Research Article

Optimization of 3D Virtual Reality Technology in High School Physics Direct-Type Teaching

Shanchao Guan,1,2 Guian Li,3 and Jiacheng Fang1,4

1School of Education, Shaanxi Normal University, Xi’an, 710062 Shaanxi, China
2Suzhou New District Yangshan Experimental Junior High School, Suzhou, 215151 Jiangsu, China
3School of Physics and Information Technology, Shaanxi Normal University, Xi’an, 710119 Shaanxi, China
4Changzhou Zhonglou District Teacher Development Center, Changzhou, 213000 Jiangsu, China

Correspondence should be addressed to Guian Li; allander@snnu.edu.cn

Received 29 March 2022; Revised 25 April 2022; Accepted 6 May 2022; Published 18 May 2022

1. Introduction

3D virtual augmented reality technology is the product of the combination of virtual reality (VR) and augmented reality (AR), which is a new product of the development of the computer simulation system. Virtual reality technology through the simulation of the real environment in the computer builds a scene similar to the real environment, the user through interaction with the computer produces a feeling as in the real environment, and you can feel in the virtual environment that it has the characteristics of the real scenario, such as vision, hearing, smell, and touch [1]. Virtual reality is widely used in many fields because it is realistic, low cost, easy to implement, repeatable, and not bound by time and space. For example, military field, medical field, aviation field, business field, manufacturing field, and game field, and most of all, it is
applied in education and training field [2]. Next, let us discuss 3D virtual reality technology applied to high school physics direct-type teaching-related software and hardware.

The 3D virtual augmented reality technology can provide an effective teaching context, set up a logical and clear inquiry process, help students experience the process of applying what they have learned to solve real problems, ensure that students effectively experience the process of scientific inquiry and thought processing, ensure the internalization of students’ core literacy, have correct scientific thinking, develop scientific inquiry ability, and form correct scientific attitudes and responsibilities.

1.1. Versatile 3D Development Tool Virtools. Virtools was developed by the French company “Dassault.” Virtools provides a main development platform for 3D virtual reality environments and five additional optional modules to provide the technical support for the implementation and expansion of the intended functions of educational applications [3]:

(1) For people who are new to the 3D digital field, it is very difficult to make some excellent digital products, because good 3D digital products not only need to have good modeling expression ability and game creativity, but also have very high requirements in the program. In the face of deep measurable 3D product development, Virtools can help users to express their own creative ideas.

(2) With Virtools, you can use the “drag-and-drop” method to put “behavioral interaction modules,” i.e., building blocks, on the interactive objects. Its advantage is that even beginners or unfamiliar with programming objects can be in the form of flowcharts, to deal with the relevant code before and after the order of all 3D objects to visualize the interaction design [4]. The use of this software, greatly reducing the threshold of learning, can improve efficiency and cost savings.

(3) Virtools software is quick to start and very easy to learn. In recent years, the application has become more and more widespread and is the leader in virtual reality technology applications.

1.2. 3D Virtual Reality Tool EON Series Software. EON Virtual Reality Systems (EON Reality) is a company that provides real-time three-dimensional interactive software design and distribution, by its EON software, for interactive 3D web pages, virtual reality, visual simulation, and multimedia applications to provide a more comprehensive solution [5]. EON virtual reality technology has a wide range of applications in many fields, including military training, engineering and construction, manufacturing and design, education and training, and e-commerce.

The development of virtual reality systems using EON consists of three major steps: inputting 3D models, completing interactive settings, and publishing. Input 3D model is usually done by 3D design software or CAD applications; after inputting the model, you can add actions to the model through EON’s visual 3D design interface, scripting, or C++ program code to complete the interactive design; finally, the production of EON files can not only be displayed through the network or storm but also with other tools that support Microsoft ActiveX controls. Finally, the produced EON files can be displayed on the web or in a storm and can also be interacted with other tools supporting Microsoft ActiveX controls. EON is easy to learn, easy to use, realistic, and integrated, and it produces a small amount of files. EON software is suitable as an optional development platform for educational applications because of its network support, distributed virtual reality support, complex interactive settings, and the realism of the created environment.

1.3. Web3D Technology and Software. Web3D, also known as network 3D, is a real-time interactive network 3D technology; its essence is a Web-based 3D interaction and rendering technology. To achieve Web3D, first of all, we need to carry out Web3D modeling work in the early stage, can be used for Web3 geometric modeling software, currently the most commonly used first is 3Ds MAX, followed by Maya and Softimage XSI, and specifically for Web3D modeling and animation of the rising star 3D Plasma, is being used by more and more design developers [6]. Web3D can also be modeled using images. The principle is to take two or more photos of the object to be modeled and use professional image modeling software to mark and position the key points on the object, according to the principle of geometric perspective and measurement, so as to establish a three-dimensional model of the object.

There are many software for developing Web3D, the more popular and representative ones are Cult3, Viewpoint, Flatland, Fluid3D, and so on. Although they are developed by different companies, they usually have the following functions: create or edit 3D scene models (but the creation is generally done with the help of professional modeling software), add or modify Web3D models, improve the interactivity of Web3D graphics compress and optimize the size of model files within the scene, and also encrypt the files.

Now, we introduce several Web3D-related software.

1.3.1. Shockwave3D. Macromedia’s Shockwave3D technology has 137 million users worldwide. It supports a skeletal deformation system; supports subdivision surface; can automatically increase or decrease the accuracy of the model according to the performance of the client machine; supports smooth surface, photorealistic texture, and cartoon rendering mode; and also supports some special effects such as smoke, fire, and water.

1.3.2. Cult3D. Cult3D is an interactive 3D software for e-commerce launched by Cycore, mainly for interactive 3D rendering of applications:

(1) Communication between Cult3D objects and JavaScript is available

(2) The built-in product configuration features can help users to develop their own product configuration solutions.
The application of virtual reality technology in education is mainly in several aspects such as virtual skill training, virtual laboratory, virtual teaching, and virtual campus roaming. The application of virtual reality in education can significantly improve the efficiency of student learning, expand students’ thinking, change the way students learn from passive acceptance to active exploration, and change the traditional teaching mode. The main applications of virtual reality technology in teaching are as follows.

1. Virtual laboratory

In the learning process, there are experiments that are somewhat dangerous or difficult to complete under the conditions of the moment. For example, in the basic learning process of gravity, it is impossible to complete experiments for students to observe physical phenomena under actual conditions because the objects in the concept are too large. In the virtual laboratory, students can simulate real phenomena through simulation experiments and are not limited by time and space and can easily perform experiments on their computers or mobile at any moment.

2. Virtual teaching

When students are learning, abstract knowledge is not easy to understand if it is always expressed in words or text. If visual phenomena can be used to show, it is more conducive to teaching. For example, in the process of teaching basic, for the electric field, which is an invisible concept, the use of virtual reality technology can simulate the electric field lines, so that students can clearly understand the distribution of electric field lines, through the movement of charged objects in the virtual electric field so that students have a more intuitive understanding of the abstract invisible electric field force.

3. Virtual campus tour

Virtual campuses usually include virtual campus landscapes, virtual laboratories, virtual libraries, and virtual administrative buildings. Users of the virtual campus are usually students, teachers, and parents, and through devices such as the mouse and keyboard, users can have a natural human-computer interaction. Users create a sense of immersion when roaming in the virtual campus. They are able to observe the campus buildings and get familiar with the campus environment.

In the research process of virtual physics teaching, the main parts to be modeled are virtual scenes, virtual laboratories, virtual experimental devices, and virtual instrumentation. 3Ds MAX is able to model complex objects such as virtual experimental devices, virtual labs, virtual voltmeters, and virtual ammeters [8]. However, Unity3D itself is also able to model. A visual tree list of resources, including all the objects and files that appear in the scene, is obtained. The ability to create parent-child relationships between objects by simply dragging and dropping them. When the parent object is rotated, scaled, moved, etc., the child objects will perform the same actions as the parent object. In other words, the child object inherits all the properties of the parent object, which makes it relatively easy to modify large amounts of data. Complex models can be built in 3Ds MAX and exported in .fbx format to be used in unity scenes.

2.1. 3D Modeling Process. A realistic virtual environment allows users to have a better immersion in the process and thus forget about the real environment they are in. In the virtual teaching platform research process, virtual labs and virtual experimental instruments are very critical parts of modeling. Virtual objects can be modeled using 3Ds MAX to model or with unity. When modeling, the model needs to be optimized as much as possible to improve the speed of computer operation. Some detailed models need to be modeled in detail, such as experimental equipment; some models that do not affect the operation much need to reduce the number of polygons as much as possible to make more efficient use of computer hardware.

The general process of 3D modeling is as follows:

1. Establish topographical features

In the modeling process, the first thing you need to do is to model the terrain and the landscape. Terrain is the carrier of the rest of the model, because objects in unity have physical characteristics, if there is no terrain to carry, the rest of the model will keep falling. Therefore, in the process of modeling the terrain, you need to do a good job of terrain planning and distribution.

2. Realize the model shape

When modeling complex objects, different modeling schemes can be chosen according to the object shape...
characteristics. For objects with obvious geometric characteristics, polygonal modeling can be chosen; for objects containing surfaces, non-uniform B spline modeling can be used.

(3) Make model material

The process of modeling virtual objects requires not only that the virtual object’s shape be close to the real object but also that the virtual object’s surface material look and feel similar to the real object. When setting the model material, it is necessary to prepare many texture materials in the early stage. The model’s material production is divided into pre and post, mainly using 3Ds MAX to arrange light, create material spheres and bake mapping, etc., while the post mainly using unity3D to arrange light and adjust the material sphere’s Shader parameters, etc.

(4) Export model

Once the model has been created, it needs to be exported in .fbx format. Before exporting, you need to check that the model is found correctly, that materials and objects are named in English and numbers and that the number of facets of the objects is correct, and that objects of the same material can be combined but that the total number of facets does not exceed 64 K. The model should not be allowed to be exported until it has passed this check.

2.2. Modeling of Virtual Charged Objects and Virtual Uniform Electric Fields. The electric field is a particularly important part of the physics teaching process, but it can only be taught to students using abstract concepts from books. In the course of this paper, abstractions are visualized, transforming invisible abstractions that can only be described in words into visual and tangible actionable knowledge that can be seen visually. In this chapter, the movement of a charged object in a uniform electric field is used as an example for modeling purposes.

Definition of homogeneous electric field is as follows:

A uniform electric field means that the strength of the electric field is the same everywhere in the electric field. Usually, two charged metal plates are used to achieve a uniform electric field. In the case of a uniform electric field, the two metal plates need to be in parallel positions and one plate needs to be positively charged and the other negatively charged. The electric field between the two plates, excluding the fringes, is a uniform electric field and the electric field lines are parallel. The electric field strength, voltage, and distance between the plates are related by the formula \( E = U/d \). The electric field strength is proportional to the voltage and inversely proportional to the distance between the two plates.

The motion of a virtual charged object in a uniform electric field experiment sets the mass \( m \) of the virtual charged sphere to 0.01 to reduce the effect of gravity on the sphere, which is difficult to achieve in reality. Only in the virtual environment can the required conditions be set to ideal conditions, thus reducing the influence of other conditions less relevant to the knowledge here.

The magnitude of the force on the ball with a point in a uniform electric field \( F = E \times q = (U \times q)/d \), that is, the magnitude of the electric field force on the ball with a point is proportional to the voltage between the two metal plates, increases with the increase in the amount of charge of the ball, and decreases with the increase in the distance between the two plates. In the process of the ball’s movement, the ball can be added to the rigid body components, changing the acceleration of gravity of the ball \( g \) to simulate the acceleration of the ball \( a \) by the force of the electric field. According to \( F = m \times g \), \( g = F/m = Eq/m = Uq/dm \), the acceleration of the ball in a uniform electric field is \( a = g = Uq/dm \). The motion of the sphere under different electric field forces is simulated by the change of the gravitational force on the sphere.

A simple object can be easily modeled in Unity by selecting Create Other in the Create menu bar and choosing Cube. In the Hierarchy, copy and paste panel1, and another panel with exactly the same characteristics will appear, named panel2; reset the \( y \) value of position of panel2 to 5, and two identical and parallel panels will appear in the scene. To indicate the difference between the positive and negative charges, set the Material color of one panel to red and the other to blue, so that the two panels can be easily distinguished.

Next, model the charged blob. Create a new material in the Material folder named ball, set the color of the material ball to green and assign the material ball to the ball by dragging and dropping it. Set the \( x \), \( y \), and \( z \) values of the ball’s position to -5, 3.5, and 0, respectively.

The first-person controller is used in this paper in order to provide a better all-round view of the experiment during the subsequent interaction. In order to prevent the first-person controller from falling off at the beginning of the experiment, Terrain was built in addition to the charged metal plate and the charged sphere during the modeling process of this experiment, and the different views of the model after it was built are shown in Figures 1 and 2.

2.3. Scene Modeling of Virtual Parabolic Motion. An object moves in a curve when the direction of the combined force \( F \) on it and its initial velocity \( v \) do not lie in the same line. When an object moves in a curve, one side of the curve is always concave and the direction of the combined force on the object is always directed towards the concave side of the surface. Similar to the synthesis and decomposition of forces, motion can be decomposed into different sub-motions. By decomposing the velocity of motion into two axes, the \( x \)-axis and the \( y \)-axis, it is easier to understand curvilinear motion by analyzing the sub-motions in different directions. The initial velocity of an object \( v \) in parabolic motion is parallel to the horizontal \( x \)-axis, if the object is thrown by gravity \( G \) alone, i.e., the direction of the combined force on the object is vertically downwards and parallel to the \( y \)-axis. The velocity of the object in the horizontal direction \( v_x \) does not change as it is not subjected to a force in the horizontal direction, however, the combined force in the vertical direction is vertically downward, so the motion in the vertical direction is uniformly variable.
When an object is in a parabolic motion, the time of motion in the air $t$ is determined by the height of the object $h$ (assuming the acceleration of gravity $g$ remains constant). Because the initial velocity of the object in the vertical direction is 0, then according to the uniform linear motion formula $h = (1/2)gt^2$, you can launch $t = \sqrt{2h/g}$. By measuring the displacement of the object in the vertical direction, you can calculate the movement time of the object $t$. Because the horizontal direction of the motion is uniform linear motion, then according to $s = v_0t$, you can launch $v_0 = s/t$, so as to calculate the horizontal velocity.

The create sphere operation can be implemented in unity. Select Sphere from the Create Other menu bar in unity and a sphere object will appear in the scene. Create a new material in the Material folder, set the material color to gray and assign it to the sphere and rename the sphere to ball and the sphere will be created.

Next, the environment is modeled. In order to avoid the ball falling out of the observable range during the throwing process, Terrain was created as Ground, and Cube1 was created as a reference for the displacement in the vertical direction during the flat throwing process in order to observe and refer to the displacement of the ball. At the same time, Cube2 is created and placed to the right of Cube1. To create Ground, Cube1 and Cube2 as a whole, create an empty object by selecting Create Empty in the Game Object menu bar and rename the empty object as Environment. The environment is created by dragging Ground, Cube1, and Cube2 underneath the Environment. Assign the grid paper to the environment’s material to complete the model. The finished model is shown in Figure 3.

3. Teaching Model of 3D Virtual Reality Technology Applied to High School Physics Direct-Type Teaching

The Virtual Chemistry Laboratory at the University of Oxford uses video and virtual reality technology to implement a virtual chemistry laboratory that shows students chemical phenomena that occur in chemistry courses [8]. Clarkson University, USA, used Java Applets to design the Electronic Teaching Assistant, a basic circuit teaching course where users can design circuits, interact and submit assignments. The Virtual Basic Lab developed at the University of Oregon, USA, which is implemented mainly in Java and covers astrobasic, energy and environment, mechanics, and thermodynamics [9]. The virtual basic lab hosted by the Department of Basic and Astronomy at Northwestern University in Canada focuses on atomic basic, mechanics, optics, and wave dynamics [10]. Foreign research in virtual reality in teaching has achieved many excellent results and developed some virtual experiment simulation systems that can improve students’ learning efficiency, but these systems are complicated to implement, do not cover enough comprehensive content, and are not strong in simulation and interactivity.

3.1. The Basic Process of Developing Virtual Experiment Courseware Using Virtools Platform

(1) Collecting materials: first we need to use a digital camera to take pictures of classroom textures and desks and chairs and collect pictures needed for various experimental equipment on the Internet and in
real laboratories. Then, use Photoshop CS software to crop and beautify them. Virtools supports mp3, wav, and other formats of sound files.

(2) Creating the model and its import and export: first is the use of 3Ds MAX software to create virtual classroom scenes, virtual experimental equipment models, and then create good lighting in the virtual scene, and to use the precollection of images for the creation of good models and scenes to assign material textures and UV mapping, if necessary, must also be baked on the scene of the model to ensure that the simulation of the experiment. After creating the model, you can use the plug-in to export the scene and model to Virtools4.0 can identify the file with the extension NMO, and then, you can import it in Virtools and create a library of related resources.

(3) Interaction and design of the model: this phase is the content development phase in the VirtoolsVirto platform. The development platform provides a variety of complex programs in an intuitive form through a graphical interface and also comes with behavior scripting modules (BBs) that can meet the needs of interactive 3D creation.

(4) Publishing the system: the finalized virtual experiment courseware should be published as a web-formatted file or packaged as an executable file, published to the relevant web pages or provided for download, so that learners and teachers can conduct virtual experiments or use it in the classroom through the network.

(5) Testing and application: at this stage, the virtual classroom is tested and applied to education and teaching, and the virtual experiment courseware is further improved according to the feedback information.

3.2. Geometric Modeling in Virtual Reality. Virtual objects are mostly composed of geometric objects. Geometric modeling deals with the topological and geometric information of the geometric model. Topological information is the number of components of each geometric object and the interrelationship between these components, including the number of points, lines, and surfaces, as well as the components near each component and their intersection locations. Geometric information refers to measurable data such as size and position of objects in geometric space, including area and length [11].

Geometric modeling of virtual objects is the representation and processing of geometric and topological information of virtual objects, i.e., the corresponding description of 3D objects in mathematical language. There are many different methods of geometric modeling, but in general, they can be divided into three main categories: multivariate, Boolean model, and nonuniform rational B-sample, and the mathematical principles of the same type of modeling methods are basically the same.

(1) Polygon

Most of the time, polygon modeling is used in the process of geometric modeling. The modeling method uses points, lines, and faces to form line segments and faces, then mosaics the line segments and faces into the object to form a polygonal mesh, and finally, uses the mesh to approximate the model. The process of modifying the model is usually done by modifying the three elements of points, lines, and faces accordingly, by reducing, adding, and changing their positions. Any object can be modeled accordingly by a sufficient number of polygons; however, the performance of the system decreases as the number of polygons increases.

Most of the time when polygon modeling is done, triangles as well as quadrilaterals are used for modeling. In this article, 3Ds MAX uses polygons to construct the original simple model and then builds the desired model by deleting or adding points and faces and adjusting their position.

(2) Boolean model

Boolean models, also known as constructive solid geometry (CsG), create complex models by adding, subtracting and other Boolean operations to basic geometric models such as spheres, cylinders, and cubes. For example, a model of a chair can consist of a cylinder with a chair face and a cube with four chair legs.

CsG has a very close relationship between the description of the object model and the generation order of the object, and it stores the basic elements and the process of combining these elements into an object. The advantages of CSG are the speed of modeling and the absence of redundant information, the disadvantages are the simplicity of storing information and the limited algorithms for model modification.
(3) Nonuniform rational B-splines

Nonuniform rational B-spline (NURBS) is a very good modeling method that is supported by many software, such as 3Ds MAX and Maya Softimage. NURBS refers to the use of curves and surfaces to model in 3D space, and each model can be represented by mathematical equations used to represent each model.

The degree is a very important parameter in NURBS modeling, it refers to the highest number of times in the mathematical equation used, the degree of a straight line is 1 and the degree of a quadratic equation is 2. In the modeling process, the cubic equation is usually used, and its degree is its highest number of times. The larger the degree value, the more circular the curve and the larger the computation.

3.3. 3D Graphic Transformation. A 3D graphic transformation is a new 3D graphic created by resizing and rotating a 3D graphic while moving it by the same scale [12]. The basic geometric transformations of 3D shapes are performed with respect to the origin and axes of coordinates and can be achieved by flush coordinate transformations.

3.3.1. 3D Translational Transformation. Move \( P(x, y, z) \) to \( P'(x', y', z') \), and then
\[
x' = x + T_x, y' = y + T_y, z' = z + T_z,
\]
\[
T_x = x' - x, T_y = y' - y, T_z = z' - z.
\]

The translational transformation matrix can be introduced as
\[
T = \begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
T_x & T_y & T_z & 1
\end{bmatrix}. \tag{2}
\]

The translation transformation matrix of the point is expressed as
\[
[x' y' z'] = [xyz]T. \tag{3}
\]

3.3.2. 3D Scale Transformation. If the center \( P(x, y, z) \) of the object is transformed in three mutually perpendicular axes relative to the far point with corresponding coordinate transformations, the transformation ratios are \( a, b, \) and \( c \). If \( a = b = c \), the object is transformed in equal proportions, and if the ratios are not equal, the object is transformed in different local proportions. The transformed coordinates are denoted as \( P'(x', y', z') \), and the transformation matrix is
\[
T = \begin{bmatrix}
a & 0 & 0 & 0 \\
0 & b & 0 & 0 \\
0 & 0 & c & 0 \\
0 & 0 & 0 & 1
\end{bmatrix}. \tag{4}
\]

The equation for the proportional transformation coordinates of a point is expressed as
\[
[x' y' z'] = [xyz]T. \tag{5}
\]

4. 3D Rotation Transformation

When the object is rotated around the coordinate axis, \( P(x, y, z) \) becomes \( P'(x', y', z') \). Then, the transformation matrix of \( P' \) is not the same for different coordinate axes.

If the point \( P \) is rotated around the \( x \)-axis, its change is
\[
x' = x, y' = y \cos \vartheta - z \sin \vartheta, z' = y \sin \vartheta + z \cos \vartheta. \tag{6}
\]

Then, transform the matrix
\[
T = \begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & \cos \vartheta & -\sin \vartheta & 0 \\
0 & \sin \vartheta & \cos \vartheta & 0 \\
0 & 0 & 0 & 1
\end{bmatrix}. \tag{7}
\]

If the point \( P \) is rotated around the \( x \)-axis, its change is
\[
[x' y' z'] = [xyz]T. \tag{8}
\]

If the point \( P \) is rotated around the \( y \)-axis, its change is
\[
T = \begin{bmatrix}
\cos \vartheta & 0 & -\sin \vartheta & 0 \\
0 & 1 & 0 & 0 \\
\sin \vartheta & 0 & \cos \vartheta & 0 \\
0 & 0 & 0 & 1
\end{bmatrix}. \tag{9}
\]
If the point $P$ is rotated around the $z$-axis, its change is

$$
[x\prime y\prime z\prime] = [xyz] \begin{bmatrix}
\cos \theta & \sin \theta & 0 & 0 \\
-\sin \theta & \cos \theta & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1
\end{bmatrix} = [xyz]T,
$$

(10)

where $\theta$ is the magnitude of the angle of rotation of point $P$ around the coordinate axis.

5. Conclusion

Virtual reality technology has important practical applications in high school physics teaching. Based on an in-depth understanding of virtual reality development software and modeling methods such as 3Ds MAX and Unity, this paper takes the key knowledge of high school physics "electric field" as an example for 3D modeling, transforming the abstract knowledge of electromagnetic field concepts that can only be described in words into tangible and actionable knowledge [13]. Scientific thinking and literacy is the centralized embodiment of human development in basic and is the correct values, necessary character, and key abilities that students gradually develop through the study of basic. Scientific thinking and literacy mainly includes "scientific thinking," "scientific inquiry," and "scientific attitude and responsibility." In the process of teaching physics in high school, physics experiments are important in helping students to understand and form a logical knowledge structure. With the continuous development of virtual reality technology, the integration of teaching knowledge of various disciplines is bound to become a new research hotspot.

Firstly, virtual reality technology provides a new type of means to teach physics. Through the setting up of immersive, realistic, and interactive strong learning environments, students are led to learn and investigate in real scenarios [14]. After a series of practical studies and follow-up surveys, it was found that most teachers are interested in teaching in virtual reality, as students are more willing to think through virtual reality scenarios, which can increase their spatial reasoning skills. During the study, it was found that students prefer to 'learn by doing,' which activates existing knowledge in their minds and stimulates higher-level interactive questions, thus building a more comprehensive and richer body of knowledge.

Secondly, virtual reality technology plays a huge role in the construction of teaching resources. With the development of dynamic environment modeling technology, real-time 3D graphics generation technology, stereo display and sensor technology, application system development tools, and system integration technology, virtual reality technology has gained tremendous development and has now become a new type of education tool. Virtual reality technology can help students create a vivid and realistic learning environment, enabling them to enhance their memory through realistic experiences, which is easier to stimulate students' interest in learning than passive indoctrination. Virtual reality technology is immersive, interactive, multisensory, conceptual, and autonomous, and its application in education can greatly promote the informatization of teaching and learning and have a positive impact on the reform of education.

In terms of the design and production of teaching resources, virtual teaching resources created by virtual means can visualize abstract knowledge and help learners to understand it, which can to a certain extent increase learners’ motivation and improve their attention, learning efficiency and teaching effectiveness.

Thirdly, the market application of virtual reality technology is promising. As a fast-developing science and technology, the high price of the equipment makes it impossible for some schools to use it. With this limitation, the teaching resources of the equipment must be developed in depth, such as physics experiment modeling and abstract concepts, to fully reflect the value of education. Immersion is the most important feature of virtual reality technology, which enables students to feel part of the environment created by the computer system, gaining tactile, gustatory, olfactory, and kinesthetic perceptions, generating resonance of thought, causing psychological immersion, feeling as if they are entering the real world and promoting deep knowledge of what they are learning. Students can assimilate knowledge according to their sensory and cognitive abilities, expand and broaden their thinking, and create new concepts and environments. With the increasing emphasis on education, many universities and companies have already invested a great deal of research into the application of virtual reality, and virtual reality technology requires constant exploration and discovery by researchers.

(1) Three-dimensional display technology: three-dimensional display mainly relies on stereo display and sensing technology; at present, these systems three-dimensional stereo sense still can not reach the system needs [15]

(2) Interactive equipment: immersive virtual reality technology mainly uses data gloves, data clothes, and helmet displays for interaction, and desktop virtual reality technology uses a mouse and keyboard [14]. The former equipment is expensive, the latter is not strong immersion, and cheap new and robust data gloves will be the future development direction of virtual reality technology

(3) Distributed virtual reality technology: virtual reality systems distributed in different places are connected by the Internet, so that users in different spaces can communicate without barriers on the same platform, which is of great significance for collaborative learning

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.
Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgments

This work was supported by the 14th session of key self-financing project of Teaching Research of Primary and Secondary Schools in Jiangsu Province “Research on experimental teaching of junior high school physics under the perspective of intelligent learning (No. 2021JY14-ZB48)”.

References