactive learning tools. Learner satisfaction at the elementary school level refers to learners' satisfaction with various aspects of their learning experiences, including course content, teaching methods, learning tools, teacher-student interactions, and other factors. Satisfaction measured learners' evaluations of their classroom experiences, reflecting their sense of enjoyment, engagement, and achievement gained throughout the learning process.

The respondents were required to use a five-point Likert scale to rate their level of agreement with the statements, where 1 = Strongly Disagree, 2 = Disagree, 3 =

Neutral, 4 = Agree, and 5 = Strongly Agree. The interpretation of the mean values was elaborated in a separate section. Arithmetic means were utilized to analyze the responses, yielding continuous numbers with decimal points. The interpretation of these mean values is as follows:

The mean value of 1 but less than 1.5 indicates "Strongly Disagree."

The mean value of 1.5 but less than 2.5 falls under the "Disagree" category.

The mean value of 2.5 but less than 3.5 represents a "Neutral" stance.

The mean value of 3.5 but less than 4.5 signifies "Agree."

The mean value of 4.5 and above belongs to the "Strongly Agree" level.

To maximize the response rate, the questionnaire included an explanation of the study's nature and purpose. Respondents were informed that their contributions are important and valuable. It is estimated that completing the questionnaire took approximately 15 to 20 minutes.

3.5 Content Validity and Reliability

3.5.1 Validity

Validity refers to the extent to which a measurement tool or method accurately measures its intended content. Factor analysis is commonly used to examine the construct validity of scales. Initially, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity can be employed to determine whether the data are suitable for factor analysis. The KMO value above 0.90 indicates that the scale is highly suitable for factor analysis; between 0.8 and 0.9, it is suitable; between 0.7 and 0.8, it is marginally suitable; between 0.6 and 0.7, it can still be considered marginally suitable, albeit with caution; between 0.5 and 0.6, factor analysis is not recommended; and below 0.5, factor analysis is deemed highly unsuitable. Additionally, factor analysis can proceed when Bartlett's test of sphericity is statistically significant at or below the specified level of significance. The questionnaire in this study was designed based on relevant literature, thereby demonstrating high content

validity. This study utilized factor analysis to assess structural validity. Specifically, exploratory factor analysis was conducted on the collected data to determine its underlying structure.

In this study, content validity and reliability of the survey instrument were important aspects to be ensured through its methodology. Content validity indicates that the survey items fully represent all aspects of a construct. Experts rated the pertinence of items to construct representation and clarity, or the lack of term definitions. All items that were ambiguous or redundant receive amendments to prevent their inclusion in future versions of the survey. The final form of our remaining variables was achieved following this test. On the other hand, reliability referred to the consistency of your survey results over time.

Ratings were as follows:

A rating of +1 indicates that the statement is "consistent with the definition."

A rating of 0 indicates "uncertain whether it aligns with the definition."

A rating of -1 indicates that the item is "not consistent with the definition."

The Index of Objective Consistency (IOC) was calculated. A content consistency index of 0.5 or greater is deemed suitable for research. The IOC analysis result was 1.00.

3.5.2 Reliability

Reliability measures how consistently an instrument measures constructs over time. A short survey questionnaire was developed, and a pilot study was conducted to assess its viability for the target population, primary school students. The purpose of the pilot study was to identify aspects of the questionnaire, such as ambiguities, item construction, and the relationship between items and their intended constructs (Gao et al., 2021). Based on the pilot study data, extracted to assess the questionnaire's internal consistency (algometric), Cronbach’s alpha was employed. Cronbach’s alpha scores of 0.7 and above are typically indicative of good internal consistency. Results from the

pilot study supported the high reliability of this questionnaire, with Cronbach's alpha values exceeding 0.8 for all subscales, indicating that our instrument consistently measures constructs related to interactive learning tools and cognitive development among dance creativity learners (Zardi et al., 2021).

3.6 Data Analysis

3.6.1 Descriptive Statistics

Descriptive statistics were used to summarize the data's basic characteristics. Frequency distributions were calculated for categorical variables (such as gender, grade, and significant). For variables, measures of central tendency (mean) and variability (standard deviation) were computed.

3.6.2 Inferential Statistics

Descriptive statistics summarized the fundamental characteristics of the data. For categorical variables such as gender, grade, and specialty, frequency distributions were calculated to showcase the number of samples within each category, providing insights into the sample. For continuous variables, such as age, measures of central tendency (e.g., mean, median, and mode) and variability (e.g., standard deviation and range) were computed to reveal the distribution and dispersion of the data. This statistical information offered a comprehensive overview of the data, enabling researchers to identify fundamental trends and characteristics and laying a foundation for further analysis.

The t-test and F-test were used to determine whether the independent variables had a statistically significant impact on the dependent variables, shedding light on the roles and interrelationships among different factors in student achievement. By combining descriptive statistics and ANOVA, researchers can systematically analyze and interpret the effects of technology on students' cognitive development and dance creativity, thereby validating research hypotheses and drawing scientific

conclusions. This process not only unveiled the potential effectiveness of educational strategies but also provided empirical evidence for further educational interventions and policy-making.

CHAPTER IV

ANALYSIS RESULT

Based on the research content presented in Chapters 1 to 3, this chapter validates the hypotheses through data collection and analysis. The SPSS software is used to test various research hypotheses, employing descriptive statistical analysis (frequency, percentage, mean, and standard deviation) and independent-sample T-tests to analyze the sample distribution of students from Hubei Hope Primary School, as well as the differences before and after implementing interactive learning tools in dance education. Data were collected and analyzed using questionnaires, learning plans, and tests. The questionnaire covered basic student information and assessed students' cognitive development and creative skills in interactive learning tools.

A total of 159 questionnaires were collected. Tests were conducted to assess students' cognitive development and creative skills in using interactive learning tools. Students were nurtured through learning plans, and pre-test and post-test data were collected to analyze the differences. To evaluate the effectiveness of interactive learning tools in dance education, Classes 1 and 2 at Hubei Hope Primary School were selected as the study population. Class 1 had 45 students, and Class 2 had 45. Students were divided into an experimental group and a control group. Students in Class 1 intake adopted an interactive learning tool, while Class 2 continued with traditional teaching methods.

4.1 To Investigate Interactive Learning Tools to Enhance the Cognitive Development of Primary School Learners in Dance Education

The study focuses on Classes 1 and 2 at Hubei Hope Primary School. It

compares the impact of interactive learning tools in dance education (experimental group) with that of traditional teaching methods (control group) on students' cognitive development, aiming to explore the effectiveness of interactive learning tools in this context.

The cognitive development facilitated by interactive learning tools in dance education is superior to that achieved through traditional teaching methods.

(1) Test whether the variance of interactive learning tools is equal to the variance of traditional teaching methods (before learning)

$\delta^2_{Interactive\ Learning\ Tools}$ Variance of interactive learning tools

$\delta^2_{traditional}$ Variance of the traditional teaching methods

$H_0: \delta^2_{Interactive\ Learning\ Tools} = \delta^2_{traditional}$ Interactive learning tools in teaching have no significant impact on students' cognitive development compared to traditional teaching methods.

$H_1: \delta^2_{Interactive\ Learning\ Tools} \neq \delta^2_{traditional}$ Interactive learning tools integrated with teaching significantly outperform traditional teaching methods in enhancing students' cognitive development.

Table 4.1 Compare the Variance of Class Interactive Learning Tools and the Variance of Class Traditional Teaching Methods (Before Learning) on Cognitive Development

Class	df	Mean	Variance	F
Interactive Learning Tools	44	20.69	10.265	1.679
Traditional Teaching Methods	44	21.98	6.113	

$$F_{0.025,44,44} = 0.550$$

$$F_{0.975,44,44} = 1.820$$

$$F_{0.025,44,44} = 0.550 < F_{compute} = 1.679 < F_{0.975,44,44} = 1.820$$

Accept null hypotheses. It means the test variance of class interactive

learning tools equals the variance of class traditional teaching methods. So, after learning, use the t-test for equal variance.

(2) Test the average cognitive development of interactive learning tools of students in Hubei Hope Primary School.

$\mu^2_{Interactive\ Learning\ Tools}$ Average the achievement of interactive learning tools

$\mu^2_{traditional\ teaching\ methods}$ Average the achievement of traditional teaching methods

$H_0: \mu^2_{Interactive\ Learning\ Tools} = \mu^2_{traditional\ teaching\ methods}$: There is no significant difference in students' cognitive development between interactive learning tools, integrated teaching, and traditional teaching methods, meaning that the mean values of the post-test scores for the two groups are equal.

$H_1: \mu^2_{Interactive\ Learning\ Tools} > \mu^2_{traditional\ teaching\ methods}$: Interactive learning tools integrated teaching in students' cognitive development is significantly superior to traditional teaching methods, indicating that the mean value of the post-test scores for the experimental group is higher than that of the control group.

Table 4.2 Comparison of Average Achievement of Interactive Learning Tools and Traditional Teaching Methods on Cognitive Development

Class	**Mean**	**Variance**	**df**	**t**
Integrating Pro Tools Technology	38.49	1.846	86	5.34
Traditional Teaching Methods	31.40	12.973		

$$t_{0.05,86} = 1.997$$

$$t_{compute} = 5.34 > t_{0.05,66} = 1.997$$

The result showed that the experimental group's mean post-test score was significantly greater than the critical value, rejecting the null hypothesis and indicating that the experimental group's mean post-test score was significantly higher than that of

the control group.

There are no significant differences in the mean values and variances of the pre-test data between the two groups, indicating that the experimental and control groups have similar initial levels. The post-test data indicate that interactive learning tools have a significant impact on students' cognitive development, with the experimental group's mean post-test score being higher than that of the control group. Therefore, the conclusion is that the interactive learning tools can significantly enhance students' cognitive development compared to traditional teaching methods.

4.2 To Investigate Interactive Learning Tools to Enhance the Creative Skills of Primary School Learners in Dance Education

The study focuses on Classes 1 and 2 at Hubei Hope Primary School. It compares the impact of interactive learning tools in dance education (experimental group) with that of traditional teaching methods (control group) on students' creative skills, aiming to explore the effectiveness of interactive learning tools in this context.

The cognitive development facilitated by interactive learning tools in dance education is superior to that achieved through traditional teaching methods.

(1) Test whether the variance of interactive learning tools is equal to the variance of traditional teaching methods (before learning)

$\delta^2_{Interactive\ Learning\ Tools}$Variance of interactive learning tools

$\delta^2_{traditional}$Variance of traditional teaching methods

H_0: $\delta^2_{Interactive\ Learning\ Tools} = \delta^2_{traditional}$Interactive learning tools have no significant impact on students' creative skills compared to traditional teaching methods.

H_1 : $\delta^2_{Interactive\ Learning\ Tools} \neq \delta^2_{traditional}$ Interactive learning tools integrated with teaching significantly outperform traditional teaching methods in

enhancing students' creative skills.

Table 4.3 Comparison of the Variance of Class Interactive Learning Tools and the Variance of Class Traditional Teaching Methods (Before Learning) on Creative Skills

Class	**df**	**Mean**	**Variance**	**F**
Interactive Learning Tools	44	32.38	6.104	1.143
Traditional Teaching Methods	44	32.98	5.340	

$$F_{0.025,32,34} = 1.995$$

$$F_{0.975,32,34} = 0.497$$

$$F_{0.025,44,44} = 0.550 < F_{compute} = 1.143 < F_{0.975,44,44} = 1.820$$

Accept null hypotheses. It means the test variance of class interactive learning tools equals the variance of class traditional teaching methods. So, after learning, use the t-test for equal variance.

(2) Test the average cognitive development of interactive learning tools of students in Hubei Hope Primary School.

$\mu^2_{Interactive\ Learning\ Tools}$Average the achievement of interactive learning tools

$\mu^2_{traditional\ teaching\ methods}$ Average the achievement of traditional teaching methods

$H_0 : \mu^2_{Interactive\ Learning\ Tools} = \mu^2_{traditional\ teaching\ methods}$ There is no significant difference in students' creative skills between interactive learning tools, integrated teaching, and traditional teaching methods, indicating that the post-test means for the two groups are equal.

$H_1 : \mu^2_{Interactive\ Learning\ Tools} > \mu^2_{traditional\ teaching\ methods}$ Interactive learning tools integrated into teaching to enhance students' creative skills are significantly superior to traditional teaching methods, as indicated by the experimental group's higher post-test scores than the control group.

Table 4.4 Compare Average Achievement of Interactive Learning Tools and Traditional Teaching Methods on Creative Skills

Class	Mean	Variance	df	t
Integrating Pro Tools Technology	38.06	1.47	86	7.37
Traditional Teaching Methods	31.65	24.13		

$$t_{0.05,86} = 1.997$$

$$t_{compute} = 7.37 > t_{0.05,86} = 1.997$$

The results showed that the experimental group's mean post-test score was significantly greater than the critical value, indicating that the null hypothesis was rejected. Furthermore, the experimental group's mean post-test score was significantly higher than the control group's.

There are no significant differences in the mean values and variances of the pre-test data between the two groups, indicating that the experimental and control groups have similar initial levels. The post-test data indicate that interactive learning tools have a significant impact on students' creative skills, with the experimental group's mean post-test score being higher than that of the control group. Therefore, the conclusion is that the interactive learning tools can significantly enhance students' creative skills compared to traditional teaching methods.

The mean values and variances of the pre-test data for both groups showed no significant differences, indicating that the initial levels of the experimental and control groups were similar. The post-test data revealed that interactive learning tools in dance education enhanced students' cognitive development and creative skills, with the experimental group scoring higher on average than the control group. Therefore, the conclusion is that, compared to traditional teaching methods, the interactive learning tools in dance education can significantly improve students' cognitive development and creative skills.

4.3 To Study Whether Primary School Learners Are Satisfied with The Interactive Learning Tools in Dance Education

Table 4-1 presents descriptive statistics on the demographic characteristics of the study sample, providing a background overview of the sample composition for subsequent analyses. The total sample size is 159, with 90 male students (56.6%) and 69 female students (43.4%), indicating a relatively balanced gender distribution, though the proportion of males is slightly higher than that of females.

Regarding prior dance experience, 80 students (50.3%) reported having experience, while 79 students (49.7%) did not, resulting in an almost equal distribution. This suggests minimal differences in the students' initial dance background, providing a balanced basis for comparing the effects of different teaching methods on students with or without prior experience.

In terms of academic performance (GPA), 21 students (13.2%) had a GPA below 2.5, 35 students (22.0%) had a GPA between 2.6 and 3.0, 49 students (30.8%) had a GPA between 3.1 and 3.5, and 54 students (34.0%) had a GPA above 3.5. The GPA distribution indicates that a higher proportion of students in the sample demonstrated strong academic performance, offering diverse perspectives for examining the impact of interactive learning tools on students with varying academic levels.

In summary, the table highlights the diversity and reasonable distribution of the sample across gender, prior dance experience, and academic performance. This provides a solid foundation for subsequent analyses and supports the exploration of how interactive learning tools affect students from different backgrounds.

Table 4.5 Descriptive Characteristics

Items	Options	Frequency	Percent%
	Male	90	56.6
Gender	Female	69	43.4
	Yes	80	50.3
Prior Dance Experience	No	79	49.7
	Under 2.5	21	13.2
	2.6-3.0	35	22.0
	3.1-3.5	49	30.8
GPA	Over3.5	54	34.0
Total		159	100.0

Table 4.6 Average, Standard Deviation, And Interpretation of the Impact of the Interactive Learning Tools On Students' Satisfaction

	Questions	Average	Std. Deviation	Interpretation
Course	Q1	3.69	0.812	Agree
Content Satisfaction	Q2	3.65	0.981	Agree
	Q3	3.60	0.982	Agree
	Q4	3.38	1.060	Neutral
	Q5	3.53	0.986	Agree
Total		3.57	0.964	Agree
Interactive	Q6	3.66	0.899	Agree
Tools Satisfaction	Q7	3.48	1.024	Neutral
	Q8	3.53	1.054	Neutral
	Q9	3.37	1.139	Neutral
	Q10	3.67	0.911	Agree
Total		3.54	1.005	Agree
Learning	Q11	3.53	0.891	Agree
Outcomes Satisfaction	Q12	3.41	1.014	Neutral
	Q13	3.40	1.142	Neutral
	Q14	3.36	1.110	Neutral
	Q15	3.50	1.030	Agree
Total		3.44	1.038	Neutral
Teacher-Student	Q16	3.40	0.975	Neutral
Interaction Satisfaction	Q17	3.49	1.049	Neutral
	Q18	3.52	1.054	Agree
	Q19	3.49	1.067	Neutral
	Q20	3.35	1.097	Neutral
Total		3.45	1.048	Neutral

Table 4.6 presents the averages, standard deviations, and interpretations of the impact of interactive learning tools on students' satisfaction across four dimensions: course content satisfaction, satisfaction with interactive tools, satisfaction with learning outcomes, and satisfaction with teacher-student interaction.

For Course Content Satisfaction, the average scores for the five questions ranged from 3.38 to 3.69, with a total average of 3.57 and a standard deviation of 0.964. The interpretation indicates that students generally agreed that the course content met their expectations, except in Q4, where responses were neutral. In the Interactive Tools Satisfaction dimension, the total average score was 3.54, with a standard deviation of 1.005. Students agreed with Q6 and Q10, while their responses to Q7, Q8, and Q9 were neutral, suggesting a mix of positive and moderate feedback on the tools used in the learning process.

For Learning Outcomes Satisfaction, the total average score was 3.44 with a standard deviation of 1.038. While students agreed with Q11 and Q15, their responses to Q12, Q13, and Q14 were neutral, indicating a more reserved perception of the tools' impact on their learning outcomes. Finally, in the Teacher-Student Interaction Satisfaction dimension, the total average score was 3.45, with a standard deviation of 1.048. Only Q18 received an "agree" interpretation, while responses to the other questions were neutral. This suggests a need to improve the fostering of stronger interactions between teachers and students when using interactive learning tools.

Overall, the findings indicate that while students generally have a positive perception of the interactive learning tools, their satisfaction levels vary across specific dimensions and questions, highlighting areas that require further improvement.

CHAPTER V

CONCLUSION AND DISCUSSION

5.1 Conclusion

Part 1 for Answering Research Question 1

The $F_{0.025,44,44} = 0.550 < F_{compute} = 1.679 < F_{0.975,44,44} = 1.820$ means the test variances for classes integrating interactive learning tools are equal to those for classes using traditional teaching methods. So, after learning, use the t-test for equal variance. The $t_{compute}=5.34>t_{0.05,66}$. The p-value of 1.997 showed that it is significantly greater than the critical value; therefore, the null hypothesis is rejected, indicating that the mean post-test score of the experimental group is significantly higher than that of the control group. The conclusion is that, compared to traditional teaching methods, interactive learning tools can significantly improve students' cognitive development.

Part 2 for Answering Research Question 2

The $F_{0.025,44,44} = 0.550 < F_{compute} = 1.143 < F_{0.975,44,44} = 1.820$ means the test variances for classes integrating interactive learning tools are equal to those for classes using traditional teaching methods. So, after learning, use the t-test for equal variance. The $t_{compute}=7.37>t_{0.05,86}$. The p-value of 1.997 showed that it is significantly greater than the critical value; therefore, the null hypothesis is rejected, indicating that the mean post-test score of the experimental group is significantly higher than that of the control group. The conclusion is that interactive learning tools, when integrated into teaching, can significantly enhance students' creative skills compared to traditional teaching methods.

Part 3 for Answering Research Question 3

The results indicate that students generally had a positive perception of the interactive learning tools, particularly regarding course content satisfaction, which

received primarily “agree” responses. However, satisfaction with interactive tools was mixed, with some meeting expectations while others fell short. Learning outcomes satisfaction and teacher-student interaction satisfaction leaned toward neutral, suggesting a limited impact in these areas. Overall, while the tools were helpful in certain aspects, improvements are needed to enhance their effectiveness, particularly in promoting better learning outcomes and enhancing teacher-student interactions.

5.2 Discussion

Part 1: To Answer Research Question No. 1

The result that interactive learning tools enhance the cognitive development of primary school learners in dance education suggests that these tools can significantly contribute to students’ intellectual growth and understanding of dance concepts. Interactive tools, such as motion capture systems, video feedback, and virtual platforms, provide students with visual, real-time feedback that helps reinforce their learning. This enables them to understand complex movements better, develop spatial awareness, and improve their retention of dance routines (Kirakosian et al., 2021). Additionally, the use of interactive tools may support personalized learning by catering to different learning paces, allowing students to revisit specific movements and techniques until they master them (Chan et al., 2019). The cognitive benefits can extend beyond just dance techniques; these tools can also foster critical thinking, problem-solving, and creativity, as students engage with challenges in the learning process and explore innovative ways to express themselves. The interactivity of the tools keeps students engaged, making the learning process more dynamic and stimulating, which can result in improved concentration and mental processing (Coogan, 2021).

However, it is essential to acknowledge that while interactive tools can enhance cognitive development, their effectiveness depends on how they are integrated into the overall teaching strategy (Bojner Horwitz et al., 2022). If not properly guided by the teacher, the tools could distract students or confuse them, especially if they lack

proper instruction on how to use them. Therefore, the impact of these tools on cognitive development should be considered alongside effective teaching methods that ensure their meaningful use (Crow & Tlhpe, 2020).

Overall, this result supports the growing body of evidence suggesting that technology can play a crucial role in improving students' cognitive abilities across various learning environments, including dance education. However, further research and refinement of these tools, along with teacher training, are necessary to fully unlock their potential in fostering cognitive development in young learners.

Part 2: To Answer Research Question No. 2

The finding that interactive learning tools enhance primary school learners' creative skills in dance education suggests that technology can provide significant support in developing students' artistic expression and innovation. By utilizing tools such as virtual reality, motion capture, or digital choreography platforms, students can explore various movement possibilities, experiment with their creative ideas, and receive immediate feedback on their performances (Chan et al., 2019). These tools encourage students to push the boundaries of their creativity by offering diverse ways to visualize, modify, and remix dance movements, thus fostering an environment where creativity is actively nurtured.

Interactive learning tools also provide students with a more immersive and engaging learning experience. For example, when students can manipulate visual representations of their movements or collaborate with virtual partners, they may be more likely to take risks and try new, creative approaches without the fear of making mistakes. The instant feedback provided by these tools helps students refine their work and explore new ideas more effectively (Bojner Horwitz et al., 2022), further enhancing their creative development. Moreover, by engaging with technology in an artistic context, students are exposed to new forms of creativity, integrating digital tools with their dance expression in ways that may not be possible through traditional methods alone (Carmona, 2021).

However, it is essential to note that the enhancement of creative skills depends on how these tools are effectively integrated into the learning process. The tools themselves are not inherently creative; it is how students interact with them and the guidance they receive from teachers that determines their creative potential. Suppose students are not provided with opportunities to reflect on their work critically or to engage in meaningful creative challenges. In that case, the tools may serve as distractions rather than catalysts for innovation (Kassing & Jay, 2020).

Furthermore, while interactive tools can certainly boost creativity, they should be used in balance with traditional methods. Dance, at its core, is a highly embodied art form, and creativity often sparks through personal expression, physical exploration, and emotional connection. Therefore, interactive tools should complement rather than replace these core elements of dance education, ensuring that students' creative skills are developed holistically (Carmona, 2021).

In conclusion, this result highlights the potential of interactive learning tools to stimulate and enhance students' creativity in dance education. When used effectively, these tools can give students the freedom to explore new ideas, receive real-time feedback, and refine their artistic expression (Li, 2021), ultimately fostering greater creative development. However, a balanced approach that integrates both digital tools and traditional teaching methods is essential to support students' creative growth fully.

Part 3: To Answer Research Question No. 3

The results highlight both the potential and limitations of interactive learning tools in dance education. Students' general agreement on course content satisfaction suggests that these tools can effectively enhance the relevance and engagement of learning materials. This demonstrates their role in supporting the delivery of structured and dynamic content, making the learning experience more enjoyable and accessible (Chan et al., 2019).

However, the mixed feedback on tool satisfaction and the neutral responses

regarding learning outcomes and teacher-student interaction indicate areas for improvement (Angelov, 2023). While they provide valuable resources for learning, their usability, adaptability, and ability to foster deeper cognitive and creative engagement need refinement. Similarly, the limited impact on teacher-student interaction suggests that these tools should be better integrated into teaching strategies to enhance communication and personalized guidance (Carmona, 2021).

From a practical perspective, these findings emphasize the importance of teacher training in effectively utilizing interactive tools, ensuring they are not only supplementary but integral to the learning process. Developers should focus on creating more intuitive and adaptive tools that cater to diverse learning styles and foster collaboration. By addressing these areas, interactive learning tools can significantly enhance student satisfaction, learning outcomes, and the overall quality of dance education.

5.3 Implementation for Practice

The findings from this research suggest that interactive learning tools can significantly enhance both the cognitive development and creative skills of primary school learners in dance education, while also increasing student satisfaction. To implement these tools effectively, schools should integrate them into the dance curriculum in a structured way, using tools such as motion capture systems, video feedback, and virtual platforms to provide students with real-time, personalized feedback. This not only helps students grasp complex dance techniques but also enables them to explore their creativity through choreography and self-expression. The ability of these tools to provide immediate visual feedback and offer students the opportunity to experiment with various movements can stimulate both cognitive understanding and creative thinking, which are essential for their overall development in dance.

Moreover, these tools support personalized learning, allowing students to progress at their own pace. As dance education often involves students with varying

levels of ability, interactive learning tools can provide flexibility, allowing students to revisit specific lessons, helping those who may struggle with certain concepts and allowing advanced students to delve deeper into more complex movements. Teachers can use data generated by these tools to tailor lessons to students' individual needs, thereby ensuring a more inclusive and supportive learning environment.

To ensure these tools are used to their full potential, teachers must receive proper training. Educators must be equipped with the knowledge to integrate these technologies seamlessly into their teaching methods, ensuring that the tools enhance, rather than distract from, the learning process. Professional development programs should be implemented to train teachers on how to effectively use these tools to foster cognitive growth, creativity, and student engagement. With adequate training and ongoing support, teachers can leverage interactive learning tools to not only improve students' technical skills but also encourage greater artistic expression and innovation in the dance classroom. This holistic approach will contribute to a more dynamic, engaging, and personalized dance education experience for primary school learners.

5.4 Recommendations for Future Research

Future research should expand the scope and depth of this study to understand better the broader impact of interactive learning tools in dance education. By including diverse student populations from various regions, grade levels, and school types, researchers can validate their findings and identify variations across contexts. Longitudinal studies would provide insights into the long-term effects of these tools on cognitive and creative development, addressing current time limitations. Additionally, future research could explore their impact on other areas such as emotional engagement, self-directed learning, and collaboration. Comparative studies on different technologies, such as virtual reality and motion capture, and their applications in various art disciplines, including music and drama, would further enhance understanding and inform practical advancements in educational technology.

5.5 Limitations of the Study

This study has several limitations that should be acknowledged. First, the sample was restricted to sixth-grade students from a single school, limiting the generalizability of the findings to other regions, age groups, and educational settings. Second, the short duration of the study limited observation to immediate effects, leaving the long-term impact of interactive learning tools unexplored. Third, the research primarily focused on cognitive and creative development, overlooking other important areas such as emotional engagement, self-directed learning, and collaboration. Finally, variations in teaching styles and students' prior familiarity with interactive tools may have influenced the results, suggesting the need for future studies to account for these variables for more robust conclusions.

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BIOGRAPHY

NAME	Ms.ATAO XU
TELEPHONE	+8613971715359
EDUCATIONAL BACKGROUND	Major: Education
GRADUATION APPROVAL DATE	July 29, 2025