A Theoretical Framework for Enhancing Preschoolers′ Traditional Chinese Cultural Learning Through Interactive Animation Design Elements

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Abstract

The purpose of this study was to enhance Chinese preschool students′ traditional culture learning skills through interactive animation, and to improve preschool students′ comprehension and creativity of traditional culture. The researchers conducted a literature review and theoretical development research on three parts: interactive animation element design, children′s psycho-cognitive development, and Traditional Chinese Culture. In the first stage, the researchers researched the literature and conducted theoretical research on the plots, characters, colors, music, and touch elements of interactive animation design elements, to refine the interactive animation elements suitable for preschool students′ comprehension and creativity. In the second stage, we summarized the interactive animations that suit the cognitive development of preschool students by combining the theories of children′s psycho-cognitive development and strategies of interactive animation design. For the third stage, traditional cultural content elements suitable for designing interactive animation were explored by studying current traditional Chinese cultural content and investigating the current situation. The results show that interactive animation technology can more effectively improve preschool students′ comprehension of traditional culture than traditional teaching. The contextualized teaching mode stimulates children′s imagination and creativity. This study not only enriches the application of interactive animation in preschool education but also provides theoretical and practical support for future interactive animation technology.

Keywords: Interactive Animation, Comprehension, Creativity, Preschool Students, Traditional Chinese Culture

Introduction

With the progress and development of the digital era, interactive animation has gradually become an important form of expression in digital media. Compared with traditional animation, interactive animation gives users the initiative in the viewing process (Xu & Liu, 2020), while retaining novel and beautiful visual theme styles in design (Ren, 2022). Interactive animation design relies on graphical, audiovisual, and operable elements (Gieryic, 2024), and according to Dahlan et al. (2023), its core characteristics include interactivity, responsiveness, engagement, and customizability. These traits distinguish it from linear animation and align well with constructivist and situational learning theories, creating extensive curricular applications, particularly in early childhood education.

China has entered the era of digital information, wherein educational technology for children is continuously evolving, to better stimulate their learning interest and cognitive potential (Pan et al., 2025). Some researchers emphasize fundamental design principles such as clear imagery, concise language, and moderate pacing (Chuang & Jamiat, 2023). Since children learn through visual, auditory, and touch channels, the continuity of narrative structure, character design, vivid colors, and rhythmic sound effects are all critical design elements influencing learning outcomes. Son & Butcher (2024) further highlight the importance of touch elements in children's interactive animation, noting that age-appropriate touch interactions can enhance memory. Integrating

multisensory information—visual, auditory, and tactile—can not only attract children's interest but also improve their understanding of learning content.

In different countries, interactive animations are adapted to local cultural contexts and educational objectives while retaining their unique artistic characteristics. For example, the BBC CBeebies content in the UK emphasizes the integration of cognitive development and social-emotional education (Woodfall, 2025), enabling children to learn problem-solving, emotional understanding, and rule awareness through participation. In Japan, interactive animation content emphasizes the integration of daily etiquette, natural science, and traditional culture (So et al., 2018), encouraging children to engage in behaviors such as gesture imitation and language repetition under the guidance of animations. In the US and Canada, the emphasis is on children's participatory and exploratory interactions, proposing "non-linear exploration" and "interactive narrative" in plot design (Kabir, 2013), and emphasizing "task-driven" approaches.

According to Jean Piaget's theory of cognitive developmental stages, preschool children aged 3-6 are at the preoperational stage, during which they are highly sensitive to sensory inputs (Piaget, 1952; Nisiewicz & Gulla, 2023). Research shows that preschoolers gradually build symbolic representational schemas, using language, gestures, imagery, play, and drawing to represent real-world concepts (Cartwright, 2024). Other studies have demonstrated that visual, auditory, and tactile elements are the three major sensory modalities influencing children's learning experience in interactive animation (Deng, 2023). These elements not only form the foundational framework of interactive animation but also function to transmit information and evoke emotion in children (Parmar et al., 2022). Nansen (2020) stated that digital media can promote children's active exploration and experimentation; tactile interaction aids in stimulating curiosity and motivation, thereby improving cognitive construction efficiency. Anggrasari & Dayu (2022) confirmed that interactive animation can transform complex and abstract content into concrete scenarios, reducing cognitive load for children.

Interactive animation is highly valued in China's preschool education, but it still faces many problems to be solved in practical application. First, some interactive animations lack the understanding of children's cognitive development stages in their design, which leads to the knowledge conveyed being too abstract and difficult for children to fully understand, limiting the cultivation of children's thinking skills and creativity, and making it difficult to build a complete and rigorous learning framework for the students (Yin & Ding, 2024). Secondly, the content and form of interactive animation are also very important (Liu & Zhang, 2016), such as the low quality of the picture, the single interaction design, the lack of a sense of logic, and other problems, which cannot effectively attract children's attention, and cannot build a great learning experience. Based on the above problems, it is necessary to deeply explore the interactive animation design elements that can promote the development of children's understanding and creativity.

Traditional Chinese Culture is rich in myths, folklore, and traditional art. Through exposure to and the study of traditional culture, children can improve their understanding and develop creative thinking and language expression skills (Zhang & Xu, 2025). Traditional Chinese Culture education for preschool students has been receiving more and more attention from the education sector in recent years. However, traditional culture is highly abstract and symbolic (Qu, 2023), which makes it difficult for preschool students, who mainly think in concrete images, to understand and accept. As suggested previously, interactive animation has the characteristic of transforming abstract cultural connotations into visual and tangible expressions; therefore, integrating

Traditional Chinese Culture into the design of interactive animation is an effective means of improving preschool students′ skills in traditional culture learning.

Some studies have also discussed how to incorporate Traditional Chinese Culture into interactive animation for cultural education and cognitive development of preschool students. However, common shortcomings remain. Recent studies show that some cultural education themes exceed children's cognitive load (Luo & Lin, 2024). Certain interactive animation works should be created with consideration for preschoolers' cognitive traits—such as concrete-image thinking, animistic tendencies, and language development level. Although Chinese interactive animations are highly interactive, they often lack effective educational value (Hu, 2021). A key reason is the absence of systematic principles based on children's cognitive differences during design, making it difficult to provide genuine instructional support. Furthermore, the educational effectiveness of interactive elements often lacks rigorous assessment mechanisms, making it challenging to measure their actual contributions to children's understanding and creativity.

The researchers considered two key dimensions in this study: interactive animation elements, and content from Traditional Chinese Culture, suitable for representation through interactive animation. The core aim was to explore how thoughtful and pedagogically informed design can enhance preschool children's comprehension and creative skills. The research focused on aligning the cognitive developmental characteristics of young children with the design of interactive animations, while also systematically identifying and selecting appropriate elements of Traditional Chinese Culture for effective digital adaptation. These inquiries sought to answer how interactive animation can foster the development of both understanding and creativity in preschool learners.

This study hypothesizes that by optimizing the design elements (visual, auditory, and tactile) of interactive animation, the comprehension of preschool students of traditional culture can be effectively enhanced, and the screening of traditional culture content can help to stimulate the expression of creativity of preschool students. In this study, a system of design elements suitable for preschool students to learn traditional culture was built to fill the gap of "child-centered" interactive animation design, explore the specific mechanisms and paths of children′s comprehension and creativity skills, and integrate educational, cognitive adaptation and design practice of interactive animation design framework. At the same time, the researchers are confident that this study will be useful to other design organizations and schools, serving as a guide for research and implementation of similar systems.

Materials and Methods

This study, a literature review, provided a theoretical foundation and creative insights for subsequent interactive animation design. The literature was analyzed and existing research findings synthesized, with theoretical foundations and research perspectives being derived from those findings. A framework for the relationship between interactive animation design and cultural education was developed, based on existing academic achievements. In the implementation process, library resources, internet open resources, and core academic databases were leveraged (Google Scholar, CNKI, Web of Science), and combined with the keywords "interactive animation," "child cognitive development," and "traditional culture" to systematically search. Journals from 2022 to 2025 were screened, and articles with repetitive, non-empirical, or irrelevant content were excluded to ensure the authority, timeliness, and relevance of the literature. In organizing the literature

findings, the researchers conducted horizontal and vertical comparisons of research findings across different periods and fields to identify the contributions and shortcomings of interactive animation, children's understanding and creativity, and traditional culture in interactive animation production, thereby constructing the theoretical framework and design methods for this study (Fig. 1).

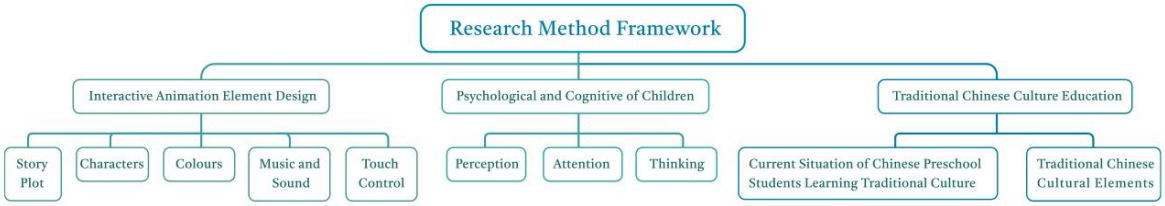

Figure 1 Study Methods Framework

Results

The results of the conceptual framework are as follows:

1. Interactive animation element design research.

Interactive animation design places significant emphasis on design elements. Kennedy and McNaught (1997) highlight that the effective use of various design elements can enhance the visual appeal, interactivity, and user experience of animations, thereby improving the overall effectiveness of interactive animations. Design elements in interactive animation include plot, character, color, music & sound, and interactive elements. During the design process, it is essential to focus on these design attributes and apply the elements appropriately to maximize the effectiveness of the interactive animation design.

1.1 Strategies for setting an interactive animated plot for children

Compared with traditional animation, children's interactive animation enhances the multi-sensory experience of sight, hearing, and touch, allowing children to interact with the storyline in real time during reading (Daryanes et al., 2023). Related research showed that a reasonable storyline can increase children's attention and help improve their comprehension and sense of participation (Morrow, 1985). The study found that the audiovisual elements of digital animation can improve preschool students' recall and story retelling skills. However, the cognitive impact of different types of interactive animation on children may differ, and the acceptability of different age groups of preschool students needs to be considered when setting the storyline.

Research has shown that for younger children aged 3-5, interactive animations, where elements of the story are clearly depicted, are needed, which can help to improve story recall and plot comprehension. For older children aged 6-7, interactive animations that implicitly extend beyond the story text are needed, which can promote the development of creative abilities (Li et al., 2023). In terms of interactivity, children aged 3-5 are more interested in plots with repetitive, simple cause-and-effect relationships, while children aged 6-7 pay more attention to cause-and-effect relationships and can make simple inferences, but still need sensory support, so children of this age are more suitable for "exploratory" or "task-based" branching stories. According to Erikson's psychosocial development theory (Erikson, 1950), children aged 3-5 are in the "initiative versus guilt" stage, where they feel shame or guilt over failure, which in turn suppresses their initiative. When setting up branching stories for children aged 3-5, consider the changes that different choices will bring. Although the

choices will affect the emotions of the characters or the development of the story, they will not make the children feel like failures (Fig. 2).

Children in the Lower Age Group 3-5 Years old

Thinking Skills	Story Description	Story Branches	Non - linear Narrative	Mental Feedback
Concrete Thinking	Clear	Simple Branches Low Exploration	Repetition Simple Cause	Positive Encouragement

Children in the Lower Age Group 6-7 Years old

Thinking Skills	Story Description	Story Branches	Non - linear Narrative	Mental Feedback
Concrete Thinking	Implicit	Low Branching Task - Driven	Complex Exploring	Task Understanding

Figure 2 Analysis of interactive animation plots for 3-5 & 6-7 years old

1.2 Strategies for setting interactive animated characters for children

Characters are transformed into visual figures through artistic techniques such as animation, anthropomorphism, deformation, and exaggeration, thereby endowing them with emotional depth. Fialho (2023) noted in his research that the different shapes of Disney cartoon characters can convey specific emotions and personality traits. Round characters are generally perceived as approachable and more likely to evoke audience affection. Some studies suggest that round shapes, lacking sharp edges, are more suitable for children's animation. In contrast, triangular characters, as Trautmann (2021) indicates, convey emotions such as sharpness, speed, and aggressiveness, which can evoke a sense of visual instability. According to Sapmayada (2024), Disney animation characters prefer elliptical designs in character creation because ellipses offer greater flexibility, animation variability, and suitability for exaggerated movements. Square shapes evoke stability, strength, and reliability, making them suitable for characters with powerful traits to enhance a sense of reliability. The Fig. 3 shows the character traits corresponding to common animated characters in graphic design, as compiled by a researcher. However, some studies show that character emotions only positively influence children through their interaction with touchscreens; passively watching videos does not stimulate children's learning motivation (Zhang et al., 2023). Therefore, shapes cannot serve as the basis for children's emotional responses but should only function as design guidelines.

Although existing research has discussed the potential impact of character design on children's emotions and cognition from the perspectives of shape, emotional expression, and animation techniques, the effective interaction between punishment and characteristics in character design and touch interaction remains unclear. Whether circular or square characters have stronger guiding and emotional effects in different contexts requires further study in conjunction with experimental results.

Figure 3 Character traits corresponding to animated characters in graphic design

Clothing is part of the visual language of a character. The color, material and style of clothing can help the audience quickly establish an awareness of the character. In interactive animation, the character's clothing can change with the development of the plot, enhancing the expressiveness of the character's growth. In the Chinese children's dress-up app "Princess Dress-Up Adventure", children can choose different costumes for the virtual character, such as Hanfu, fairy tale costumes, modern costumes, etc. Research has found that different clothing materials exhibit significant differences in their dynamic presentation in interactive displays (Choi, 2022). For example, fairy tale princess dresses made of light, transparent gauze are more popular with girls, while metallic armor or combat uniforms are more popular with boys.

1.3 Strategies for setting interactive animated color for children

In the preschool years, different colors stimulate children's visual nerves differently and stimulate their associations. Children aged 3-4 can distinguish basic colors such as red, yellow, blue, green, orange, and purple. The vision of 5-6 years old begins to approach adult vision, gradually recognising all the hues in the spectrum and distinguishing between more obvious colors in terms of brightness. Psychologist Birren (2016) showed that colors can affect children's moods. For example, some warm and harmonious colors can bring children experiences and enjoyment, and help them maintain a happy state of mind. Some dull and gloomy colors will cause children to feel anxious. Different colors also represent different emotions in psychology (Fig. 4). By associating colors with emotions, children intuitively respond to colors in their paintings and their daily lives. For example, red represents anger, blue represents sadness, and yellow represents happiness. Therefore, the appropriate use of colors can ensure children's learning effectiveness.

The Fig. 5 shows some representative psychological literature on children's colors. According to research, color characteristics have a significant psychological impact on children, and children also have an inherent concept of color, such as a light blue sky, dark blue sea, red sun, and other established color images. The choice of colors by children can show their inner emotions, and different colors also have different emotional meanings. The choice of colors in animation design has a significant impact on children's emotional experience.

Figure 4 Emotions color (Adapted from Plutchik & Kellerman, 1980)

References	Design	Participant	Results
Anna Franklin, Paul G. Davies (2004)	Research comparing children's emotional associations with different colours	7-8 years old	Children are able to associate specific colours with emotions. Red is often associated with anger, blue with sadness and yellow with happiness. Children begin to form associations between colours and emotions at an early stage.
Gail F. Melson, Alan F. Hull (1995)	The influence of different colours on the emotions and behaviour of preschool children	4-5 years old	The use of bright, warm colours (e.g. yellow, orange) in the classroom can improve children's concentration and participation, while cool colours (e.g. blue, green) can help calm hyperactivity.
Patricia Valdez, Albert Mehrabian (1994)	The influence of colour on children's memory performance	6-7 years old	Background colours can affect children's memory performance. Specifically, children can remember detailed information more accurately against a red background, while they can remember overall concepts better against a blue background.
SiyingJi;Yunong Yan;Youzhi Feng;Mengfan Liu (2025)	Based on experiments on children's eye movements, the study investigated the influence and characteristics of colour on the attention of children aged 6 to 9	6-9 years old	Orange, yellow and blue of different hues and shades have a significant impact on children's concentration when reading. In particular, the choice and matching of colours directly affect children's reading efficiency and concentration.
Claire Golomb (1992)	Study of children's use of colour in drawings	2-12 years old	As they get older, children gradually develop the use of colour in their drawings from random selection to purposeful expression. Younger children tend to use bright colours, while older children begin to choose colours based on the real colours of objects, reflecting the development of cognitive and perceptual abilities.
Rhoda Kellogg (1969)	The relationship between colour and emotional expression in children's drawings	2-6 years old	The colours that children use in their drawings are closely related to their emotional state. For example, children in a positive mood tend to use brighter colours, while those in a low mood may choose darker shades. This shows that colour plays an important role in children's emotional expression.
John Matthews (1994)	The influence of cultural background on the choice of colours in children's drawings	3-7 years old	Comparing the use of colour in children's drawings from different cultural backgrounds, it was found that cultural factors significantly influence children's colour choices. Children from tropical regions tend to prefer warm colours, while those from cold regions prefer cool colours. This reflects the influence of environment and culture on children's perception and use of colour.
Sarah M. Johnson, Emily R. Smith (2018)	The emotional expression of colour in children's animation	5-7 years old	Bright and saturated colours in animations can trigger positive emotional responses in children, such as happiness and excitement, while dull or low-saturation colours may trigger negative emotions such as sadness or fear. This suggests that the choice of colours in animation design has an important impact on children's emotional experience.
David L. Thompson, Laura J. Williams (2020)	Based on experiments on children's eye movements, the study investigated the influence and characteristics of colour on the attention of children aged 6 to 9	8-10 years old	Using brightly coloured and contrasting characters in animations can effectively improve children's concentration. In contrast, characters with monotonous colours or low contrast may cause children to lose concentration.
Michael A. Green, Sophia T. Brown (2017)	Colour and children's comprehension of animated content	6-9 years old	Animated designs with bright colours that match the plot content can help children understand the storyline and remember it better. On the other hand, designs with colours that don't match the content may interfere with children's understanding of the animated content.

Figure 5 Literatures on children's color psychology and emotional expression (1969-2025)

Therefore, to further understand children′s perception of color, many studies have compared the color sensitivity of boys and girls, including research on animation design and interface design tailored to boys and girls. Jakovljević et al. (2021) proposed that different colors also have different effects on the comprehension and attention of boys and girls.

Fig. 5 summarizes the researchers′ findings based on literature data regarding the preferred duration of attention to color between boys and girls. According to extensive data, children exhibit certain differences in the duration of attention toward different colors, with an average attention span ranging from 5 to 7.5 seconds. Boys tend to prefer cool tones, such as blue, green, and dark hues, while girls prefer warm tones and bright colors, such as red and purple, which are also considered more approachable (Fig. 6). However, some psychologists also note that it is not advisable to frame children′s understanding of color based on adult perceptions, as the colors children currently prefer merely represent a stage in their developmental growth.

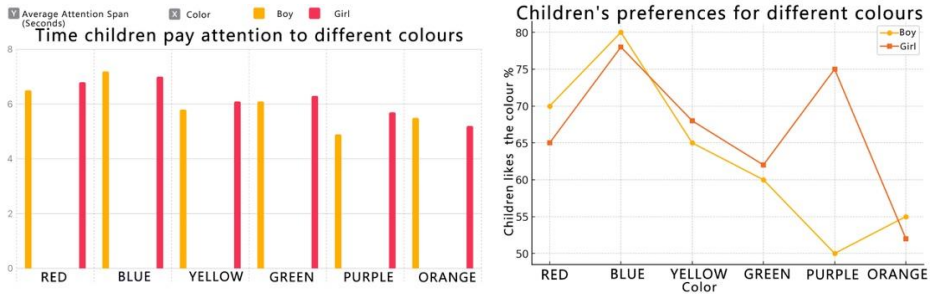

Figure 6 Duration of attention and degree of liking for different colors in children Data table

Brightness and luminosity are also important color factors for preschoolers.3-4 years old can distinguish basic colors such as red, yellow, blue, green and orange. 5-6 years old can begin to distinguish more obvious color luminosities (Fig. 7). According to the characteristics of children's visual development, high-luminosity colors are the earliest and easiest for children to perceive and recognize. A light-yellow background enhances visual clarity, helping children to recognize content more quickly and increase comprehension. Child et al. (1968) proposed that colors with lower brightness are more suitable for use in a calm, focused environment, and that high-brightness colors can extend children's attention span compared to low-brightness colors. At the same time, high-brightness colors can quickly attract children's attention, and too high a brightness may cause visual fatigue, thereby reducing concentration. For puzzle-solving games, appropriate low-brightness colors can help children focus more on the core content without being distracted by overly bright elements. When making interactive choices, high-contrast buttons are easier for children to identify, but excessive brightness should be avoided.

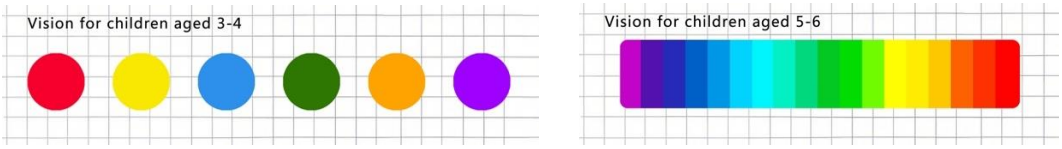

Figure 7 Color vision in children aged 3-6 (Adapted from Wang et al., 2003)

1.4 Strategies for setting interactive animated music and sound for children

The age of 3-5 is a critical period for children's initial education. Children aged 3-5 have gradually developed the ability to perceive and recognize music through their auditory senses. At the same time, children at this stage will also unconsciously hum, expressing their emotions through the frequency and amplitude of the music. For example, they will be excited by cheerful music and calm by soothing music. Caracci et al. (2022) published in the journal of graphics that in an experiment, that constructing a mapping between sound and picture and an interactive platform for children's sound-picture interaction can effectively enhance children's interactive experience and increase their interest in drawing pictures.

The music in interactive animations refers to background music. Different background music can also produce different effects. Experimental research (Cassaday et al., 2002) found that in a learning environment with soft music in the background, children's emotions are more stable, and the learning time is 22% longer than in an environment without background music. Soft, looped music is also more conducive to concentration and comprehension. When soft music is played in the background, children will have a higher memory of information when learning basic concepts such as letters, shapes, and colors. Sound effects include dialogue and prompts.

Dialogue is designed so that background music does not cover the voice and interactive sound effects, and for preschool students aged 3-6, there can be appropriate pauses to allow students to think independently. Interactive prompts are an important part of interactive music. Because this sound effect can guide children through interactive tasks, for example, conveying information through sound effects, a successful "ding dong" sound indicates a reward, and an incorrect "beep" sound reminds them to try again. Correct prompts can strengthen memory and make it easier for children to recall what they have learned. Bertelson and Tisseyre (1969) confirmed that prompts of different lengths have different reminder effects (Table 1). Too long an audio effect is likely to cause negative emotions in children, which will affect learning outcomes.

Table 1 The response effects of different sound effects on children

Sound Duration	Scene	Children's Responses
Short (0.2-0.5 seconds)	Button clicks, swipes, feedback	Instant feedback improves concentration
Medium length (0.5-1 second)	Rewards, error messages, task start	Enhances interactivity and aids comprehension
Long sound effect (1-2 seconds)	Countdown, special animations, situational sound effects	Create a sense of immersion and guide emotions

1.5 Strategies for setting interactive animated touch elements for children

Touch elements are a characteristic of interactive animation design, and intuitive operation allows users to interact with the machine. This interaction puts the user in the driving seat and is designed to cater to interactive and fun learning methods. In children's interactive animations, because children are at an early stage of cognition, we have to consider the design of the touch elements of the interactive animation.

In children's interactive animations, the main touch elements are in the form of clicks, drags, swipes, pinches, and rotations (Fig. 8). In interactive animation learning, children's cognition is obtained through these parts of the touch method. Xie et al. (2018) have confirmed that the reasonable use of touch elements can help children understand cause-and-effect relationships more quickly, strengthen their understanding of logic, and thus better enhance their understanding and creativity. It has been confirmed by child experts that active touch in interactive animations can increase attention and concentration and also improve memory, compared to passive viewing of interactive animations. Therefore, touch element design can help enhance the interactive animation experience.

Figure 8 Children's touch gestures in interactive animations

According to research on interactive animation apps currently on the market, clicking and dragging are the most commonly used interactive button forms. Especially for interactive animation designed for children aged 3-4, clicking and dragging are the simplest forms of interaction, quickly helping children establish cause-and-effect relationships within the story. Interactive animations designed for children aged 5-6 can add interactive

button forms such as swiping and pinching, because the cognition of 5–6-year-olds is gradually developing. Swiping can exercise the fine control of children's fingers and wrists, and pinching will help children observe. Swiping buttons are suitable for exploratory interactive animations, such as zooming in on a map. During the touch control process, an effective mechanism needs to be established with the child. Sluggishness and slow feedback can cause unnecessary cognitive distraction in the learning process. In addition, Lanna & Oro (2019) found in their research that children aged 3-6 years old occasionally drag and click unnecessarily on the device due to physical limitations, so effective guidance is needed during the design process.

2. Cognitive and psychological development in children

Understanding children's cognitive development is very helpful for interactive animation design, as it directly affects how children can improve their understanding and creativity through interactive animation. Children of different ages differ in perception and attention, language development and thinking and calculation. By studying the literature on children's cognition from the ages of 3 to 6, researchers will understand how to improve their understanding and creativity through interactive animation.

2.1 Perception

Children in the pre-operational stage are in a concrete thinking mode and cannot understand abstract concepts. Children in this stage can associate real-life objects or events with representational symbols, and their internal mental representations are extremely rich. They begin to use symbols to replace the real world or express real ideas through drawings. They use simple lines and colors to replace "mum", "sun" and "animals". Children at this stage believe that some things are also conscious and alive. They often extend human consciousness and motives to inanimate things, for example, treating toys as real companions and pencils as a castle. This process is called "Animism" (Tylor, 1871).

The animist perspective is widely used in character design for interactive animation. Goldman and Poulin-Dubois (2024) proposed that the anthropomorphic behaviour of characters in interactive animation can better engage children in the role, such as "speaking", jumping" and "smiling", which will promote the development of children's imagination and creativity. In addition, according to the researcher's studies of the literature on the design of interactive animation characters, animal characters are more popular than human characters. Compared with human characters, talking animals, animals that wear clothes or animals that can dance are more likely to stimulate children's imagination. The reasonable use of animism theory to help children establish an emotional connection is important for interactive animation design. Interactive animation design that conforms to children's perceptual characteristics can enhance their interest, strengthen the interactive experience, and thus promote their understanding of the learning content and the development of creativity.

2.2 Attention

Attention is the initial stage of children's thinking. The stability and concentration of attention directly affect the acquisition and processing of information. Children's attention span also increases with age.

- Children aged 3-4 years old generally have an attention span of about 5-10 minutes.
- Children aged 5-6 years old have an attention span of about 10-15 minutes.

According to Leontiev (1978), children's attention can be divided into two types:

- Inattentive attention: At the early age of 3-4 years old, children mainly have inattentive attention, which is passive and easily distracted.

• Intentional attention: As children grow older, they begin to develop a sense of purpose and goal orientation, and their attention gradually becomes autonomous and controllable.

Children with intentional attention paid more attention to details and refinement than those with unintentional attention. At the same time, there were significant differences in their attention to graphics, colors, sounds, and interactions. Fig.9 shows cartoon graphics designed by researcher to facilitate intuitive comparison of the detail levels of similar graphics. Based on the image, the blue bear graphic pays more attention to detail changes than the orange bear graphic, and the interactive buttons have changed from simple geometric shapes to recognizable complex shapes. Based on the above research, in terms of color, the focus has shifted from basic colors to recognizable color layers (Fig. 10).

Lin (2011) concluded in his study on the role of animation in enhancing children's attention that children should actively search for or utilize specific visual information within animations to enhance their attention. This strategy also reduces cognitive load caused by irrelevant searches, freeing up working memory capacity for more intrinsic learning. In interactive animations, guiding children to actively search for visual content can improve their attention. However, it is important to consider the varying durations of attention among different children and design interactive animations appropriately.

Figure 9 Comparison of attention graphics in children of different ages

Figure 10 Comparison of attention color in children of different ages (Adapted from Wang et al., 2003)

2.3 Thinking

Children in the pre-operational stage of thinking mainly use intuitive thinking, and they like stories that present exaggerated visuals, story-driven plots, and simple cause-and-effect interactions. At the same time, children in this stage are in an irreversible thinking mode and have difficulty thinking backwards. For example, when children pour juice from a short and fat cup into a tall and thin cup, due to their irreversible thinking, they will mistakenly believe that there is more juice in the tall and thin cup because they only focus on the height and ignore the fact that the volume remains the same (Cognitive Development Theory, 1952). In conjunction with this research, some interactive animation designs will use demonstrations to help children demonstrate logical thinking. This will greatly help children establish cause and effect relationships, such as putting apples in a basket in sequence, or rescuing trapped animals in sequence, etc. At the same time, the undo and redo touch elements

in the interactive animation will cause difficulties for children to understand, resulting in frustration due to incorrect operation. Voice-over animation guidance is more acceptable and easier for children to understand than pure pictures or text.

3. Content of traditional Chinese Culture

Research on Traditional Chinese Culture focuses on the current state of preschool students' learning of Traditional Chinese Culture and the content of traditional culture. Through research on these two aspects, a traditional culture suitable for interactive animation design is selected, thereby enabling preschool students to understand and creatively learn traditional culture. This is also the ultimate goal of the research.

3.1 Research on the Current Status of Preschool Students Learning Traditional Culture in China

According to the current educational planning for kindergartens, there are significant differences and distinctions in the content and objectives of traditional culture education between preschool students aged 3-4 and those aged 5-6.

- 3-4 years old students: The curriculum primarily focuses on reading and literacy. Through teacher-led instruction, children learn to read traditional cultural texts and develop literacy skills through reading. This stage emphasizes language input and knowledge absorption, serving as a foundational phase centered on cultivating comprehension skills.
- 5-6 years old students: Based on reading and literacy, traditional culture storytelling is added. Children not only master the connotations of traditional culture, but also form their understanding and can narrate it creatively.

Therefore, from the perspective of curriculum structure, 3-4 years old students mainly focus on understanding, while 5-6 years old students gradually transition to creative expression. The core goal of both is to enhance preschool students' understanding and creativity in traditional culture.

Preschool students learn traditional culture mainly through art activities conducted by teachers in kindergartens, parenting education for parents, picture book reading for children, and interactive game experiences. The Fig. 11 shows a survey questionnaire conducted in 2022 in Jinshui District, Zhengzhou, Henan Province, China, targeting students in a kindergarten. The questionnaire shows the ranking of preschool students' preferences for different traditional culture learning methods. As can be seen, Game& Interactive Experiences (20%) and Craftsmanship (18%) are the two favorite learning methods for students. In contrast, Drama (7%) and Learn with Parents (4%) are less popular.

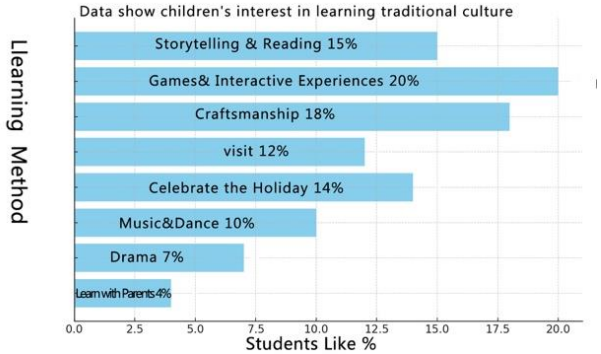

Figure 11 Data show children's interest in learning traditional culture

The kindergarten also conducted a questionnaire on the way of learning through play and interaction (Fig. 12). The research shows that Role-Playing and Interactive Animation are children's favorite ways of interaction, at 25% and 20% respectively.

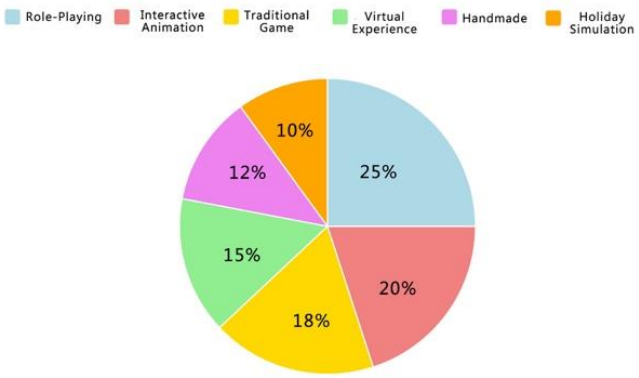

Figure 12 Children's preferences for different ways of playing and interacting

3.2 Traditional Chinese cultural elements

Interactive animation learning methods have market potential in China. Judging from the current click rates of traditional culture-related animations among Chinese children until 2022 (no interactive animation click rates found), the top three types of animations that children like are myths and legends, traditional festivals, and intangible cultural heritage techniques (Table 2).

Table 2 Click rate of traditional culture-related animations among Chinese children table (until 2022)(Ten thousand calculate)

	Animation	Click Rate (Ten Thousand)
1	Mythology	250
2	Traditional Festival	230
3	Intangible Cultural Heritage	196
4	Historical Allusion	170
5	Story of Chinese Idiom	142
6	Farming Culture	127
7	Theatrical Art	98

First, Chinese mythological stories (such as idiom stories, myths and legends, and historical anecdotes) are highly narrative and are suitable for increasing engagement through role-playing and interactive experiences. By setting up different branches that influence the direction of the story, a single storyline can develop into multiple plots, thereby increasing understanding of traditional culture. This interaction not only stimulates creative thinking, but also deepens understanding of traditional cultural plots and characters. Secondly, traditional festival-related content (such as the Spring Festival, Dragon Boat Festival, and Mid-Autumn Festival) is suitable for guiding children's participation through task-based interactive experiences. As Bao (2024) pointed out, traditional festivals are more suitable for creating children's picture books, which can spark children's interest through interactive reading. In some Chinese interactive animation apps, interactive designs such as the

"dumpling-making" and the "zongzi-making" activities allow children to select ingredients and operate tools to complete the festival activities.

Third, Chinese arts and crafts (such as Chinese calligraphy, shadow puppetry, and Peking opera) are more suitable for interactive animation design that emphasizes control and exploration. These arts and crafts emphasize hands-on practice and sensory feedback, allowing children to form a preliminary understanding of traditional arts and crafts.

In terms of character design, differentiation should be made based on cultural categories and narrative styles. Mythological characters should adopt classic designs (such as Sun Wukong, Nezha, and Zhu Bajie) to reinforce the story's recognizability. Festival-themed content should be presented in the form of cartoon animals + cultural props, such as cats wearing theatrical costumes or zodiac animals eating dumplings, to increase cultural appeal.

Additionally, in interactive animation, typical motion design is equally crucial. Typical motions refer to representative, repetitive, and easily recognizable body language that helps enhance a character's emotional expression and improve character recognition. As Nie (2005) mentioned in *Animation Introduction*, many characters in traditional Chinese animation have fixed, iconic actions, such as Sun Wukong swinging his golden staff, Nezha riding the wind and fire wheels, and Black Cat Detective saluting. These actions can not only serve as key feedback points or trigger mechanisms during interaction but also function as cultural memories.

In subsequent practice and research, the design of character images and typical movements in Traditional Chinese Culture can be studied in terms of children's cognitive and emotional acceptance of different styles of character design and movement. In addition, the assessment model for whether interactive animation can promote the learning effectiveness of traditional culture among preschool students' needs to be further refined in the future.

Discussion

Research indicates that the rational design of interactive animated elements can promote the development of preschool students' comprehension and creativity. Through the design of open-ended plots, dynamic visual guidance, musical rhythm control, and cause-and-effect operations, their learning motivation can be stimulated. As noted by Li et al. (2024) and Agustina et al. (2023), highly interactive technologies can effectively enhance children's interest and initiative in learning through timely feedback, dynamic participation, and personalized path design, promoting the development of various skills such as language comprehension, logical reasoning, and creative expression. In the design and analysis of interactive animation elements, this study classified and discussed children of different age groups. This layered design approach is consistent with Vygotsky's theory of the "zone of proximal development" (Vygotsky, 1978). Through appropriate guidance and support from interactive animation elements, students can gradually move from their current actual abilities to a higher level of cognition. This theory has been proven in the studies of Eun (2019), Daneshfar and Moharami (2018), Herodotou (2018). This theory helps to improve the understanding and problem-solving skills of preschool students.

The cognitive development of preschool students is characterized by animism, a tendency to focus on single features, and irreversible thinking. Based on this information, interactive animations utilize visualization, contextualization, and operationalization to support the cognitive development of preschool students, aligning

with children's understanding patterns. This finding aligns with the conclusions of Vedechkina and Borgonovi (2021), who found that dynamic presentation and interactive mechanisms can guide children's attention, enhance the depth and breadth of understanding, and thereby promote the development of flexible and creative thinking.

Layered planning of traditional cultural elements facilitates progressive learning. Combining standardized movements from Traditional Chinese Culture enhances children's cultural familiarity. Designing with cultural context not only optimizes teaching but also serves as an important pathway for children to transition from imitation to creation. This finding aligns with Blumberg et al. (2019)'s research conclusion that integrating specific cultural behavioral elements into interactive scenarios facilitates cognitive process transfer toward contextual and active creation in cultural learning.

Conclusions and Suggestions

The findings in this study supports and validate the hypothesis that interactive animation elements can boost a preschooler's interest in traditional culture and their ability to understand it. Furthermore, traditional cultural content is great for being remade into these animations, which helps children move from simply imitating what they see to creating their own new ideas.. The results show that:

1. Interactive animation elements suitable for children's cognitive characteristics, such as clear, structured plots, graphic character designs, effective guidance through color and music elements, and reasonable touch feedback mechanisms, can effectively enhance preschool students' interest in learning and cultural comprehension skills. Meanwhile, children's perception, attention, and thinking skills also directly affect the teaching effectiveness of interactive animation, strengthening their understanding of story development and imaginative thinking.

2. Traditional Chinese Culture, with distinctive visual characteristics and stylized movements, such as myths and legends, traditional crafts, and traditional Chinese art, is suitable for re-creation in interactive animation design, intending to facilitate cognitive transfer from imitation to creation in children. At the same time, combining the principle of layered design provides an effective path for children's cultural learning.

3. Reasonable interactive animation design can improve preschool students' comprehension skills and creativity. For the future, we recommend the following: First, conduct in-depth research on interactive animation design strategies for children with special educational needs (such as language development delays and autism spectrum disorders) at different age stages (3-4 and 5-6). Second, combine the application of technologies such as augmented reality (AR) and virtual reality (VR) in traditional cultural learning to enhance children's interactive experience and creative expression in virtual environments. Test the acceptance of interactive animations in a multicultural context to establish adaptive validation and expression paradigms tailored to different cultural backgrounds.

This study has some limitations that should be noted. One limitation of this study is that it primarily relies on literature and theoretical analysis, lacking empirical data support, particularly in terms of in-depth experimental comparisons of specific responses and behavioral manifestations among children of different age groups. Additionally, during the initial stages of selecting traditional cultural content and establishing a preliminary framework, quantitative assessments of the subsequent learning outcomes for preschool students remain limited. These limitations point the way forward for future research. Subsequent studies involving

interactive animation design and field testing will enrich the design dimensions and data support, thereby promoting the deeper development of interactive animation in preschool education and providing a theoretical foundation for cross-cultural integration research.

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Author Contributions

Author 1 (Jingyue Zhang): Research design, literature review, data collection and interpretation, manuscript writing, and communication.

Author 2 (Chayanis Chuenchaichon): Theoretical guidance, development and design of methodology, data analysis and design, manuscript review.

Conflict of Interests

The author declares no conflict of interest.

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