

Interactive Study of Multimedia and Virtual Technology in Art Education

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Quan Liu

Kyungil University, Gyeongsan-si, Korea

Haiyan Chen (✉)

Wuhan University, Wuhan, China

970619255@qq.com

M. James C. Crabbe

Oxford University, Oxford OX2 6UD, UK

University of Bedfordshire, Luton, UK

Shanxi University, Taiyuan, China

Abstract—Art education an important part of aesthetic education. It is indispensable for the comprehensive and healthy development of human beings. The basic task is to cultivate creative ability, human aesthetics, and appreciation. Art education is conducive to improving the humanistic cultivation of young students, enhancing the spiritual realm of human beings, and cultivating the creative ability of young people. It has irreplaceable social, cultural, and anthropological significance for promoting the comprehensive and healthy development of people. The development of multimedia information technology provides a new teaching method for art education and teaching in a contemporary setting. This teaching method can guide students to optimize or change the methods and concepts of traditional art creation and aesthetic value. However, traditional art education multimedia technology has poor teaching effects due to limited teaching conditions. This requires the use of multimedia technology and other technologies for interactive fusion. Therefore, this paper proposes an interactive fusion model of multimedia and virtual technology, which is verified by the model. It was found that this integrated education method could not only simulate the real environment and expand the cognitive scope of students, but also could promote students' learning motivation as well as situational and authentic learning experiences.

Keywords—Art education, multimedia technology, virtual technology, cognitive scope, interactive fusion, wellbeing, creativity

1 Introduction

The essential connotation of art education is to allow the subject of the art, that is, the student, to resonate and touch the soul under the influence of both the artwork and

the artistic atmosphere. School art education has become an important role in the development of education in China, and is gradually moving towards a new formal and positive development path. Art education is an indispensable part of the education system, and it is one of the basic ways to comprehensively implement quality education in contemporary China. It means that through the study and research of basic works of art and artistic knowledge, we can use the vision of artists to think and look at things more and in different ways. It also allows us to grasp elements of innovation and creativity, thus influencing students from the upper layers of psychology and the senses [1]. It needs an educational method used to cultivate and shape students to be more perfect, with rich imagination, creativity, keen perception, and perceptual insight. It should promote students' learning, and make them more interested in philosophical, ideological and political issues, and be more conducive to training comprehensive creative talents for all subjects.

There are many roles for art education. The first is through art education aimed at cultivating students' aesthetic sentiments and aesthetic vision through the aesthetic mentality and emotion of students. The second is to make them see the beauty and beauty of life through art education in real life. Therefore, the educational significance and practical function of art education are very important. It is a guide to inspire students to embark on an artistic journey and plays a vital role in the development of students. In addition, it also plays a key role in promoting the overall development of students [2]. It is also a way to educate and cultivate students' flexible use of physical functions, as well as developing the operation of the brain conducive to cultivating students' 'healthy personality', developing their observation, imagination and creativity, and helping students to develop their true potential. The significance of art education also has great value and meaning. Art education is an education for the comprehensive development of people. It helps to improve the cognition and creativity of individuals for real life. Artistic thinking plays a huge role in regulating the senses of the human body, while at the same time, it also has a regulatory function. Artistic creation is truly original, a process of invention full of vitality. This affirms the re-creative and regenerative ability and positive role of art education. Art education also helps to enhance and strengthen people's aesthetic ability. From the perspective of the formation of beauty, art education is of great significance to awaken and shape an understanding of beauty by students [3]. Students' perception of the world is direct, and their brains can directly form a fixed cognitive structure for beautiful things. Therefore, art education can play a valuable role in awakening and enlightening students. This is the early forming process of art education at the student stage. Art education awakens people's need for aesthetics, cultivates their aesthetic tastes, and forms their aesthetic concepts. Through the feeling, appreciation, understanding and creation of artistic works, people will gradually form a certain aesthetic ability, which will affect people physically, mentally and spiritually. Resonance of works of art or artistic images is the joyous role of art education [4]. Once a person becomes the subject of aesthetics, in daily life, he or she can improve their lives in accordance with a style of beauty, and can use the aesthetic object to delight the mind and body, and make full use of the aesthetic function of art. Art education helps to improve people's ability to adapt and solve problems. With the continuous progress of society and the

continuous development of the economy, people may become weaker in a fast-developing social process, such as poor adaptability, low mental capacity, weak stress resistance, low control capacity and other issues. People need to find an external form to regulate their inner emotions to better adapt to this progressive society. Therefore, the moderating role of art education is particularly important. Art education helps to cultivate people's ability to communicate in society, not only to learn to create, but also to solve problems in many areas, to learn to cooperate and to communicate.

At present, there are some problems in art education. Class classroom art education overemphasizes test-taking skills, ignoring the emotional and joyful education process of art education, failing to grasp the essential characteristics of art, ignoring the aesthetic value of art, and ignoring the aesthetics of students. Cultivation of ability; lack of experiential teaching of art education, art experience, contact and other characteristics are not fully utilized; they cannot make students achieve the aesthetic perception of real life [5]. Various phenomena reflect the lack of art education in the contemporary and imperfect Chinese education system. This requires an interactive teaching mode to meet the multi-level needs of different learners.

2 Forms of Art Education

2.1 Art education multimedia technology

Multimedia technology for art education is a form of art education that involves many disciplines and cross-domains. It is the connection between art creation and science and technology. Multimedia education is a form in which teachers use a variety of media forms for teaching activities. From the perspective of multimedia, multimedia education can be defined as the use of visual and auditory channels to process text, image, sound and other information representations. Compared to distance learning, more emphasis is placed on the spatial and temporal distance between teaching and learning behaviors, and multimedia learning emphasizes the diversity of learning resources [6].

The multimedia technology of art education is based on the comprehensive expression of various visual and auditory media such as pictures, text, sound, and images presented on digital screens. Functionally, it is an interface for transferring and exchanging knowledge and information between people and multimedia learning materials. It is dynamic, interactive, and based on-screen display; combining many types of media.

Virtual and Reality Technology: Virtual reality (VR) is a cutting-edge technology that can lead the viewer into a virtual space, which is developed by a VR technology processor. Passively watching the screen fully immerse one's existence into the real world and replaces it. In a sense, everything seen on a computer is part of a "virtual" world. Images and text that exist only in the wired world are displayed or not governed by electronic switches. And "virtual reality" refers to a three-dimensional experience with the presence of "users", which requires the help of tools, such as a head-mounted display, data gloves or body suits (including fiber optic cabling) [7].

Experiencing a simulated world that is presented in response to user actions. It comprehensively uses computer graphics, simulation technology, multimedia technology, artificial intelligence technology, computer network technology, parallel processing technology and multi-sensor technology to simulate human vision, hearing, touch and other sensory organ functions. In this realm, language and gestures are used to interact with it in real time, creating a comfortable and multi-dimensional information space.

Virtual reality takes computer technology as its core and presents people with a realistic and integrated sensory environment in a specific range. A variety of sensing devices assist students to intervene in an immersive interactive environment built with computing information, enabling students to integrate into this environment and appear to be immersive. It also allows students to perform various activities in this virtual environment, like interacting with and influencing objects in the real world. Virtual reality technology can enable students to experience an artistic atmosphere more realistically, and feel the environment created by the artist, as if to experience and learn in a real environment. In addition to the use of graphic display panels, scene restoration, and other forms of multimedia for art education, subject to design principles and teaching concepts, science and technology can be used to demonstrate the subject of teaching objects [8]. One can emphasize the teaching content-virtual technology (using acoustic and optical technology, multimedia technology and computer technology), to bring a colorful and multi-sensory experience to students, enhance the display effect of the content, as well as arousing students' enthusiasm for learning, and increasing classroom 'Fun'. Such an interactive teaching mode is shown in Figure 1.

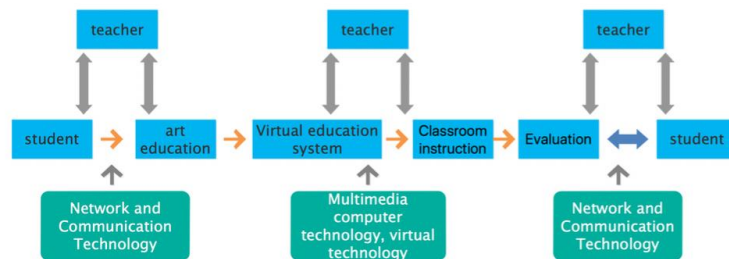


Fig. 1. Interactive teaching model diagram.

From Fig.1, we see that this is a student-centred process. Students are the main body, students are the core of the entire experimental process; students are the main line, the entire experimental process, and all other links are centred around the main line; the teacher is at the periphery of the model to assist and control the entire experimental process [9]. The system structured by technology provides a guarantee for students to complete the entire open experiment, and students are more connected with the system structured by technology; the entire model relies on these technologies as a supporting force.

3 Interaction Research

With the deep integration of information technology and education, interaction has become one of the most important characteristics in the process of multimedia education activities. The interactivity of learning resources reflects the ability of learning resources to support teaching interaction, which directly affects the effect of the interaction between learners and learning resources. It is a key indicator to evaluate the quality of learning resources. Multimedia information resources with good interactivity can meet the general needs of people for effective digital learning. Good interactivity is the key to improving the effectiveness of digital learning through learning resources. The rational design of multimedia interoperability is the root of promoting digital learning interactions [10].

The interactive research of multimedia and virtual technology in art education includes the interactivity of interfaces, the interactivity of courseware, the interactivity of multimedia teaching materials, the interactivity of online courses, the interactivity of learning environments, and the interactivity of learning resources.

3.1 Teaching interactivity

Teaching interaction is divided into three levels: operation interaction, information interaction and concept interaction. as shown in Fig. 2.

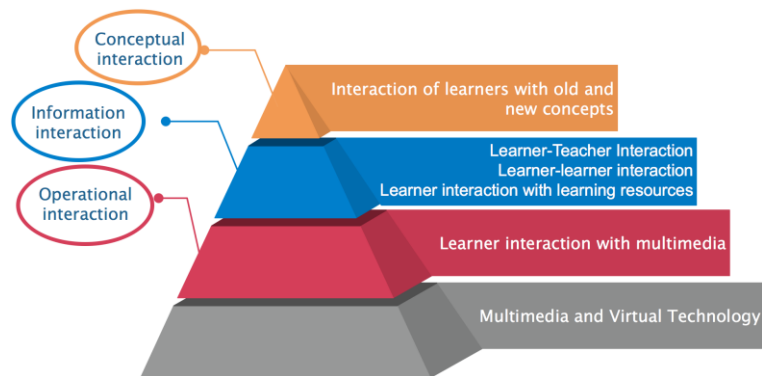


Fig. 2. Interactive Hierarchy of Teaching Mode.

The interaction between the learner and the multimedia is the most basic and specific form of interaction among the three, as well as the lowest-level form of interaction. The concept interaction is the interaction between the new and old concepts of the learner, at the cognitive level, and is the most abstract and advanced level of interaction among the three, and the ultimate goal of the teaching interaction [11]. The information interaction is the interaction between learners and teaching elements, including teacher-student interaction, student-student interaction, and interaction between learners and learning resources; its level of abstraction is between the operation interaction and the concept interaction.

3.2 Interface interactivity

The interactive mode of the interface is divided into operation instruction generation mode, virtual-real fusion scene generation mode, and extensible interactive addition mode. The operation instruction generation mode mainly uses three-dimensional registration technology to generate a series of input instructions for operating the teaching scene, such as the transformation of the scene, the call of teaching resources in the scene, and the operation of virtual objects in the scene. The generation mode of the virtual-real fusion scene is mainly to use 3D technology to generate a series of augmented reality scenes that represent the meaning of instructional operations in the teaching scene [12]. The interaction event can be expressed by Equation 1.

$$RIE = (ID, Type, "marker", d, r, p, s, a, TimeSpan) \quad (1)$$

Where

- *ID* represents the encoding of the event;
- *Type* is a certain event type;
- “Marker” indicates a character string used to mark whether the event is a marker recognition event;
- *d* indicates a flag point (or motion state) detection flag bit;
- *p* represents the position of the centre of mass of the landmark point (or the object that produces the motion behaviour) in the world coordinate system, which can be divided into p_x, p_y, p_z in the three-dimensional space;
- *s* represents the zoom factor of the landmark (or the object that produces the motion behaviour) in the world coordinate system, which can be divided into s_x, s_y, s_z in the stereo space;
- *a* represents the rotation angle of the landmark (or the object that generates the motion behaviour) in the world coordinate system, which can be divided into a_x, a_y, a_z in the three-dimensional space;
- *TimeSpan* represents the total continuous recognition time scale of the landmark from recognition to the beginning.

4 Establishment of Interactive Teaching Platform

The interactive teaching platform refers to the construction of a realistic computer virtual environment based on digital multimedia technology combined with computer technology. Through visual, auditory, and tactile functions, users can perceive and operate various virtual objects in the virtual environment to create an immersive feeling.

In essence, this interactive virtual reality is an advanced computer user interface. It provides users with a variety of intuitive and natural real-time perceptual and interac-

tive means such as viewing, listening, and touching to maximize convenience [13]. Interactive teaching has three prominent features, namely the “3I” features: Interaction, Imagination, and Immersion.

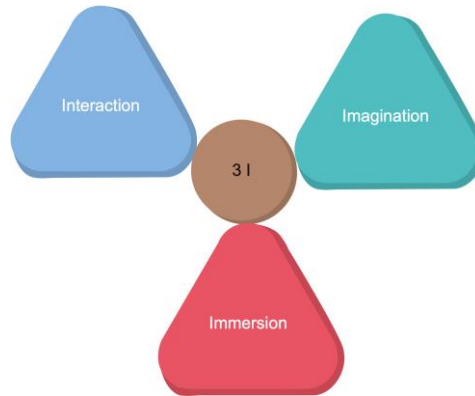


Fig. 3. Basic Features of Interactive Teaching Platform

Immersive refers to a three-dimensional virtual environment created by a computer to enable users to get an immersive experience. Interaction refers to the user’s ability to interact with various objects in the virtual environment. Participants use special equipment and human natural skills to investigate and operate the simulated environment [14]. It is a key factor for human-machine harmony. Imagination means that virtual reality can help users immersed in this environment to acquire new knowledge, improve perceptual and rational knowledge, and thus generate new ideas.

4.1 Shelf structure design

The design of the interactive teaching platform uses the VIEW system, which allows operators to explore the artificial world with a full perspective through natural interaction methods. The hardware architecture of the interactive teaching platform is shown in the figure 4.

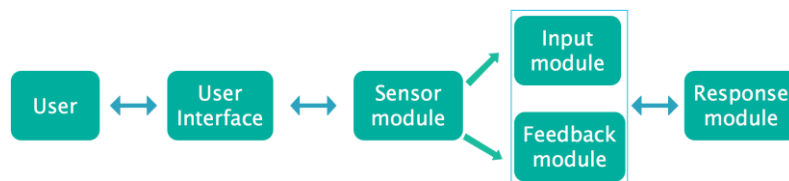


Fig. 4. Interactive teaching platform hardware system structure diagram.

The amount of multimedia computing in art education is huge, and it needs a real-time nature. This requires the implementation of multimedia cloud task scheduling in the interaction with virtual technology, while ensuring the quality of service, so as to

obtain the minimum resource consumption. Interactive multimedia and virtual technology are mainly composed of an end-user layer, a data exchange layer, and a technical service architecture layer, as shown in Figure 5.

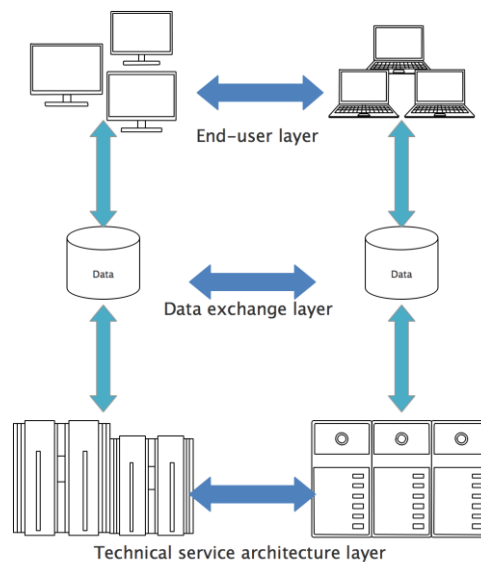


Fig. 5. Multimedia and Virtual Technology Interactive Service System.

4.2 Design of interactive scenes

The design of interactive scenes can generally adopt virtual and realistic design methods. Mainstream design methods include geometric modelling and image-based design. Image-based modelling design methods are used in this paper. Image modelling-based virtual reality technology refers to the use of captured discrete graphics or video to obtain a picture sequence, stitch the picture sequence into a continuous panoramic image, and then organize multiple panoramic images into a virtual panoramic space through a suitable spatial model [15]. It has the advantages of easy modelling, fast drawing, strong realism, small amount of data, and small interactivity.

Construction of virtual teachers: In order to build a teaching intelligent guidance system with the participation of virtual teachers, this paper introduces chroma keying technology. First, use the green screen to record lessons to collect teaching videos with real teachers' participation. Second, create 3D models bound to the teaching videos and use the 3D registration data passed in by the human-computer interaction module to superimpose these 3D models onto the corresponding virtual-real fusion scene. Position, and finally, use chroma keying technology to key out other scenes in the video except the teacher.

Construction of multi-level scenarios: Using 3D registration technology and chroma keying technology, the real video image is integrated in the middle layer of

the virtual and real fusion scene to build the effect of real objects blocking the virtual scene.

Light and shadow construction: When drawing lights and shadows, the generation of shadows due to virtual objects in an augmented reality scene needs to deal with complex environments. In the case that most scenes are real objects, the local lighting effects of a small number of virtual objects need to be processed. In addition, the impact of virtual objects and virtual light sources on the real scene needs to be considered. This process involves rendering the entire real-world scene to obtain a global lighting effect, and adding corresponding effects to the virtual and real objects in the scene according to different lighting effects.

Motion effect construction: In order to make the virtual objects in the teaching scene have similar physical effects to the real objects, the basic physical effects provided by the physics engine need to be used to reconstruct efficient and realistic simulations of various physical effects required in teaching, making the teaching scene more realistic and vivid.

4.3 Algorithm design in interaction process

In an interactive virtual scene, users can operate corresponding devices in the scene by operating handles, keyboard devices, and data gloves, among which collision detection problems are inevitable. At present, commonly used collision detection algorithms are: Oriented Bounding Box (OBB) algorithm, Ax-is-Aligned Bounding Box (AABB) algorithm, Fixed Directions Hulls (FDH) Algorithm and Sphere algorithm. The advantage of the OBB algorithm is its arbitrariness. The smallest cuboid that can surround the object can be constructed in any direction. Its inspection effect is better than that of the AABB algorithm and the Sphere algorithm. It has good redundancy, but it also has a large amount of calculation and a relatively large inspection process [16]. Therefore, this paper adopts an improved OBB collision detection algorithm, which can significantly simplify the calculation process and increase the calculation rate. The specific algorithm steps are as follows.

1. Determine the projection interval range

The projection range of the scene model on the x-axis [Pxmin, Pxmax].

2. Bisection projection interval

The projection interval of the scene model on the x-axis is divided into n ($n \in \mathbb{Z}^+$), and the calculation formula is as follows

$$h = \frac{P_{x\max} - P_{x\min}}{k} \quad (n \in \mathbb{Z}^+) \quad (2)$$

Where: h represents the length of an interval.

3. Establishing vertex sets based on subset encoding

According to the projection position of each vertex on the x-axis, the vertex set U of the model is divided into n subsets, and the encoding of each subset in the vertex set U is calculated.

$$U_i = \{(x, y, z) | P_{x_{\min}} + i \times h \leq x, P_{x_{\min}} < P_{x_{\max}} + (i+1) \times h\} \quad (3)$$

Where: $i = \overline{1, m}$.

4. Extract the vertex set U'

$$U' = \{(x, y, z) | x, y, z\} \quad (4)$$

At least one of the coordinate values is the maximum or minimum value of the subset i, $i = \overline{1, k}$

5. Constructing the OBB bounding box

$$\mu = \frac{1}{6n} \sum_{i=1}^n (p^i + q^i + r^i) \quad (5)$$

$$C_{jk} = \frac{1}{3n} \sum_{i=1}^n (\bar{p}_j^i \bar{p}_k^i + \bar{q}_j^i \bar{q}_k^i + \bar{r}_j^i \bar{r}_k^i), j \geq 1, k \leq 3 \quad (6)$$

Where n is the number of triangles in the scene model, $\bar{p}^i = p^i - \mu, \bar{q}^i = q^i - \mu, \bar{r}^i = r^i - \mu$ is a 3 * 1 vector, C_{jk} is a 3 * 3 covariance matrix, μ represents the mean, and C represents the covariance.

5 Model Evaluation

5.1 Evaluation theory

In order to verify the practicability of the interactive operation platform of multimedia and virtual technology, it is necessary to carry out an applicability assessment based on the students' learning motivation, authenticity learning experience and contextual learning experience [17,18]. One needs to assess application methods using inferential statistical principles.

1. Sample description

$$S = \sqrt{\frac{\sum (x - m)^2}{N}} \quad (7)$$

μ is the mean, N is the capacity of the population, and x is the variable.

2. Sample average

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i \tag{8}$$

3. Distribution of sample variance

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2 \tag{9}$$

4. t statistics

$$t = \frac{(\bar{x} - m)\sqrt{n}}{s} \sim t(n-1) \tag{10}$$

5. F statistic

$$F = \frac{s_1^2}{s_2^2} \sim F(n_1 - 1, n_2 - 1) \tag{11}$$

5.2 Evaluation method

The experimental subjects selected 60 students from two classes of an art education major in a certain university, of which 30 students in the first class were in the T1 group, 30 students in the second class were in the T2 group; the T1 group was the experimental group, and the T2 group was the control group. The experimental group adopted the interactive teaching method of multimedia and virtual technology, and the control group adopted the traditional multimedia teaching method, that is, the teacher used PowerPoint to teach [19,20]. The evaluation method was in the form of a questionnaire. The results of the questionnaire were scored, and the evaluation results shown in Table 1.

Table 1. Evaluation results data graph

Attributes	Class	Likert scale					Average value	Standard deviation
		<i>Very satisfied</i>	<i>Satisfied</i>	<i>Average</i>	<i>Dissatisfied</i>	<i>Very dissatisfied</i>		
Attention	T1	15	36	39	8	1	3.30	4.8989
	T2	45	40	27	4	1	3.90	4.3243
Relativity	T1	20	28	42	10	1	3.37	4.8682
	T2	35	56	24	2	1	3.93	5.4497
Self-Confidence	T1	25	40	36	6	1	3.60	4.6583
	T2	35	64	18	2	1	4.10	6.1400
Satisfaction	T1	35	48	27	4	1	3.83	4.6583
	T2	45	60	18	2	0	4.17	6.1400

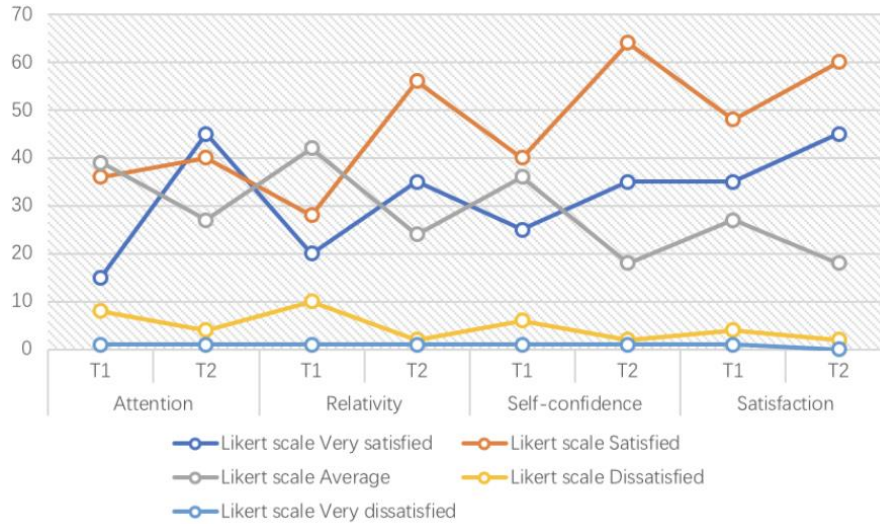


Fig. 6. Satisfaction map.

Through model comparison and verification, it was found that the interactive teaching methods using multimedia and virtual technology, the average value of students in learning motivation, authenticity learning experience and situational learning experience was about 4, which is a satisfactory level [21]. There were no significant differences between the T1 and the T2 groups. This shows the effectiveness of the research method proposed in this paper.

6 Conclusion

Art education aims to improve peoples’ spiritual realm. The ultimate goal is to cultivate peoples’ personality, promote their all-round development and the progress of the whole society. This interactive fusion is an educational form based on digital and multimedia information communication technology as both a carrier and a pillar. The changes and development of multimedia and interactive methods have evolved along with the progress of computer technology and network information transmission technology. Augmented reality technology can effectively improve education and teaching activities. More and more researchers have begun to apply augmented reality technology to the field of education. At the same time, virtual technology as a product of multimedia art has important research significance and value.

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9 Authors

Quan Liu is a Ph.D. of Kyungil University of Korean and a teacher of Wuchang Institute of technology. His main research fields are educational technology and educational management. blazingsnow@126.com

Chen Haiyan is a doctoral student of Institute of Education Sciences, Wuhan University, his research direction is higher education management, and his research specialty is higher education administration. 970619255@qq.com

M. James C. Crabbe is a Supernumerary Fellow of Wolfson College, Oxford University, and former Executive Dean of the Faculty of Creative Arts, Science and Technology at the University of Bedfordshire, UK. He is an Emeritus Professor, a ‘100 Talents’ Special Visiting Professor at Shanxi University (China), Guest Professor at Wuhan Business University (China) and Honorary Professor at Changchun University of Science & Technology (China). james.crabbe@wolfson.ox.ac.uk

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