Application of Virtual Starry Night Teaching Technology in Aesthetics Teaching

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Abstract—**Given the trend of societal informatization, modern education technologies represented by computer technology and network technology have been applied in class practices to enrich teaching content, expand students' interests, and achieve teaching reform and innovation. This study proposes the use of virtual Starry Night teaching technology, establishes its connotation and education value, analyzes its supporting technology, and designs and implements a virtual Starry Night teaching environment. Virtual Starry Night teaching technology is a combined multimedia technology applied in the course: Principles of Aesthetics. A teaching control experiment was then conducted. Results show that virtual Starry teaching technology can significantly boost students' motivation to learn and improve the teaching effect. This approach is a teaching method worthy of promotion and attention.**

Index Terms—**virtual Starry Night, teaching; aesthetics, virtual reality, teaching reform**

I. INTRODUCTION

As science and technology improve and teaching reform advances, replacement of traditional teaching methods with modern teaching techniques is an inevitable development. Modern information technologies represented by computer technology and network technology have been introduced into the teaching field and classroom practice. These technologies greatly enrich teaching content, mobilize students' learning interests, and stimulate students' autonomous learning and innovation abilities. An aesthetic education course is a quality-oriented education course required for college students majoring in philosophy, literature, and art. This course is also an elective course favored by students majoring in science, engineering, and medicine. The basic content of this course includes essence, characteristics, expression, psychological factors, universality, individuality, and sense of beauty. This course involves philosophy, psychology, literature and art theory, and history. This course is abstract and profound, thus making it hard for most students to understand [1].

To alter the poor classroom teaching status of aesthetics-related courses, the classroom teaching mode must be innovative. Multimedia and network technology are utilized to transform traditional classroom teaching modes, optimize teaching processes, and conduct teaching reforms. Berk [2] proposed the use of video clips in multimedia course presentations, such as TV clips, movie clips, YouTube clips, and mtvU clips. Teaching experiments verify that a mixed video clip course is suitable for the new generation of college students and can effectively improve academic records. Therefore, a mixed video clip

course is an effective, diversified, and intelligent teaching method. With the rapid development of information-based education, the application of high and new technology has become the progressive direction of the educational field. Researchers find that the application of virtual reality technology can fully mobilize learners' thinking and sensory organs. For teaching content that is difficult to approach and for situations that are difficult to recreate, virtual reality technology can conduct multidirectional observation in a scene and simulate a specific situation. Jou and Liu [3] created a virtual interaction environment for the practical teaching of technical equipment in engineering courses. They found that such a virtual teaching environment can significantly improve practical operation ability and motivation of the participants. Some researchers have applied virtual teaching technology in college anthropotomy classes, created virtual microscopes for teaching, and considered virtual teaching technology as a beneficial teaching technique for increasing students' interest in learning [4].

The above information-technology-based teaching approaches can improve students' learning to some extent. This study proposes the virtual Starry Night teaching technology, establishes its connotations and educational value, analyzes its supporting technology, and designs and implements a virtual Starry Night teaching environment. This environment was applied in the course: Principles of Aesthetics. Furthermore, a control experiment was conducted to verify its teaching effect.

II. CONNOTATION AND VALUE OF VIRTUAL STARRY NIGHT TEACHING TECHNOLOGY

A. Basic concept of virtual Starry Night teaching technology

Starry Night is the most famous 3D Starry Night virtual software. Its sense of reality makes it popular to many astrophiles, and it can conduct 3D virtual demonstrations and roaming similar to Google Earth. Starry Night can vividly and rapidly simulate astronomical phenomena that are hard to observe. Constellation cognition is taken as an example. In Starry Night, constellation lines and corresponding myth images can be shown; observation time and apparent motion speed can also be set. Virtual Starry Night teaching technology in this research refers to the use of computers, multimedia, 3D Starry Night virtual software, and sensor technology in the teaching process to generate virtual environment approximates that can be considered true environments in a visual space sense. In this environment, students can generate the same visual feelings and experiences provided by a true environment.

The essence of Starry Night teaching technology is to simulate highly vivid environments in space such that students can obtain true experiences and improve teaching effect.

B. Value of virtual Starry Night teaching technology

Virtual Starry Night teaching technology complies with modern learning concepts and provides a new platform for teachers' teaching activities and students' learning activities. Virtual Starry Night teaching technology has the following educational value:

(1) Satisfies the "stimulus response" mechanism of behaviorism. Behaviorism theory holds that human behavioral expression is a response to external stimulus. Such a response is generated from learning owing to stimulus in the environment. Students who are in the real environment for a long time have established correlation between space virtual stimulus and response. In other words, once students feel stimulus in space vision in a classroom, corresponding feelings and responses will be generated and the learning effect will be enhanced.

(2) Satisfies the situation design requirement of constructivism. Constructivism considers learning as a process wherein learners actively construct internal mental representations. The factor that significantly influences learning capacity is the interaction between learners and the environment. In the vivid image teaching environments offered by virtual Starry Night teaching technology, students can obtain objective perceptions. Thus, this technology contributes to stimulating students' image thinking ability and learning in approximately natural environments and situations.

(3) Compensates for the limitation or shortcomings of teaching conditions. In practical teaching processes, some necessary teaching links or experimental activities cannot be implemented because of limitations in location and teaching funds. With the help of virtual Starry Night teaching technology, teachers can depend on information technology to simulate reality, enable students to perceive experiences that are consistent with reality, enrich course cognition, and deepen knowledge understanding.

(4) Presents rich knowledge in a short period. Virtual Starry Night teaching technology can abstract and compress spontaneous changes that occur after a long period and then present them to students. In this way, knowledge (e.g., celestial body motion and plant growth) can be acquired, observed, and understood easily. Learning efficiency also improves.

C. Key components of virtual Starry Night teaching technology

A traditional distance learning system is illustrated in Figure 1. The advantage of this system is the collection of learning resources for users. However, its shortcomings are the lack of interaction among users and the limited connection among users and resources. Thus, mobilizing the lasting interest of users is difficult. In this manner, distance learning systems cannot achieve their purpose.

1) Virtual reality

Virtual reality (VR) [5] is a simulation environment that approaches reality and is created by computer and electronic technology. By using multiple types of sensors, users may feel and operate virtual environments in a natural manner. The key technologies of VR include dynamic environment modeling, real-time 3D graph generation, 3D display, and sensors.

2) Multimedia technology

Multimedia refers to the rational collocation and coordination of two or more types of media [6]. Multimedia displays through different angles and forms to promote information understanding and memory, such as PPT, games [7, 8], and computer-assisted video learning [9]. In the teaching process, multimedia is used to provide students with visual and auditory stimulus. Multiple stimuli are used to simulate students' learning enthusiasm and improve the learning effect.

III. DESIGN AND IMPLEMENTATION OF VIRTUAL STARRY NIGHT TEACHING ENVIRONMENT

A. Functions of virtual Starry Night teaching environment

A virtual Starry Night teaching environment provides students with an approximately real virtual world. To reach the expected teaching effect, a virtual Starry Night teaching environment needs to have the following functions:

(1) Combination of virtuality and reality. An approximately real environment should be presented for students to achieve the combination of virtual images and the users' surrounding environment. Students can perceive the work that approaches reality, observe the world from various perspectives, reach a perfect unification of real world and sensory effects, and enhance the sense of immersion.

(2) Real-time interaction and synchronization of the real world and virtual world. When students' positions and sight are altered, the image displayed by the equipment should be adjusted and changed.

(3) Natural interaction. In the interaction process, a virtual Starry Night teaching environment can remove the need for traditional mouse and keyboard modes and design relevant action orders according to the users' habits. After monitoring equipment catches these action orders, the virtual Starry Night teaching environment interprets and executes them.

B. Design of virtual Starry Night teaching environment

Relevant design is conducted according to the functional features of the virtual Starry Night teaching environment. A virtual Starry Night teaching environment consists of three parts: an environmental monitoring module, a system control module, and a media display module (Figure 1).

The environmental monitoring module is used to realize the monitoring of students' positions and students' interactive orders. A position sensor can detect students' position information. The camera can perceive the students' sight or receive students' action order information. Data transmission equipment transmits the students' position information and order information to the system control module.

The system control module consists of a computer controller and multimedia database. A multimedia database stores videos, images, and other media information gathered from different directions. The media information is bound with position information, as shown in Figure 2. After a computer controller receives position information,
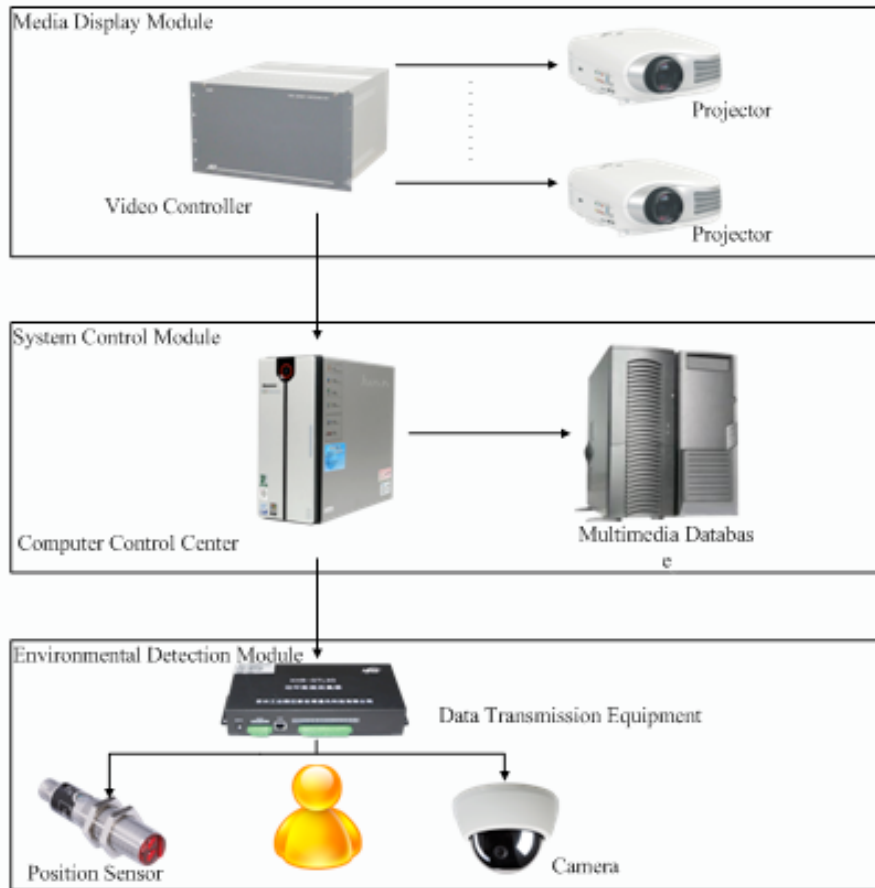
Figure 1. Schematic of virtual Starry Night teaching environment composition
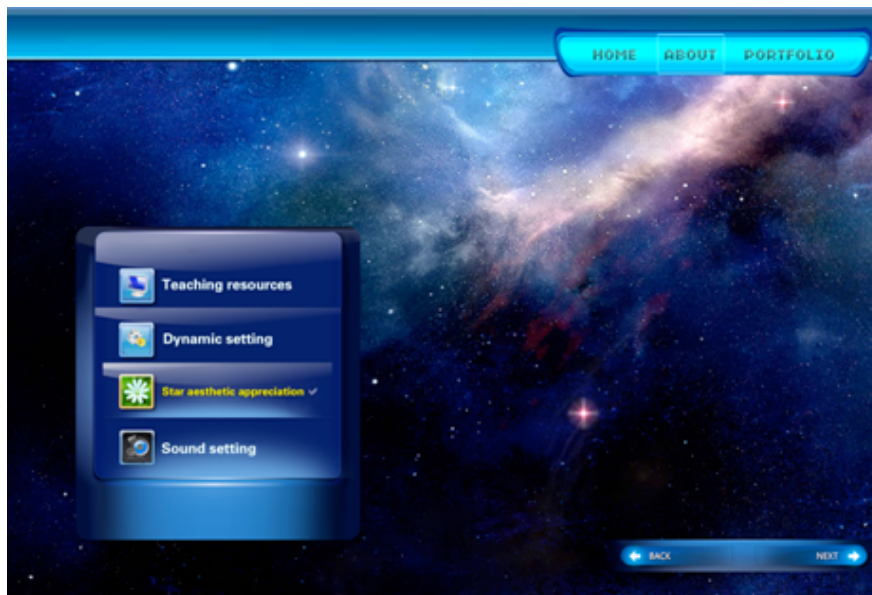

Figure 2. Media information under different directions

it retrieves corresponding media information from a multimedia database according to the students' position information and sends the media information to the media display module. After the computer controller receives the order information. It analyzes the order information and executes a predefined order action.

The media display module displays media information according to the order sent by a system control module. It is composed of a video matrix controller and several projectors. Each projector corresponds to different positions. After the video matrix controller receives the media information sent by the system control module, a corresponding projector is chosen for display according to the corresponding relationship between the media information and position information.

C. Deployment of virtual Starry Night teaching environment

The display modes of a virtual space mainly include a sphere model, polyhedron model, or cylinder model. Sphere and polyhedron models can reflect the situation from any angle in the response space, but a sphere model needs to store a large amount of media information. Furthermore, a media display definition under different angles is not even, thus affecting the visual effect. In the polyhedron model, the projection handling complexity of media information is high and the realization difficulty is large. The cylinder model simplifies the sphere model and can present a 360° visual angle at the horizontal direction. Furthermore, the images presented are even, and the validity of details is high. However, given the limitations in the vertical direction, the virtual Starry Night teaching environment designed in this paper adopts a cylinder model.

The schematic of the virtual Starry Night teaching environment deployment is shown in Figure 3. In a fixed site, the annular screen forms a cylinder (for an annular object in the figure, actual deployment can be the self-ring or the whole ring according to expenditure limitations or teaching needs), and students view the environment via a cylinder screen. The projectors are deployed at different positions of the cylinder screen according to position deployment. The position sensor and camera are placed within the effective range. Several position sensors or cameras are set up as required. A system controller, multimedia, database, and video matrix controller can be deployed according to the site conditions. These devices can be connected through wired or wireless transmission modes.

The author created and deployed a virtual Starry Night teaching environment on campus. The cylinder screen is a semi-ring, as shown in Figure 4.
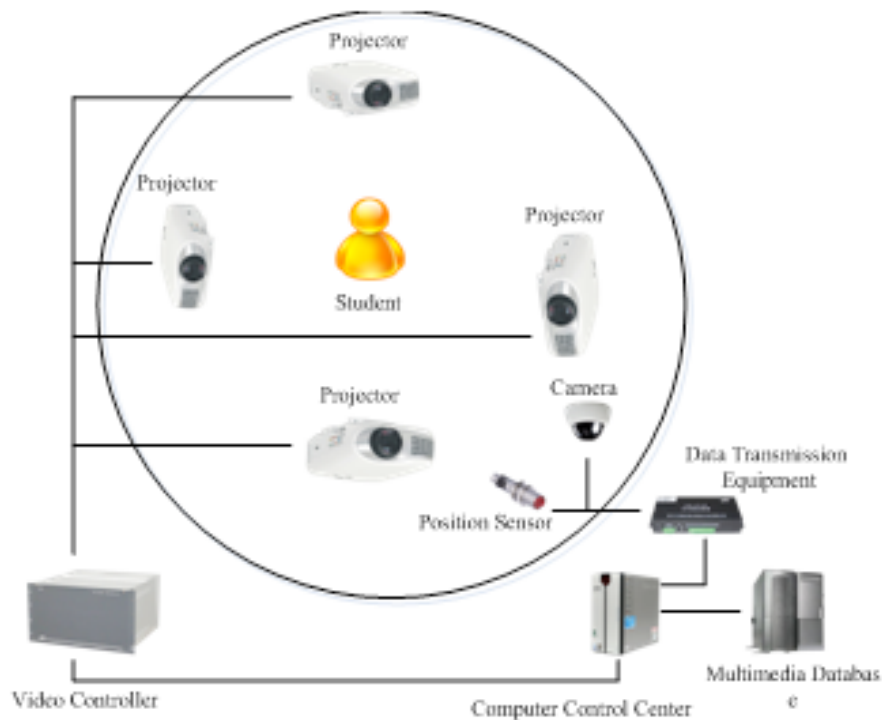

Figure 3. Schematic of virtual Starry Night teaching equipment deployment

Figure 4. Virtual Starry Night teaching environment

IV. VERIFICATION AND RESULT ANALYSIS

A. Experimental subject

Principle of Aesthetics is one of the required courses for college students majoring in Chinese language and literature and mainly teaches the essence, features, and expression of aesthetics. It involves multi-disciplinary content such as philosophy, psychology, literature and art theory, and history. This course is very abstract and difficult to understand. New teaching methodologies are needed to conduct teaching innovation and reform. Relevant trials are suitable. Therefore, the author chose such a course for this experiment. This experiment verifies the functions and effects of virtual Starry Night teaching technology in the teaching process.

In 2014, 189 freshmen majored in Chinese language and literature and were grouped into two large classes, including 94 students in the experimental group and 95 students in control group. During the teaching of Principles of Aesthetics, students in the experimental group completed classroom learning in a virtual Starry Night teaching environment, whereas the students in the control group completed classroom learning in a traditional classroom environment.

B. Method

The learning motivation survey used in this study adopted the learning motivation scale prepared by Amabile, Hill, and Hennessey [10] and revised by Chi and Xin [11]. Many studies have proven that revised learning motivation scales have many ideal reliability and validity indexes; thus, such scales can be used for relevant studies on Chinese subjects [11]. The scale consists of 30 items, including internal motivation and external motivation scales. The internal motivation scale includes two factors: challenge (8 items: 3, 26, 13, 7, 10, 27, 5 and 17) and enthusiasm (6 items: 20, 23, 30, 22, 8 and 11). The scale adopts a 4-level scoring method: 1 means complete incon-

formity; 2 means relative inconformity; 3 means conformity; 4 means complete conformity. A higher score means a stronger motivation level. Questions 1 and 16 were scored reversely.

C. Results

Virtual Starry teaching technology contributed to improving students' learning motivation.

Prior to the intervention, the experimental and control groups were comparable in terms of learning motivation and six dimensions. Inter-group comparison had no statistical differences (P > 0.05). After the intervention, four dimensions of the experimental group significantly improved compared to pre-intervention. The four dimensions include challenge, enthusiasm, attention to interpersonal competition, and return pursuit. The difference has statistical significance (P < 0.05). Furthermore, two dimensions also improved: dependence on others' evaluation and selection of simple tasks. However, the difference has no statistical significance compared with pre-intervention (P > 0.05). The changes of the control group are insignificant in learning motivation and six dimensions; the difference has no statistical significance compared with pre-intervention (P > 0.05). Based on the index change values of the experimental group and control group before and after the intervention, the change values of the experimental group in learning motivation (challenge, enthusiasm, attention to interpersonal competition, and return pursuit) were greater than the control group, and the difference had statistical significance (P < 0.05). The change values of the experimental group in dependence on others' evaluation and selection of simple tasks show no significant difference from the control group (P>0.05). This result indicates that virtual Starry Night teaching technology improved the learning motivation of the objects of study, which is reflected in four dimensions: challenge, enthusiasm, attention to interpersonal competition, and return pursuit. See Table 1 for details.

TABLE I.
FUNCTION OF VIRTUAL STARRY NIGHT TEACHING TECHNOLOGY ON STUDENTS' LEARNING MOTIVATION

Index	Group	Before intervention	After intervention	Intra-group comparison	Comparison of inter-group change values before and after intervention
Challenge	Experimental group	3.11±0.62	3.32±0.61	P=0.025	P=0.013
	Control group	3.12±0.65	3.10±0.60	P=0.842	
enthusiasm	Experimental group	3.08±0.71	3.34±0.62	P=0.008	P=0.012
	Control group	3.09±0.68	3.11±0.63	P=0.917	
Dependence on others' evaluation	Experimental group	2.78±0.58	2.84±0.54	P=0.463	P=0.615
	Control group	2.76±0.57	2.80±0.55	P=0.752	
Selection of simple tasks	Experimental group	2.58±0.51	2.63±0.45	P=0.541	P=0.481
	Control group	2.56±0.54	2.58±0.52	P=0.717	
Attention to interpersonal competition	Experimental group	3.01±0.55	3.21±0.65	P=0.045	P=0.046
	Control group	3.00±0.60	3.02±0.61	P=0.842	
Return pursuit	Experimental group	2.21±0.55	2.41±0.45	P=0.009	P=0.003
	Control group	2.18±0.51	2.21±0.47	P=0.751	
Leaning motivation	Experimental group	2.80±0.54	2.96±0.56	P=0.047	P=0.046
	Control group	2.79±0.49	2.80±0.57	P=0.798	

V. CONCLUSIONS

Given that the humanistic quality of education for Chinese college students is improving continuously, the status of aesthetics teaching will significantly improve over time. The original elementary courses of philosophy, Chinese, and art majors have been consolidated. Principles of Aesthetics gradually will become a public elective course for humanistic education for other various types of majors. The teaching content of Principles of Aesthetics includes rich humanity and art materials as well as colorful, natural, and humane sceneries. This course also presents features such as spatiality, comprehensiveness, and diachronism. Thus, a scientific and correct teaching method is one of the key links for aesthetics teaching because this factor directly influences the actual effect of aesthetics teaching. China's aesthetics teaching methods have been obsolete and single for a long time. Colleges also fail to develop feasible teaching methods that can comply with the psychological characteristics of college students according to the actual needs of aesthetics teaching. This failure significantly affects the improvement of the actual teaching levels and damages the students' enthusiasm and initiative for learning the aesthetics course material. We should utilize virtual Starry Night multimedia technology to achieve synchronous text-image information transfer with sound, animation, and video and present the courseware for teaching so students have the feeling of being personally on the scene. This study appropriately adds corresponding practice content in aesthetics teaching, fully utilizes virtual Starry Night education technology, and provides rich network resources: strong audio, image, and other visual and auditory experiences. Hence, every student can have the desire of seeking knowledge and aesthetic perception ability. Furthermore, such a vivid sensual experience can be applied to further understand aesthetic theory, break through time-space limits, expand teaching information transmission, help students solve aesthetics problems from multiple perspectives, and help students perceive objects from different aspects to solve dynamic and static as well as abstract and concrete contradictions. Correspondingly, such a virtual Starry Night aesthetic course makes original single teaching activity vivid, improves the classroom atmosphere, enhances the students' aesthetics experiences, facilitates independent learning, and boosts students' learning motivation and academic performance. Therefore, virtual Starry Night teaching technology can significantly promote teaching in aesthetics-related courses. This type of technology has extensive application prospects.

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