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## Construction of Art Education Platform in Primary and Secondary Schools Based on Virtual Reality Technology

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### ABSTRACT

Today, with the rapid development of information technology, Virtual reality (VR) has developed rapidly, and has been popularized in many fields such as film and television, sports and so on. If VR can be successfully introduced and applied in art teaching in primary and secondary schools, it will create a good situation for students to perceive art works, which will stimulate their interest in learning art knowledge and improve their learning effect. Based on 3D image VR, this paper constructs a VR visualization model of art in primary and secondary schools to promote the digital reform of art teaching and the ecological construction of digital education. The simulation results show that the stability of the art visualization model constructed in this paper is still about 90% when there are many business sets, and the subjective scores of art teachers and students are better. The results verify the effectiveness and reliability of the VR visualization model based on VR, which can provide technical support for the construction of art education platform. The VR visualization model is applied to the construction of art education platform in primary and secondary schools, which will promote the innovation and optimization of art teaching.

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## 1. Introduction

Today, with the rapid development of information technology, VR has developed rapidly, and has been popularized in many fields such as film and television, sports and so on, and has achieved good application results [1]. The appearance of multimedia-assisted instruction brings convenience to education, and the improvement of teaching effect after multimedia-assisted instruction is obvious to all [2]. Under the background of quality education, all walks of life pay more and more attention to the cultivation and promotion of students' comprehensive quality. As an important part of quality education, art teaching in primary and secondary schools is characterized by abstract content and strong thinking. In this regard, art teachers actively explore new teaching methods, create real situations through multimedia technology, and promote the visualization of art knowledge, but its teaching effect is average [3]. VR is the product of big data, and its application in art teaching has certain

advantages. That is, VR takes pictures of real scenes in real life, and then uses computer modeling to simulate the two-dimensional plan into a real three-dimensional space and present it to the viewers [4]. Network and VR can create a good learning environment for people, promote the application of high-tech information technology in human life and study, and thus accelerate the modernization of education in China. If VR can be successfully introduced and applied in art teaching in primary and secondary schools, creating a good situation for students to perceive art works will help stimulate their interest in learning art knowledge and improve students' learning effect, which has a strong application value [5].

A positive situation can stimulate students' desire to explore and learn independently and deepen their understanding of what they have learned. Because of the aesthetic particularity of the art discipline itself and the need of teaching objectives, the creation of situations is particularly important. There are various ways to create situations, for example, using language description, using pictures or using multimedia devices to create situations, etc [6]. Using virtual simulation worlds such as VR perception, simulation environment

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and sensor devices, people can interact with each other in the virtual world, which has attracted the attention of art education. Art teachers should actively use VR to implement virtual teaching, build a systematic knowledge system for students, and create a real and three-dimensional art teaching situation, so as to enhance students' understanding and application of knowledge and promote their comprehensive development [7]. As a brand-new technology in the digital era, VR uses computers to simulate real scenes, and through special head display or glasses, the real objects are blurred and virtual objects are realized, and a brand-new scene is constructed [8]. Art courses are characterized by perception, understanding and creation of visual images, and images are a very important part of art courses [9]. As a new media platform, VR can be introduced into art classroom teaching by teachers to guide students' learning, or it can be used as a platform for students to learn independently after class.

## **2. Application of VR technology in art teaching**

### **2.1 Application value of VR in art teaching**

Under the background of economic globalization, the competition between countries and enterprises has gradually evolved into talent competition. In order to improve the comprehensive quality of the people, the state actively carries out quality education, and the new curriculum standard of fine arts in primary and secondary schools emphasizes the cultivation and promotion of students' innovative quality, aesthetic level and autonomous learning consciousness. However, at present, some schools attach importance to the teaching of mathematics, English and other subjects, ignoring the development of art courses, which leads to some students' weak aesthetic consciousness and their comprehensive quality not being comprehensively improved. VR overcomes the limitations of teaching venues, whether it is auditory, visual, tactile, realistic sensory experience, and makes the experienter feel as if he were there. Generally speaking, learning motivation is divided into internal motivation and external motivation [10]. Under the background of quality-oriented education, teachers should combine VR with art textbooks, use VR software to create a three-dimensional life situation, so that students can be there, understand the structure of real objects by rotating, zooming in and out, and deeply understand the meaning of art terms. VR can bring students into a completely realistic teaching situation, and gain pleasure and satisfaction through interactive experience, so as to mobilize students to take the initiative to learn, stimulate their learning motivation and increase their learning experience and participation. Situational learning solves the problem that traditional teaching is divorced from reality,

challenges the limitations brought by traditional teaching venues, and promotes students' learning by setting scenes similar to their living environment.

In the past, traditional art teaching in primary and secondary schools mainly used art teachers to show related teaching contents in kind, or demonstrated some specific art operations for students on the spot in class. However, due to the different positions of students in the classroom, the observation effect of some students may be affected by the difference of observation angles. Compared with two-dimensional images, the immersive teaching brought by VR makes the classroom more lively and interesting. More importantly, this learning experience will stimulate students' creativity and imagination [11]. The purpose of art education in primary and secondary schools is not only to let students have certain artistic knowledge, but also to build aesthetic consciousness for students. The establishment of aesthetic consciousness needs to be accumulated over time, and it is the active reflection of the subjective aesthetic attributes of objective perceptual images. If people don't have a universal evaluation standard about interest, they can't have active and effective spiritual communication and aesthetic evaluation. By bringing VR into art classes in primary and secondary schools, students can learn more about painting, sculpture, architecture, design and other arts, so as to cultivate students' aesthetic ability.

### **2.2 Three-dimensional visual modeling of art images**

Introducing VR into art education in primary and secondary schools can help teachers make effective use of resources in teaching design and achieve teaching goals more intuitively. Teachers can give full play to the advantages of VR in teaching design, assist art teaching, overcome the important and difficult points in teaching, impart knowledge more easily and improve classroom efficiency. Under the background of VR, teachers can use VR view to show students the three-dimensional design process, and use related technologies to change the color and style of objects, so as to stimulate students' design interest and potential. For example, in the teaching of packaging design, teachers use VR view to show the design process of packaging box formed by folding, cutting and designing white paper from all directions and angles. The process of image recognition and model training is shown in Figure 1.

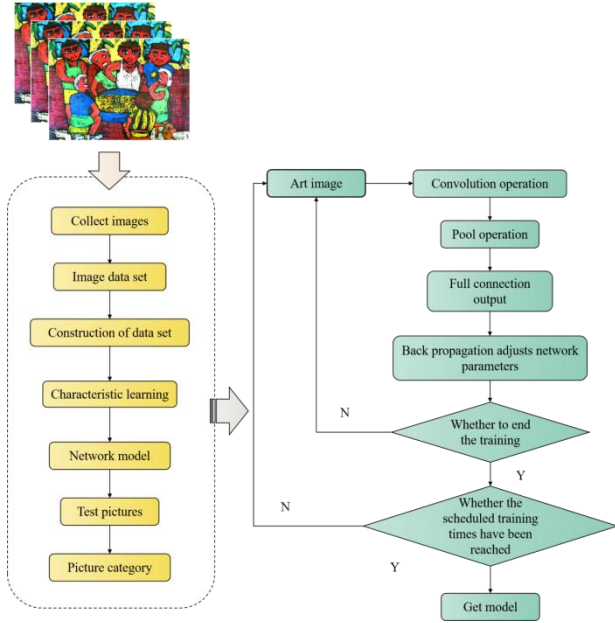


Figure 1: Art image recognition and model training process.

Introducing VR into art classes in primary and secondary schools can greatly enrich teaching means and methods, and use it as an auxiliary classroom teaching tool to make up for the time and space limitation in teaching, so that students can get immersive experience in the classroom. As the main course content of art teaching in primary and secondary schools, painting requires students to show the outline, light, structure, space and texture of objects through simple lines, which has higher requirements for students' thinking ability, spatial perspective and internal structure shaping ability. In VR teaching, teachers can use VR to show students the internal structure of three-dimensional images, and truly restore the texture, contour, structure, light and other parameters of objects. Students can observe the contour, spatial change and texture of objects from a distance, a close distance, looking up and down, etc. by using functions such as zooming and angle adjustment. The three-dimensional interactive model of art resources in primary and secondary schools is shown in Figure 2.

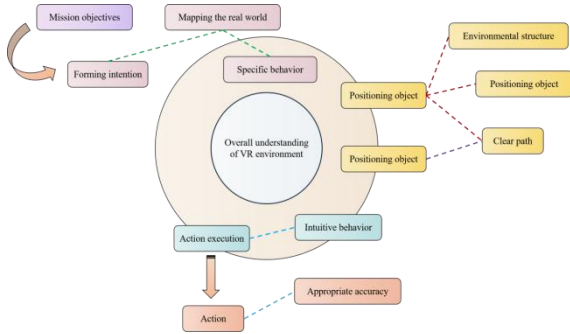


Figure 2: Three-dimensional interactive model of art resources in primary and secondary schools.

### 3. 3D Reconstruction of Art Images

VR, frame synchronization and integration of original point cloud data are adopted to realize the point cloud information fusion of original art images. The median filter is used to preprocess the point cloud data in the original art image, and the output value after preprocessing is:

$$\psi_{i,j} = \text{median}[\Lambda_{i+m,j+n}; (m,n) \in w] \{ \Lambda_{ij}; (i,j) \in Z^2 \} \quad (1)$$

Where:  $m$  and  $n$  represent the size of the window in the horizontal and vertical directions respectively;  $w$ ,  $Z^2$  respectively represent the plane window specification and the serial number of the two-dimensional data string;  $\Lambda_{ij}$  and  $\psi_{i,j}$  respectively indicate that the point cloud coordinates on the image are the output values of  $(i,j)$  after median filtering.

In the three-dimensional space, on the  $a$ -th image, the minimum calculation method of the square sum of the distance between the vertical projection point of the space point  $\mathcal{G}$  and the pixel point  $\hat{w}$  is as follows:

$$\min = \sum_{g=1}^g \sum_{a=1}^A v_{ga} d(E_a S_g, \hat{w})^2 \quad (2)$$

In order to eliminate the registration noise in the image, the initial value is randomly selected and linearly transformed. Local linear approximation method and nonlinear least square method are used to achieve image iteration to convergence and maximum likelihood estimation.

In order to better reflect the distribution of pixels in the image, the Gaussian Zhengtai distribution project of point cloud data optimized by VR will be used to form the reconstruction model. The change of pixels in the image frame in the time domain  $O$  is represented by  $\{X_1, X_2, \dots, X_O\}$ , and the time  $X_i$  of pixels in the frame is selected randomly, so the ratio of  $X_i$  to the background of the reconstructed image is:

$$Q(X_i) = \sum_{i=1}^L f(X, Y) w_{i,j} \quad (3)$$

Where:  $f(X, Y)$  is used to describe the Gaussian probability density function, which is a function of the mean value  $\mu_i$  of Gaussian distribution and the covariance  $\mu_0^2$  of Gaussian distribution items, and  $L$  is the number of Gaussian distribution items. The pixel gray scale of the image points is described by the average value  $\mu_i$  of Gaussian distribution, and the pixel variance is described by  $\sigma^2$ . Then, the

background image is described by the relationship function between gray scale and variance:

$$K(X, Y) = [\mu_i, \sigma^2] \tag{4}$$

By restricting the pixel gray calculation process of each frame point, according to the definition of image gray, the correct matching of the point cloud position of foreground, background image and original art image is implemented, and the 3D reconstruction of art image is realized.

#### 4. Result analysis and discussion

After understanding the basic characteristics of VR and its effect and influence in art education, teachers should fully realize that the rapid development of VR provides a good opportunity for the development of art teaching in primary and secondary schools, and its far-reaching influence on the future development of education. Students can also use VR to enter the interior of an object to observe its internal structure, and move the light source to observe the line, color and light changes of the object. Through comparison, they can master the painting characteristics of light and structure, and then improve their painting level.

VR-assisted instruction frees art teachers from the tedious preparation of teaching materials, but it also weakens the role of art teachers. If art teachers want to continue to play a leading role in teaching, they must keep pace with the times and strive to improve their comprehensive quality. Although VR is gradually coming into our daily life, there are still some challenges in how to make use of VR in art teaching in primary and secondary schools. For example, due to the high technical threshold of educational resource design and development, it is difficult for subject teachers to independently develop VR courseware needed for teaching, and the quality of VR resources depends on developers' understanding and grasp of teaching content and teaching methods. Figure 3 shows the accuracy comparison of different algorithms.

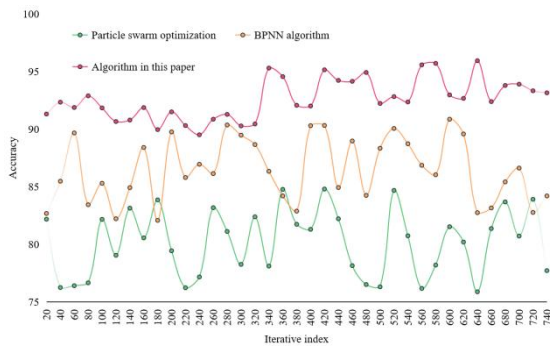


Figure 3: Accuracy comparison results of different algorithms.

The VR visual modeling algorithm proposed in this paper has higher accuracy of image recognition. During the art teaching in primary and secondary

schools, VR application involves more professional equipment and instruments, and the price is relatively high. Therefore, in order to ensure the smooth application of VR, it is necessary to increase the educational investment of schools and actively purchase some related equipment for VR application. The stability results of the art education platform are shown in Figure 4.

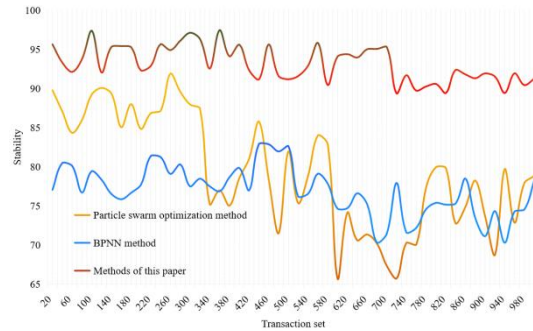


Figure 4: Stability results of the platform.

It can be seen that the stability of the art education platform constructed in this paper is relatively high, and its stability is still around 90% when there are many transaction sets. With the emergence of virtual teaching, we should inherit and learn from the old traditional teaching ideas and concepts, and reform those outdated, backward, inefficient and costly teaching methods and means. Because of the particularity of art itself, it is a course that integrates appreciation and hands-on ability, and the training of motor skills is far higher than that of general courses.

In using VR to assist art teaching, we can't ignore the cultivation of motor skills in art teaching in primary and secondary schools. In the process of teaching, students are immersed in VR, and it is difficult for teachers to monitor students' learning situation. Too many functions and rich simulation scenes in the virtual world will interfere with learners' absorption of important content. This paper selects 260 art teachers and students to evaluate the art education platform constructed in this paper. The subjective grading results of art teachers and students are shown in Figure 5.

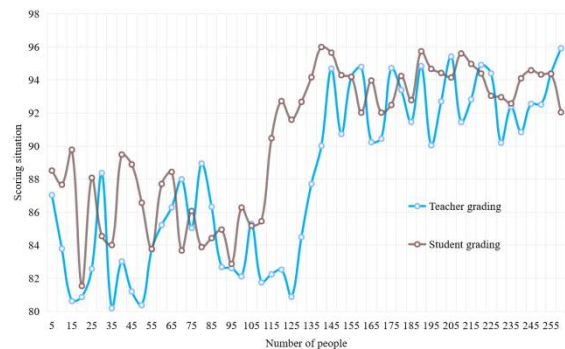


Figure 5: Subjective rating results of art teachers and students.

The results show that the subjective scores of art teachers and students are better. The results verify the effectiveness and reliability of the art education platform based on VR, which can provide some technical support for art teaching. In today's art courses in primary and secondary schools, the classroom mode dominated unilaterally by teachers still accounts for the majority, while the application of VR will improve the original teaching mode and increase the proportion of students' spontaneous exploration of knowledge in the classroom. It can not only exercise students' ability of active learning, but also cultivate students' teamwork ability and innovative spirit in the long-term teaching process, and promote the all-round development of primary and secondary school students.

## 5. Conclusions

Today, with the rapid development of information technology, VR has developed rapidly, and has been popularized in many fields such as film and television, sports and so on, and achieved good application results. In this paper, based on 3D image VR, a VR visualization model of art in primary and secondary schools is constructed to promote the digital reform of art teaching. The experimental results show that the VR visualization model constructed in this paper has high stability, and its stability is still about 90% when there are many transaction sets. At the same time, the subjective scores of art teachers and students are better. The experimental results verify the validity and reliability of the art visualization model based on VR, which can provide technical support for the construction of art teaching platform in primary and secondary schools. It provides a good opportunity for the development of VR art teaching in primary and secondary schools. However, in actual teaching, in order to successfully apply VR, it is necessary to increase the investment of teaching funds, actively purchase some VR supporting hardware and equipment, and strengthen the construction of teachers. At the same time, according to the teaching needs of art courses, VR should be applied to teaching links such as class opening, teaching and appreciation.

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