Research on the Teaching Practice of Art Based on Virtual Reality Technology and Analysis of the Effect of Teaching Practice

Jiaqi Yang(✉)

Graduate School, Emilio Aguinaldo College, Manila, Philippines
JIAQI.YANG.mnl@eac.edu.ph

Abstract. With the development and popularity of virtual reality technology, today's teaching methods and learning styles are changing. Many teaching activities today are exploring the integration of virtual technology, yet the specific effects are difficult to test. The author uses "VR teaching" and "traditional teaching" as a comparison. Three core research questions are answered." Learners' acceptance of using virtual reality technology in teaching, whether virtual reality technology can promote creativity, and whether virtual reality technology facilitates learning. This paper first compares the application and exploration of virtual reality technology in education and teaching at home and abroad, and its current status in art teaching. By introducing virtual reality technology to the experimental group in different teaching sessions, the VR software platform and VR hardware headset were used to assist teaching, while the control group was conducted in the traditional teaching mode, and the learners' participation and mind flow status were collected after the experiment so as to conduct a comprehensive analysis. Students' works in different teaching formats were scored, corresponding to the indicators, and analyzed. VR teaching differs from traditional in form. In traditional education classes there are always students who are distracted, reading extracurricular books or other novels, and in some cases even skipping class, all of which indicate that students are not interested in this type of class. Traditional education is a passive way for students to gain knowledge from the teacher's lectures, which makes learning boring and often does not yield good results if students lack initiative and motivation. VR teaching makes knowledge more interesting, and it has the three characteristics of immersion, interactivity and spatiality, so that students are fully engaged in the three-dimensional virtual environment space constructed by the simulation system. Through visual, auditory and behavioral interaction to perceive that environment, enhance students' interest degree, imagination. It is possible to turn difficult knowledge points and some concepts into videos or pictures with the help of VR panoramic technology, which makes it easier for students to understand by virtue of their visual experience. This paper examines the analysis and study of student learning outcomes under the teaching techniques of virtual reality technology. New teaching techniques can be used more often in future teaching.

Keywords: Virtual reality technology · Teaching Art in Primary Schools · Teaching practice · Artistic aesthetics

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1 Introduction

Art education is by nature a creative education. Most of what distinguishes the subject of Fine Art from other disciplines is its openness and plurality; there are no constant standards in aesthetic art, and the ultimate orientation is the pursuit of possibility and creativity. In primary school art teaching, the main objective is to exercise students' basic skills such as mental thinking, work creation, hands-on practice and artistic aesthetics. An immersive environment tends to inspire stimulate learners to generate creativity, and the relative independence of the space will enhance concentration. The objectives of art teaching are also changed in depth and in a flexible manner. Through a stage-by-stage training model students are required to first acquire basic knowledge and skills, and the focus of learning needs to be on enhancing students' understanding of art knowledge, the enhancement of relevant skills, the appreciation of artistic aesthetics, the learning of artistic expression and the development of creative thinking and hands-on practical skills for students at all stages.

2 Pre-experimental Preparation

2.1 Experimental Design

According to the needs of the teaching design, an experimental class and a control class were set up with 27 and 25 students respectively in a third grade school in JH, with the same teacher conducting each lesson and the class environment being adjusted according to the content and teaching needs [1]. The course "Southern Song Official Kiln" was selected for two teaching contents. The author redesigned the course content and teaching methods on the basis of the original course, and both lesson contents were implemented by comparing the experimental group with the control group. The Southern Song Dynasty Kilns course consists of four sessions, divided into teaching sessions and creative sessions, which also include two teaching activities using virtual reality technology.

To ensure experimental reliability, in the first course, Class 301 was selected as the experimental group and Class 302 as the control group. In the second course, the two groups were switched, with Class 301 as the control group and Class 302 as the experimental group [2]. The overall design idea is as follows:

The first phase of the experiment was the teaching and learning implementation process, with lesson 1 using the 'Southern Song Official Kiln' course as the implementation vehicle. The specific implementation is shown in Tables 1 and 2 [3].

Lesson 2 uses the Terracotta Warriors and Horses course as a vehicle for historical facts and is implemented in the following Table 2:

2.2 Experimental Subjects

In this study, the third grade of a school in HZ city of Z province was used as the target of teaching implementation, and two classes (301 and 302) of the third grade were selected to carry out a comparative experimental teaching. There were two teaching

Table 1. Participation in the Southern Song Dynasty Official Kilns course

Grouping	Participating Classes	Number of participants	Teaching style
Experimental group	Class 301	27	Virtual reality environments
Control group	Class 302	25	Traditional teaching

Table 2. Participation in the Terracotta Warriors and Horses of the First Qin Emperor course

Grouping	Participating Classes	Number of participants	Teaching style
Experimental group	Class 301	27	Teaching in virtual reality environments
Control group	Class 302	25	Traditional teaching

components in the experiment, and the two classes had 25 and 27 students respectively, with a relatively even number of male and female students. The teacher's analysis of the creativity level of the pre-production work showed that the students in the two classes were of equal creativity level [4].

2.3 Measuring Tools

The technology acceptance model in this paper is based on the Technology Acceptance Scale developed by Davis et al. This type of scale is used to investigate the acceptance of a new technology by the general public at the time of its initial diffusion. The original scale is divided into two dimensions: perceived usefulness and perceived ease of use of the technology by users [5].

2.4 Software Platforms

The ceramics production software used in this course and the development of teaching resources were developed in conjunction with Kawanuclear. The software was developed on the Unity3D engine and the software was developed and designed after meticulous combing of the porcelain manufacturing process [6].

2.5 HITS Algorithm Web Search Technology

The HITS (Hyperlink-Induced Topic Search) algorithm is used here. The algorithm is as follows: submit the query content q to the traditional keyword-based search engine. The search engine returns many web pages, from which the top n web pages are taken as the root set, denoted by S. S satisfies the following three conditions: 1. The number

of web pages in S is relatively small. 2. Most of the pages in S are pages related to query q. 3. The pages in S contain a large number of authoritative pages. By adding pages referenced by S and pages referencing S to S, S is expanded into a larger set T. The Hub pages in T are the vertex set V1, the authoritative pages are the vertex set V2, and the hyperlinks from pages in Vl to pages in V2 are the edge set E. A bipartite directed graph SG = (V1, V2, E) is formed. For any vertex v in V1, the Hub value of web page v is denoted by h(v), and for vertex u in V2, the Authority value of the web page is denoted by a(u). At the beginning, h(v) = a(u) = 1, execute I operation on u to modify its a(u), and O operation on v to modify its h(v), then normalize a(u) and h(v), and so on repeatedly calculate the following operations I, O until a(u) and h(v) converge.

$$\text{Ioperation} : a(u) = \sum_{v(v,u)=E} h(v) \tag{1}$$

$$\text{Ooperation} : h(v) = \sum_{u:(v,u)=E} a(u) \tag{2}$$

Normalization of a(u), h(v) is required after each iteration.

$$a(u) = a(u) / \sqrt{\sum_{q \in V_2} \left[a(q)\right]^2} h(v) = h(v) / \sqrt{\sum_{q \in V_1} \left[h(q)\right]^2}$$

Equation (1) reflects that if a web page is pointed to by many good Hubs, its authority value increases accordingly (i.e., the authority value increases to the sum of the existing Hub values of all the pages pointing to it). Equation (2) reflects the fact that if a page points to many good authority pages, the Hub value increases accordingly (i.e., the Hub value increases to the sum of the authority values of all pages linked to that page).

3 Teaching Implementation Process

At the beginning of the VR art teaching, the project team conducted a detailed reading of the art teaching materials, with the help of the Compulsory Education Art Curriculum Standards (2011 edition), to find the most suitable important and difficult points to be integrated into VR, and to make breakthroughs one by one to promote the practical advantages of VR education technology in the application of art teaching [7].

3.1 The Implementation of the Southern Song Dynasty Kilns

1) Instructional Design

The author has chosen to redesign the content of the third grade course "Southern Song Official Kiln", which is the first of the famous "Five Famous Kilns" in China, and the experimental group of this course has designed to use virtual reality technology to combine with pottery teaching, learning about the Southern Song Official Kiln through VR technology and designing a pottery of their own through VR headsets and software. The team will use VR technology to learn about the Southern Song Dynasty official

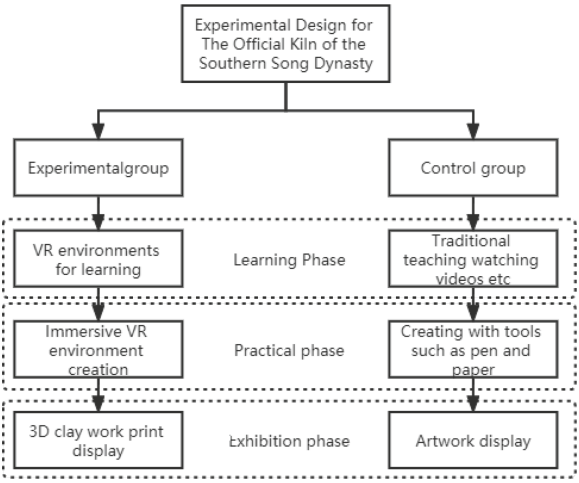

Fig. 1. Experimental Design for The Official Kiln of the Southern Song Dynasty

kilns and design their own pottery through the VR headset and software, and recreate it with the knowledge they have learnt. The general design idea is as following Fig. 1:

(1) Course Topics
Official kilns were the official kilns where porcelain was fired in ancient times, and porcelain from the Southern Song dynasty was produced through a complex and meticulous process, which has resulted in very few collections surviving to this day due to its limited production and difficulty of preservation. The exquisite work of the official kilns also testifies to the technological and cultural prosperity of the Southern Song period. The main objective of this course is to enable students to learn about the five most famous porcelains of the Song dynasty in China, and inparticular to grasp the three main characteristics of the Southern Song official kilns and the process of their formation, in order to inspire students to cherish the art of pottery and the love of Chinese culture through a small insight into the larger picture [8].
(2) Course Objectives
(3) Teaching Plan
(4) Analysis of the learning situation
(5) Analysis of teaching materials
(6) Teaching methods

2) Resource Development

The development process of virtual reality teaching resources broadly includes: (1) analysis and preparation, including learning needs analysis, learning situation analysis, etc.; (2) scenario script design, interaction method design, evaluation design, etc.; (3) operation structure design and idea design. (4) courseware development, development tools including graphic image processing tools, 3D model building tools and virtual reality resource development tools, etc.; (5) product testing, the virtual reality resource content design, scene production, interactive experience, etc. to improve, and finally

Table 3. Inputs analysis

Reliability statistics	
Kronbach Alpha	Number of items
.914	35

Table 4. Heart flow reliability analysis

Reliability statistics	
Kronbach Alpha	Number of items
.914	35

released for use. The common platforms used for virtual reality courseware development are: UE4, VR-platform and Unity3D.

4 Analysis of the Effect of VR Technology on Learning

A total of 52 questionnaires were sent to the experimental and control classes, excluding non-attending students and invalid questionnaires, and a total of 46 valid questionnaires were returned.

For this study, Research Question 2 (Can virtual reality technology benefit learning outcomes?) (1. Does virtual reality technology facilitate learners' understanding? 2. Does virtual reality technology indirectly contribute to learners' increased engagement in learning? 3. Can virtual reality environments influence mental flow states?) Conduct data analysis.

In order to ensure the reliability and scientific validity of the questionnaire, the results were first analysed by subjecting the collected achievement data, mindstream experience and learning engagement questionnaires to a reliability analysis and the results are shown in the Tables 3 and 4.

Basedon the fact that the Clonbach coefficients of both questionnaires are closer to 1, it can be proved that the questionnaire has good consistency and the questionnaire has a high reliability and scientific validity. Having verified the authenticity of all the data involved in question two, the data analysis for question two begins below.

5 Analysis of VR Technology on the Creativity of Works

5.1 Scale Data Analysis

Can virtual reality technology stimulate creativity enhancement in learners? During the study of this question, the experimental and control classes were randomly selected by the teaching staff in order to ensure random scientific validity. To ensure the validity of the experiment, an initial comparison was made between the two groups of students'

Table 5. Creativity pre-test t-test

	Group	Number	Average
Creativity of work	Experimental Classes	27	3.335
	Control Classes	25	3.323

Table 6. Score for Creativity in Southern Song Official Kiln works in Session 1

Group	Number	Average	Standard deviation	Variance
Experimental class 301	27	77.00	0.355	0.733
Compare to Class 302	25	69.78	6.961	48.451

creativity to test whether there was a difference between the two groups at the initial level of creativity. The previous works of the two classes were selected separately and the professional teachers were asked to rate the creativity of the works. Using an independent samples t-test, the comparison showed that there was no significant difference in the creativity of the two groups' past work (T = 0.355; p) 0.05), and it can be said that there was no difference in the initial level of creativity between the experimental and control groups and that a follow-up study could be carried out. As showing in Table 5.

For this research question, the authors carried out the analysis and processing of the data. After the completion of two course works, "The Official Kiln of the Southern Song Dynasty" and "The Terracotta Warriors of the Qin Dynasty", the creativity of all the works was assessed and scored by the specialist teachers.

In the work creation session of the Southern Song Official Kiln course, the experimental group, Class 301, used VR pottery software to design their works, while the control group, Class 302, used pen and paper to design their works, with some of the results shown in the picture. After completing the artwork design, the learners explained their thoughts on the artwork design. As showing in Table 6.

The creativity scores through the course work showed a significant difference in the creativity scores of the experimental group's work compared to the paper and pencil group. This indicates that virtual reality technology facilitates students' creativity performance to some extent and has a positive effect on creativity learning. As showing in Fig. 2.

5.2 Analysis of the Work

The author has found that the work under virtual reality must not only be in line with the teaching content, but also ensure the presentation under the technology. The application of virtual reality technology in terms of the sense of three-dimensional space and human-computer interaction can make students more helpful for the creation of their works. The VR software was aided by tools that stimulated the creation of more innovative and creative work. It is also thanks to these aids that the subjects' work is differentiated

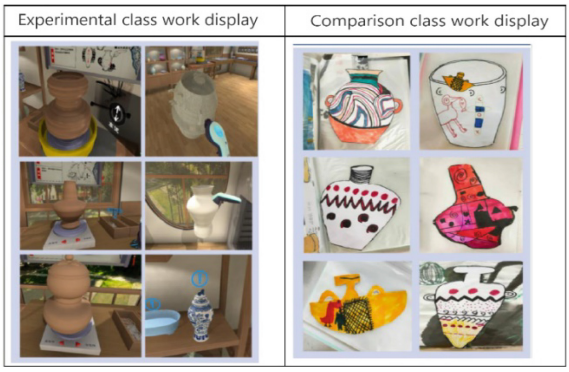

Fig. 2. Artwork display

and more varied, avoiding the homogeneity of the paper and pencil group process. In a more separate space, learners are more able to concentrate on their work and are more inspired to create. I suspect that the different forms of creative tools may hinder learners' creativity and I plan to provide the same tools for learners to complete their work in the second experiment.

5.3 Interview Analysis

For this question, students in the experimental class were randomly selected as subjects for interviews. The subjects were all positive about the use of virtual reality technology.

Participant A replied, "This technology is so interesting and brings us a lot of interest and freshness in the classroom! I can do whatever I want, it's much easier than real clay."

Subject B replied, "In such a helmet, I am completely immersed in it without being disturbed by the teacher or classmates. The work I designed is a modified version of a hot pot, and the tools inside help me beautify my work."

Subject C replied; "The tools inside the helmet also help me and inspire my creation during operation, some existing templates can be used in it, and I hope there are more functions to help me finish."

Respondent D: "I think there is more content in VR than in watercolor pencil painting, and I can play with it in such a three-dimensional space. I really like this format."

Due to the young age of the subjects, the responses to the questions in the interview process were not focused enough, and through the author's further understanding, it was found that the application of virtual reality technology allowed the students to be more helpful in the creation of their works.

In the interview process with the teacher also talked about some of the actual situation, through the introduction of VR, the children's interest in learning has increased significantly, through the VR let students take the initiative to learn, teaching content visualization and concrete, can deepen the impression, and let the freedom to control the learning progress can also greatly enhance the effect, VR also indirectly maintain the supervision of the children's classroom order, better classroom content learning and development.

6 Conclusions

This paper is designed with the intention of applying virtual reality technology to teaching and learning, optimising teaching and learning through effectiveness analysis. It explores ways and strategies to integrate virtual reality into teaching and learning, and to truly use technology to bring about changes in teaching and learning. Before the teaching practice begins, this paper analyses the feasibility of using virtual reality technology in the art classroom by combing through the relevant literature on virtual reality application in education and workplace technology education, and identifying the problems that exist in the current classroom. Based on the characteristics of virtual reality technology and the teaching requirements of the art curriculum, after two classroom teaching practices, the following conclusions were obtained:

(1) As "digital natives" in the information age, primary school learners are more receptive to the use of virtual reality technology in the art classroom, recognise and adapt to its teaching methods, and show a higher willingness to use it because they do not have learning barriers due to the intervention of new technology. In particular they show a greater ease of use than adult teachers in terms of the operation of the software platform.
(2) The experimental data and interviews revealed that the application of virtual reality technology had a positive impact on the effectiveness of classroom teaching, including: the intervention of the technology facilitated learners' understanding of classroom knowledge, especially the detailed knowledge that could not be fully taken into account by traditional teaching, and students who used virtual reality devices for teaching could understand more easily and grasp the key contents of teaching more thoroughly; virtual reality technology The virtual reality technology allows learners to enter a deeper state of mind flow, and the virtual reality equipment allows learners to focus on the learning situation faster in a short period of time; VR technology enhances learner engagement, and the different forms of teaching resources and organisation allow students to concentrate and become highly engaged in the classroom. Higher levels of cognitive engagement, behavioural engagement, emotional engagement and social engagement are demonstrated.
(3) Virtual reality technology enhances the creative performance of learners' work. Virtual reality devices can bring learners more inspiration and imagination, and the immersive creative environment is more conducive to creativity. At the same time, the software's support tools can also help learners to create their work, inspiring creativity and optimising their work.

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