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Design of Children's Artistic Creation Products Integrating AR and Tangible Interactions

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Abstract. To enhance the aesthetic and creative development of children aged 7 to 12, the research aims to create interactive children's artistic creation products that are better suited for their learning and experience growth. This research proposes a method based on Interface interaction hierarchy Design and gesture interactions within an augmented reality (AR) spatial environment. Taking children as the research subjects, this study aims to reshape the contemporary methods of artistic creation for children. Firstly, a questionnaire survey was conducted to comprehend their attitudes, opinions, and experiences regarding children's artistic creation products that integrate AR and tangible interactions. Secondly, an A/B comparative user experience test was conducted, involving the participation of 40 children who used children's artistic creation products integrating AR and tangible interactions. Their usage processes and outcomes related to visual interfaces and spatial interactions were documented. The results confirm that the purity and intensity of colors, and the dynamic effects of images will attract children. A single-level interactive interface is better suited for children to navigate and execute commands. And regarding spatial gesture interactions, employing familiar hand-held actions based on everyday intuitive gestures (such as grabbing for movement, zooming, rotating, etc.) makes it easier for children to naturally interact and successfully engage in artistic creations. Within the process steps of combining software and hardware operations, triggering software interface commands through the recognition of the physical product's form and the hand's grip style offers increased simplicity and usability. This study contributes to the artistic creation field within future virtual reality environments like AR, by providing a more intricate approach to behavior design, centered around children's capabilities. It offers refined methods for integrated hardware and software interaction, immersive creative experiences, and design decisions for interactive interfaces. In conclusion, this study concludes in a design practice based on the research findings. It affirms that the proposed method for designing children's artistic creation product contributes significantly to enhancing children's artistic expression and fostering creativity. This research provides a new perspective and methodology for the future development of children's artistic creation product designs.

Keywords. Augmented Reality, Artistic Creation, Space Interaction, Tangible Interaction, Children Gesture Design

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1. Introduction

The emergence of digital media and new technologies has immersed us in a media-centric society that evolves alongside technological progress. These progressions have reshaped how we connect, create, access, and use information, as well as in the mediums through which we engage in these activities. [1] With the intervention of digital technology, contemporary children's artistic creation is gradually undergoing a shift towards digitalization. The incorporation of technologies such as Augmented Reality (AR), Virtual Reality (VR), and Artificial Intelligence (AI) has expanded the realm of artistic creation, providing greater possibilities for creative expression. The medium for artistic creation is no longer restricted to paper, gradually extending into virtual spaces.

Based on research into interactive children's product design that incorporates audiovisual associations, it has been observed that children aged 7 to 12, during this stage of artistic development, become more discerning about their creations. And the structured sequence for depicting objects no longer satisfies them. While frameworks are still used for drawing, they are more intricate than the ones used in earlier stages. Overlapping becomes visible, and there's a heightened sense of spatial relationships [2]. Furthermore, by emphasizing art-based and multimodal practices, not only does it describe children's knowledge and comprehension of the surrounding world, but also various symbolic representations such as auditory cues, gestures, language, spatial relationships, and visual patterns can be employed to elucidate essential content and concepts. This approach uncovers children's creativity and facilitates effective communication methods [3]. Hence, we have chosen to target the age range of 7-12 years, a pivotal period for enhancing aesthetics and creativity. During this stage, children have moved beyond the unstructured scribbles of their early years and entered a phase characterized by a deeper understanding of concepts and divergent thinking. Exposure to artistic creation products during this stage can nurture children's artistic perception and creativity, allowing them to explore their interests, values, and sense of identity. This contributes to the development of their individual expression and self-concept.

Therefore, this paper presents a method based on interface hierarchy design within an AR spatial environment and gesture interactions. The study centers on children as research subjects, aiming to reshape contemporary approaches to children's artistic creation. Employing questionnaire surveys and A/B comparative experimental tests, the study engaged 40 children aged 7-12 years in a series of tests encompassing visual colors, animations, software interaction hierarchies, spatial gesture interactions, and methods of triggering operational functions. This research endeavors to offer a new perspective and methodology for the future development of children's art education.

2. Literature review

2.1. The Status of Research on Children's Artistic Creations

Children's artistic creation plays a significant role in their growth and development. Artistic creation serves as a means not only for expressing personality and emotions but also for nurturing children's creativity, imagination, and expressive abilities. By engaging in artistic creation, children can exhibit their inner worlds, discover themselves, and enhance their self-confidence.

Existing children's artistic creation products also encompass various interaction modes, primarily categorized into tangible interaction and virtual interaction. The majority of commonly seen products are based on tangible interaction, where children can use physical tools such as brushes, handles, and other tangible instruments for creation. They directly engage in drawing, doodling, coloring, and other forms of artistic expression on physical surfaces like paper or clay. With the advancement of technology, virtual interaction is also gaining prominence. Some products support gesture interaction, allowing children to control the shape, size, and color of brushes using gestures. This enhances the interactivity and enjoyment of the creative process [4]. For example, Tracy's research substantiated that incorporating digital artistic creation tools as supplements is highly useful for learning traditional paper-based artistic creation forms and enhancing overall learning [5]. Various projects in children's art education from different countries, a series of experimental art projects initiated by Google Creative Lab, and virtual reality interactive art exhibitions held worldwide by the Japanese new media art collective TeamLab are successful examples of applying generative art to contemporary children's art education. Such as AI shadow puppetry and VR art learning courses. These artistic creation products break down the boundaries between art and technology, sparking children's active engagement in artistic creation [6].

These interaction modes aim to stimulate children's creativity and imagination, and foster their interest and learning in art. Additionally, certain products integrate both tangible interaction and virtual reality technologies, allowing children to interact with virtual artworks, thereby enhancing the sense of immersion and engagement in the creative process.

2.2. Application and development of AR technology and tangible interaction in children's artistic creation

Some studies suggest that technology can significantly enhance children's learning experiences across various subjects [7]. tangible interaction technology refers to the technology that involves interacting with physical objects. Research on tangible interaction is inspired by various disciplines, including psychology, sociology, engineering, and human-computer interaction [8]. The combination of tangible interaction technology and AR technology allows children to immerse themselves more effectively in artistic creation. In recent years, the utilization of AR technology and tangible interaction has gained increasing prominence in children's artistic creation. The use of augmented reality systems enhances students' engagement in visual art learning [9]. There are already numerous examples of using AR technology for artistic creation. For instance, by leveraging sensor technology and tangible interaction devices, children can interact with digital artworks through gestures, language, sound, and other means. This enhances their sense of engagement during artistic creation, thereby increasing their interest and curiosity in artistic exploration [10]. Through the combination of AR technology and tangible interaction, children can interact with virtual artworks, enhancing their understanding and appreciation of art pieces. The integration of new technology not only provides children with novel artistic experiences but also enriches the content and format of children's art education. It helps expand their horizons and stimulates their creativity.

In conclusion, the design of children's art creation products that integrate AR and tangible interaction requires following specific design methods and processes. To ensure the quality and effectiveness of these products, this paper employs questionnaire surveys, experimental design research methods, and AB comparison tests. Placing children's needs and experiences at the forefront, the study conducts research on children's requirements and collects user feedback. By assessing factors such as children's preferences for visual interfaces, the intuitiveness of visual operations, and the natural comfort of spatial gesture interactions, the study aims to better understand their expectations and needs. This approach helps cater to the children's requirements and assess the effectiveness and sustainability of their artistic learning experiences in an AR environment.

3. Method

3.1. Questionnaire Design

To explore the usage needs of the target users for art creation products, this study surveyed the form of a questionnaire. The survey was conducted for both children and educators to understand their attitudes, opinions, and experiences regarding children's art creation products that integrate AR and tangible interaction. Through quantitative and qualitative data analysis, the study aimed to gather insights into users' perspectives on the product as well as their suggestions for improvement.

Children are the primary subjects of this research, but the survey was distributed to parents of these children. Through the internet, a survey was disseminated to parents of children nationwide to collect user data. The purpose was to establish a more direct connection with parents and gain insights into the current developmental status of various abilities in their children. This also aimed to understand parents' perceptions of their children's capabilities and their expectations regarding art creation products. The collected data serves as a foundational reference for further case studies in this area[11]. The purpose of this survey is to utilize the gathered information and data to ascertain the psychological, behavioral, and needs aspects of children. It aims to acquire user preferences and explore opportunities that can guide design practices. Additionally, it serves as guidance for creating prototypes of art creation products and exploring methods to establish immersive experiences for children.

The questionnaire is divided into three sections. The first section aims to gather basic information about the survey participants. The second section focuses primarily on the practical usage of children's art creation products. The third section involves understanding the expectations of the target users regarding art creation products,to uncover potential opportunities for the design of children's art creation products. Certain questions in the survey employ the Likert 10-level scale, where users rate the provided content based on their real experiences and feelings, ranging from "Dislike Very Much" (1) to "Like Very Much" (10). The questionnaire statements are presented as shown in Table 1, comprising a total of 11 questions.

Table 1. Survey Questionnaire on Visual Brightness, Color, and Motion Effects in Children's Group

variate	Question
Basic Information	Ages of Parents and Children Gender of Children Age of Children Whether to contact children's art education What products or toys related to artistic creation have you used

Product Using condition	What kind of activities do children like to do? What tools do children use to draw and doodle? Brightness: Brighter colors can stimulate children's interest in using Dynamic effect: More dynamic effects can stimulate children's interest in using Color range: How many colors do you think are more suitable for children?

3.2. Interaction Interface Testing

The purpose of this experiment is to explore the influence of the design of icon hierarchy and icon distance in interactive interface on the operation of children aged 7-12 years old in an AR environment, and to produce the design scheme of Child-centered functional icon hierarchy and distance in AR environment by setting two experiments. The two experimental objectives are divided into two items: (1) In the AR interactive interface, which is more suitable for children's choice and operation of art functions, single-level and double-level function icons. (2) Whether the distance between icons in the AR interface affects children's tapping efficiency.

The two experimental designs primarily employed the AB comparison testing method and observational method for conducting research. A total of 40 children aged 7-12 were recruited for this testing, and an AR headset was prepared. For investigating the impact of icon hierarchy on children's interactions. A flow is designed that requires children to tap the functional steps and provides A/B single-level and double-level interfaces (Image 1).

By recording the completion times of children, a comparison can be made to determine which design approach enhances the efficiency of children's ability to quickly retrieve functions. Subsequently, through the creation of charts, a comparison can be made to identify which icon hierarchy better aligns with a child-centric design approach based on their abilities.

Image 1. Setting of action steps and A/B Icon Hierarchy interface

In testing the influence of icon distance on children's operation, as shown in Image 2, a process requiring children to open functional steps is designed, and an interface with different icon distance between A and B interface. The interval is 2PX and 1PX respectively. By recording the completion time of children, the interface in which the design scheme has a higher fault tolerance rate is compared, and it is helpful for children to quickly retrieve the function. Then the chart is drawn to compare which distance between icons is more consistent with the child-centered design.

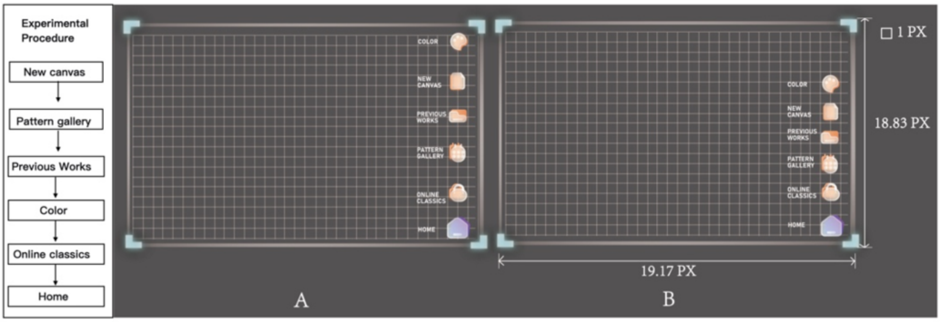

Image 2. Setting of action steps and A/B Icon distance style on the interface

3.3. Gesture and Spatial Interaction Testing

The purpose of this experiment is to explore the design of different gestures and spatial interactions in an AR environment. Three sets of gestures were designed to control the zooming, rotation, and movement of virtual objects. The testing objectives are divided into three parts: (1) In spatial interactions within the AR environment, which gesture is more suitable for children to zoom in on objects to achieve artistic shaping tasks? (2) In spatial interactions within the AR environment, which gesture is more suitable for children to rotate virtual objects? (3) In spatial interactions within the AR environment, which gesture is more suitable for children to move objects and graphics?

This experimental design primarily employed A/B testing and questionnaire surveys. As illustrated in Image 3, at the Gesture and Spatial Interaction Testing site, a total of 40 children aged 7 to 12 were gathered, and AR glasses were provided for them to wear. In the software, we design A and B different gestures to move, rotate and zoom virtual objects in the space. Subsequently, a questionnaire was distributed to the children for them to rate their experiences, as shown in Table 2. And a chart is drawn to compare which gesture command is more in line with the child-centered design and easier to operate and learn.

Image 3. Experiment site of gesture and space interaction test

Table 2. Test score table for zooming, moving, and rotating virtual objects in AR space.

Test content	Gesture category	Satisfaction rating (check)
Zoom object test	Gesture Test A	1 2 3 4 5 6 7 8 9 10
	Gesture Test B	1 2 3 4 5 6 7 8 9 10
Moving object test	Gesture Test A	1 2 3 4 5 6 7 8 9 10
	Gesture Test B	1 2 3 4 5 6 7 8 9 10
Rotating object test	Gesture Test A	1 2 3 4 5 6 7 8 9 10

	Gesture Test B	1 2 3 4 5 6 7 8 9 10
The test of ways to trigger the function of artistic creation	Gesture Test A	1 2 3 4 5 6 7 8 9 10
	Gesture Test B	1 2 3 4 5 6 7 8 9 10

In the AR spatial testing, as shown in Image 4, the AR software was designed to use gestures of single-handed palm expansion and contraction, as well as double-handed spreading and closing, to control the zooming of virtual objects. The purpose of this design was to assess which gesture was better suited for children to manipulate object zooming, and to enable children to achieve smoother transitions between objects during object sculpting.

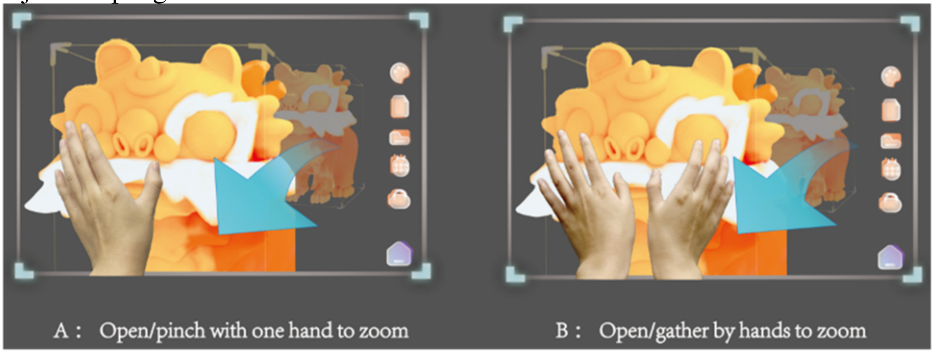

Image 4. A/B Different gestures control virtual object zoom.

In the AR space testing, as shown in Image 5, in the AR software design, different gestures are used to trigger the rotation of virtual objects, including swaying with a single hand palm facing left or right, and swaying with 2 or 3 fingers facing left or right. This aims to test which gesture is more suitable for children to control object rotation, enabling smoother and more convenient color selection or virtual object rotation during children's interactions.

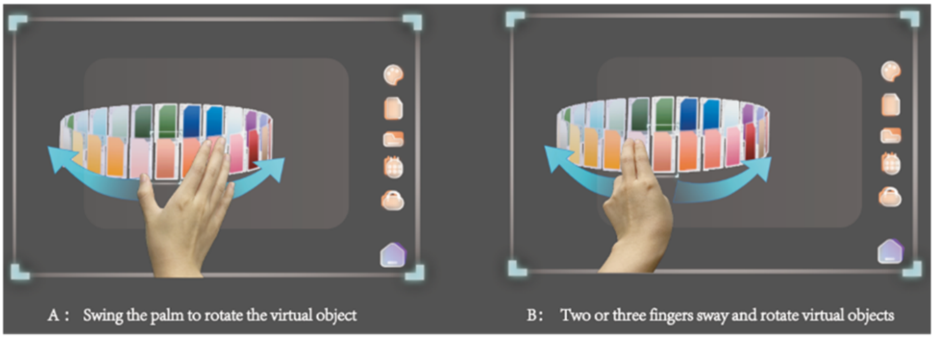

Image 5. A/B Different Gestures for Controlling Virtual Object Rotation

In the AR testing environment, as shown in Image 6, within the AR software design, two different gestures are used to control the rotation of virtual objects: one is using a clenched fist for movement and the other is using an open hand for movement. The purpose of this testing is to determine which of these gestures is more suitable for children to manipulate object movement, aiming to provide a smoother and more natural experience for children when dragging objects or placing them in different positions within the virtual space.

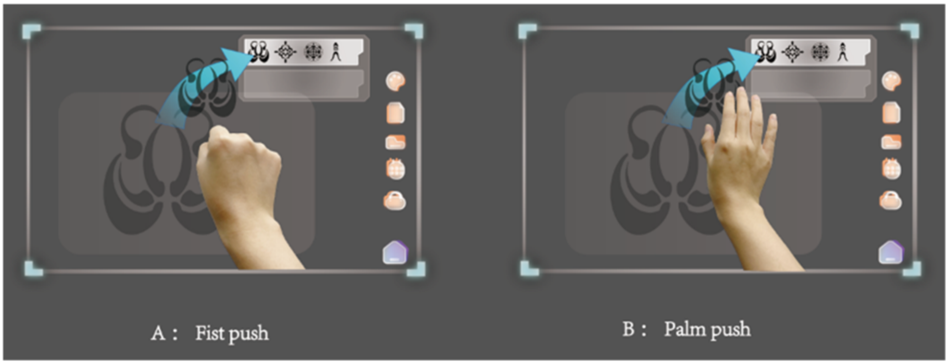

Image 6. A/B Different Gestures for Controlling Virtual Object Movement

3.4. Testing of Integrated Software and Hardware Trigger Functions

The objective of this experiment is to explore the methods of activating different functions in an AR environment through integrated interaction between handheld physical art tools and virtual interfaces. Explore which type of triggering method is more suitable for children.

This experiment is primarily designed using the AB testing method and questionnaire survey. A total of 40 children aged 7 to 12 are gathered, and an AR headset along with a physical handheld tool are prepared. The AR visual capabilities can recognize the appearance of the physical handheld tool and the grip of the hand. The methods to activate different creative functions are depicted in Image 7. They involve either recognizing the physical tool's appearance and hand grip through the interface or activating the functions by physically pressing the tool onto the functional icons.

And then, we administered a questionnaire (Table 2) to the children to gather their ratings, and then compared the results using graphical representations to contrast which method of activating artistic creation functions is more suitable for children.

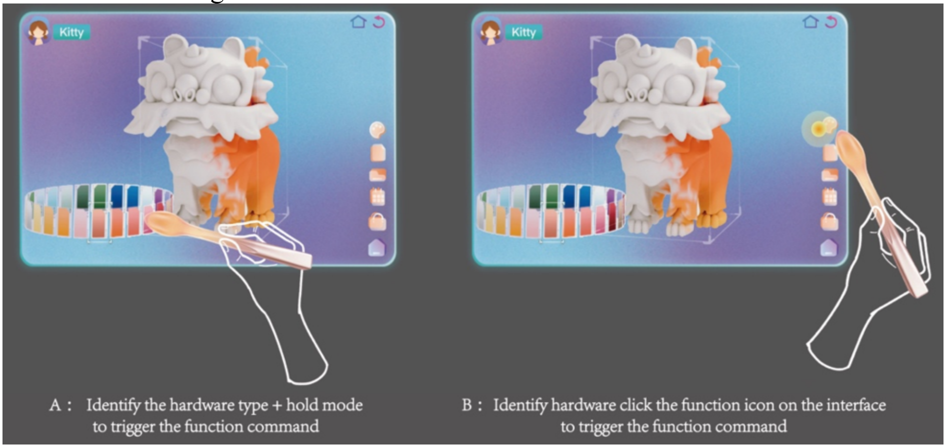

Image 7. Different Methods of Triggering Various Artistic Creation Commands (A and B)

4. Result

4.1. Questionnaire Results

The questionnaire collection was conducted in China. The sampling technique used was random sampling, which has the advantage of collecting sufficient data within a relatively limited time while ensuring the universality of the data. The questionnaire collection methods included online questionnaire surveys and on-site questionnaire surveys.

The advantage of online questionnaires is their convenience for respondents and the ability to reach a broader range of people. Online questionnaires are distributed to survey participants through instant messaging apps, emails, and other online tools. A total of 103 online questionnaires were collected. The sample characteristics are shown in Table 3, and the basic results of the questionnaire are shown in Figure 1.

Table 3 provides a comprehensive overview of the sample characteristics. Among the collected responses, male children accounted for 60.19%, while female children accounted for 39.81%. Children aged 5-7 constituted 22.33% of the sample, those aged 8-10 comprised 40.78%, and children aged 11-12 represented 36.89%. Notably, 80.58% of the children had been exposed to children's art education.

Table 3. Sample characteristics

trait	type	Frequency	Percentage
gender	Male	62	60.19%
	Female	41	39.81%
age	5-7	23	22.33%
	8-10	42	40.78%
	11-12	38	36.89%
whether to contact children's art education	yes	83	80.58%
	no	20	19.42%

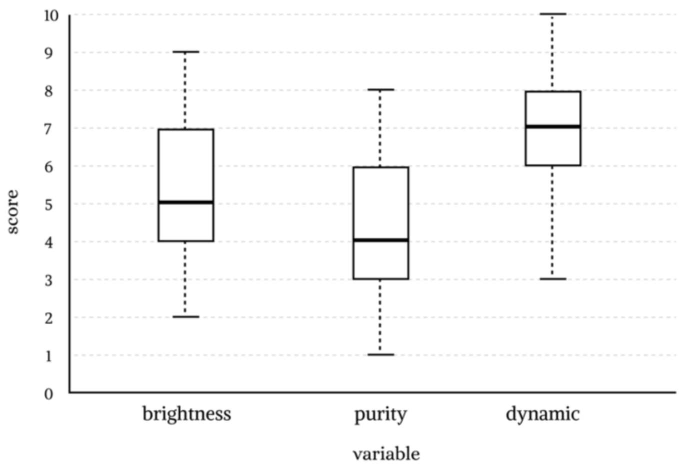

Figure 1. Questionnaire Results

The questionnaire results indicate that children are more sensitive to high-brightness colors, and most parents would choose to display 4-7 colors with high purity and brightness in a single interface for their children. Special effects feedback can attract children's immersive experiences. Their daily activities include drawing, playing musical instruments, basic programming, and dancing. The toys at home typically have both entertainment and educational aspects, such as early learning robots, electronic drawing boards, LEGO toys, and electronic pets. 83.24% of children use physical paper and pens as their drawing tools, while 16.76% of children use electronic devices such as tablets for drawing. Some children have also experienced virtual reality art creation systems in museums. In terms of interface, using graphical language instead of traditional text makes it easier for children to quickly understand functional attributes. Additionally, simplifying complex steps of an art experience can help children focus more on the entire process of art creation.

4.2. Experimental Test Results for Functional Icon Hierarchy and Distance in the Interaction Interface

The experimental conclusion reveals that during the testing of different interface designs for functional icon interaction hierarchy (Figure 2), 95% of the children completed the given selection process within the 20-60s time frame. However, within the same time frame, only 55% of the children completed the process in the dual-function option hierarchy design (Table 4). This indicates that the design with a single-function hierarchy results in shorter operation times for children. This experimental result highlights that simplifying unnecessary steps in interface design can lead to smoother interactions for children, and it also enhances the promptness of receiving feedback on functionality.

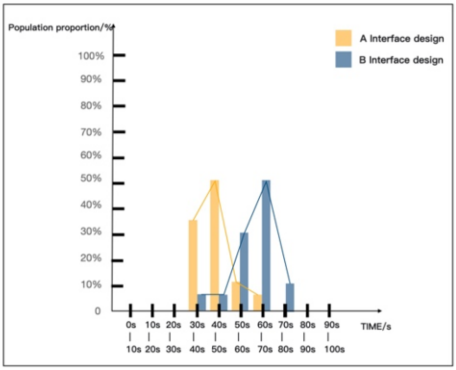

Figure 2. The reaction time for children to tap the icon in the A and B interface.

Table 4. Analysis Table for Two Different Functional Icon Hierarchy Levels, A and B

Type	A	B
20s-30s	0.0%	0.0%
20s-40s	35.0%	5.0%
20s-50s	85.0%	10.0%
20s-60s	95.0%	40.0%
20s-70s	100.0%	90.0%
20s-80s	100.0%	100.0%

In the test of different spacing designs between functional icons (Figure 3), for the design with icons spaced 1 pixel apart, 90% of the children completed the given selection process in the 10s—50s time range. In the same time range, 70% of the children completed the process in the design with icons spaced 2 pixels apart. This indicates that a tightly spaced design of icons with a distance of 1 pixel in the AR interface leads to shorter operational times for children, creating a smaller visual area and thus making it easier to locate the icons. (Table 5)

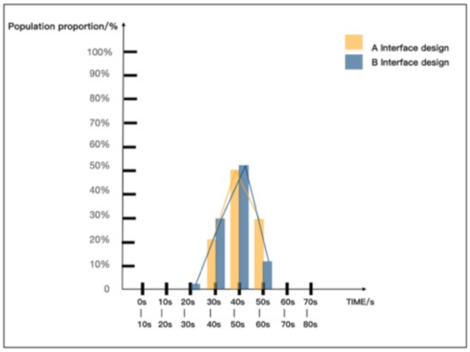

Figure 3. The reaction time for children to tap the icon in the A and B interface.

Table 5. Analysis Table for two different distance function icons (A and B)

Time/s \Type	A	B
10s-20s	0.0%	0.0%
10s-30s	0.0%	2.5%
10s-40s	20.0%	37.5%
10s-50s	70.0%	90.0%
10s-60s	100.0%	100.0%

The experimental conclusion regarding the interaction between different gestures and controlling virtual object zooming in the virtual environment (Figure 4), based on the analysis of experimental data, 75% of the children rated Gesture A between 7-10 points, whereas only 5% of children rated Gesture B within the same range. This indicates that for the virtual object zooming command, the gesture of single-handed opening and closing is more effective. (Table 6)

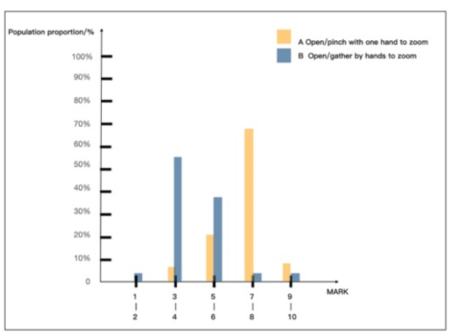

Figure 4. The proportion comparison between zoom gesture A and B in satisfaction

Table 6. Analysis of Questionnaire Ratings for A and B Gestures in Controlling Virtual Object Zooming

Mark / Type	A	B
1-2	0.0%	2.5%
3-4	5.0%	55.0%

5-6	20.0%	37.5%
7-8	67.5%	2.5%
9-10	7.5%	2.5%

In the testing of the interaction relationship for different gestures controlling the rotation of virtual objects in the interface (Figure 5), the analysis of experimental data indicates that 82.5% of children rated gesture A between 7 and 10 points, while only 10% of children rated gesture B in the same range. This clearly demonstrates that in the context of virtual object rotation commands, the interface's recognition of the left-right shaking gesture with the palm has a higher error tolerance and results in greater satisfaction among children (Table 7).

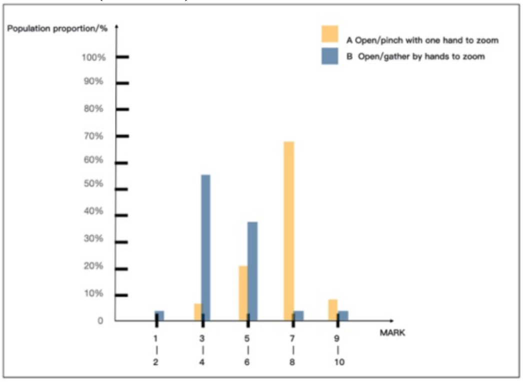

Figure 5. The proportion comparison between rotate gesture A and B in satisfaction

Table 7. Analysis of Questionnaire Ratings for A and B Gestures in Controlling Virtual Object Rotation

Mark \Type	A	B
1-2	0.0%	12.5%
3-4	0.0%	62.5%
5-6	17.5%	15.0%
7-8	75.0%	5.0%
9-10	7.5%	5.0%

In the testing of the interaction relationship for different gestures controlling the movement of virtual objects in the spatial environment (Figure 6), the analysis of experimental data indicates that 52.5% of children rated gesture A between 7 and 10 points, while 72.5% of children rated gesture B in the same range. This clearly shows that in the context of controlling virtual object movement commands, the use of the gesture B, involving palm pushing or pulling, leads to a more natural and convenient experience, resulting in higher satisfaction among children. (Table 8)

Therefore, in the AR environment, it is evident that children prefer using natural and instinctive gestures from daily life during the interaction process of controlling virtual object zooming, rotation, and movement. These gestures have a higher tolerance for errors, leading to better feedback and easier control in achieving the desired effects.

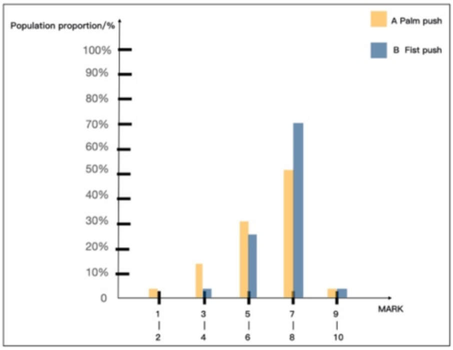

Figure 6. The proportion comparison between move gesture A and B in satisfaction

Table 8. The Analysis of Questionnaire Ratings for A and B Gestures in Controlling Virtual Object Movement

Mark / Type	A	B
1-2	2.5%	0.0%
3-4	15.0%	2.5%
5-6	30.0%	25.0%
7-8	50.0%	70.0%
9-10	2.5%	2.5%

4.3. Experimental Test Results of Software-Hardware Integration Triggered the Interface Functions

The experimental conclusions indicate that in testing the interactive relationship of triggering different functions through software-hardware integration (Figure 7), the analysis of experimental data reveals that children who gave a score between 7-10 for triggering functions through recognizing the physical model's form and hand grip posture accounted for 85%. Additionally, children who scored between 7-10 for triggering interface functions through physically tapping on icons in the interface accounted for 75%. Comparatively, Method A has a slight advantage. Therefore, when designing software-hardware interactive links, retaining both methods to trigger different creative function commands is advisable, allowing children to choose based on their personal preferences. (Table 9)

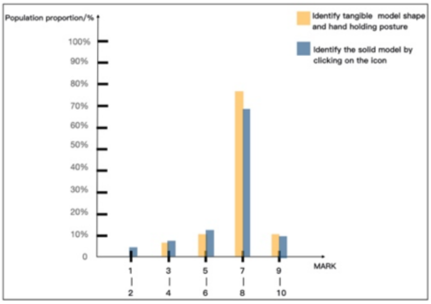

Figure 7. The proportion comparison between Trigger function mode A and B in satisfaction

Table 9. Questionnaire Rating Data Analysis for Triggering Different Functions through Two Different Methods (A and B)

Mark / Type	A	B
1-2	0.0%	5.0%

3-4	5.0%	7.5%
5-6	10.0%	12.5%
7-8	75.0%	67.5%
9-10	10.0%	7.5%

5. Design Practice

The practical results of this project's design have been implemented in the design that integrates AR visual interfaces with hardware (Image 8). The combined software and hardware product design has pioneered an innovative model for digital art education. Integrating art education with Augmented Reality (AR), this approach enables children to learn the creative processes of various traditional art disciplines through multimodal interactions.

In the field of digital art education, we have combined Augmented Reality (AR) technology to design three physical smart products with the children agency. Firstly, the AR system recognizes the distinct forms of the physical hardware and the way they are held. Subsequently, the digital interface automatically transitions between shape sculpting, painting coloring, and magical material effects functionalities. The innovative integration of the verified visual interface design, hardware tool design, and the interconnected design of gestures and virtual objects enhances the potential of digital art education to encompass a wide range of artistic disciplines in the future. This interactive design is adaptable to various forms of artistic learning. The entry point of toy design is to utilize associative experiences, which involve transitioning from one sensory experience to another, creating a fusion of sensory stimulation and psychological mapping. This approach allows users to gain richer experiences and achieve educational enlightenment goals [12].

Indeed, in the design practice, the incorporation of visual content (including 4-7 colors, animations, etc.) along with engaging and enjoyable behavior and process design aims to ignite children's artistic interests and creativity. This approach immerses children in the AR space, allowing them to perceive and shape their everyday reality anew, providing a sense of hope and anticipation through the product. The goal is to design and empower artistic education to seamlessly integrate into the artistic lives of the new generation.

Image 8. AR Visual Image of Integrated Software-Hardware Triggering Function

6. Conclusion

In summary, this study proposes a method that integrates AR with tangible interaction, with a focus on children as the research subjects, aiming to reshape contemporary art creation methods for children. The research employs a combination of questionnaire surveys and AB comparative experimental tests, involving 40 children aged 7 to 12 years. These tests cover various aspects including visual color, animation effects, software interaction hierarchy, spatial gesture interaction, and operational methods for triggering functionalities.

The results confirm the following findings: (1) Displaying 4-7 colors with high purity and brightness, along with special effects feedback, can engage children in an immersive experience within a single interface. (2) A single-level interactive interface is better suited for children to navigate and execute commands. Replacing traditional text with graphical language makes it easier for children to quickly understand functional attributes, and the spacing between icons within the interface affects children's operational efficiency, with relatively clustered areas being more suitable for children to locate items efficiently. (3) Regarding spatial gesture interactions, employing hand gestures that mimic familiar physical actions from everyday life (such as grabbing to move, zooming, rotating, etc.) makes it easier for children to naturally interact and successfully engage in artistic creations. (4) Within the process steps of combining software and hardware operations, triggering software interface commands through the recognition of the physical product's form and the hand's grip style offers increased simplicity and usability. This study contributes to the artistic creation field within future virtual reality environments like AR, by providing a more intricate approach to behavior design, centered around children's capabilities. It offers refined methods for integrated hardware and software interaction, immersive creative experiences, and design decisions for interactive interfaces.

This article aims to explore innovative interactive design for children's art education based on augmented reality technology. The goal is to enhance children's awareness and understanding of various art forms, while nurturing their artistic expression and creativity. However, this study has certain limitations, such as its focus on individual functional requirements in the conducted experimental tests, without conducting a comprehensive examination of the entire interaction process. Further investigation could delve into this aspect in future research. Nevertheless, the conclusions drawn from this study are valuable for enhancing children's comfort and proficiency in operating within the AR virtual reality environment, thereby fostering their artistic expression and creativity. This research provides new perspectives and approaches for the future development of children's art education, contributing positively to their holistic growth and the preservation of traditional culture.

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