Exploration and Prospect of Future Science Teaching Mode in the Field of Metaverse

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Abstract: In the context of the recent new crown pneumonia epidemic, long-duration online teaching has become a new trend in teaching development. With the continuous emergence of new information technologies, such as AR, MR, VR technologies, virtual reality resources, and network environments, the metaverse field has become an important environment for future teaching development. Based on the current demand towards virtual teaching and the recent development and improvement of the metaverse field, this paper explores the impact of the metaverse technology on science teaching, and accordingly puts forward the prospect of the science teaching model in the metaverse field, and discusses the impact of the metaverse technology on science teaching, including the teaching goals of strengthening scientific concepts, cultivating scientific thinking, encouraging inquiry practice, and clarifying attitude and responsibility; it involves the technical, environmental, and ethical conditions that need to be realized for science teaching to enter the metaverse field; the actual operation procedures that can be divided into three levels and and seven modules; the efficient, continuous, and diverse evaluation of the entire teaching activity, which provides new perspectives for solving the common problems in the current online science teaching and realizing the innovation of science teaching mode, enabling teachers and learners to accept the influence of the progress of science and technology itself in science teaching activities, and to better develop their own scientific literacy through independent inquiry and practice.

1. Introduction

Since 2021, known as the debut year of the *metaverse*, the concept of integrating artificial intelligence, digital twin, blockchain, cloud computing, big data, communication technology, and other technologies has developed rapidly. Through the continuous in-depth research by different organizations and scholars, the conceptual connotation and technical requirements of the metaverse have been constructed into a fully integrated system, which further makes the metaverse practical. Focusing on the field of teaching, Metaverse is an important teaching field that using artificial intelligence, virtual reality and other technologies to provide teachers and learners with a virtual teaching interactive environment; it is a response to the "New Generation Artificial Intelligence Development Plan" issued by the State Council in 2017. It is an important way to "establish a learner-centered educational environment, provide accurate push education services, and realize the customization of daily education and lifelong education"; it is the further development of modern

teaching, and the development of virtual reality intelligent modeling, group Intelligence, cross-media analysis and reasoning, and hybrid augmented intelligence teaching are new trends that make breakthroughs in traditional teaching in terms of environment, concepts, and methods; it is also an exploration made in an attempt to solve the problems occur in the online teaching during the pandemic. Under this background, science education and teaching will change in all aspects of the current teaching model. As participants in teaching activities, teachers and learners should keep abreast of the changes in the field, adapt to their new roles and new experiences, so as to achieve teaching goals, master scientific knowledge, and cultivate scientific awareness. This paper uses the literature method, logical analysis and other research methods to explore and look forward to the reform of the science teaching mode in the metaverse field, and to provide a reference for the upcoming metaverse science teaching in the near future.

2. The Connotation and Educational Properties of the Metaverse

2.1. The Origin and Development of the Concept of the Metaverse

The term "metaverse" was first used in 1992 in the science fiction novel "Avalanche" by Neal Stephenson to describe a virtual space parallel to the real world. The main body of the space is a virtual city, presented as a featureless black planet. Users can enter the planet from the real world to interact with other users by purchasing virtual land properties and develop buildings on it through virtual reality technology, such as VR glasses and other devices. [1]

With the development and progress of technology, the concept of metaverse has gradually settled from virtual to reality, and this process is accompanied by people's discussions on the definition and connotation of metaverse. Dave Baszucki, CEO of Roblox, the first company to go public with the concept of the metaverse, defines the metaverse as: a 3D virtual world that connects people with their digital identities, where people can interact with each other in this world and create as much as to one's content. According to futurist Luke Shabro, the metaverse is a fuzzy digital hybrid reality with infinite and irreplaceable items and characters, unrestricted by the physical limitations and constraints of reality. [2]

The broader, more general definition of the metaverse holds that the concept describes an online 3D virtual environment that utilizes network technology to develop permanently into the future. [3] This virtual environment requires users to enter through VR glasses, mobile phones, computers and other devices in the real world. It is the integration of the real world and the virtual world. [4] With the support of communication networks and embodied reality technology, the connection between the virtual and the real world is realized. With the development and promotion of virtual environment (VR), mixed reality (MR), augmented reality (AR) and other technologies, the public has gradually accepted and entered the metaverse environment. For example, the use of mixed reality technology to integrate computer image technology, visual wearable devices, sensing technology and other related technologies to build an interactive system that enables users to interact with the virtual world in the real world. The environment of the virtual world and the environment of the real physical world are deeply integrated in people's consciousness and memory to achieve the organic unity of virtual and reality. Because the metaverse has the characteristics of strong interaction, persistence, immersion and audio-visual, [5] this space has the characteristics of real time and virtual space, so it is parallel to the real world in time and space. At present, there are cases where the metaverse is used in the fields of video games, business, real estate, education, etc., such as Open Simulator, Minecraft, Roblox, etc. People use hardware devices and applications to enter the metaverse and communicate with each other, work together, and have fun game. [6-8]

2.2. The Educational Attributes of the Metaverse Concept

The educational metaverse is a concept that is generated along with the promotion of education into the metaverse environment. It is an educational application of the metaverse, and thus a special field that conforms to the basic laws of education and the metaverse environment is derived. By creating digital identities for teachers, learners, managers and other personnel related to educational activities, all parties enter the educational field in the virtual world to jointly carry out educational activities, communicating and interacting in the virtual teaching place, which meets the teaching requirements from teachers and students in both the real and the virtual worlds. The characteristics of the metaverse itself can supplement the teaching design links that are difficult to achieve in the real world, so as to surpass the limitations of teaching in the real world in a specific dimension, and play a convenient and efficient role in the special field of the educational metaverse.

3. The Significance of the Metaverse to Science Teaching

Teaching, as the most basic activity in the educational process, plays a very important role in both the traditional reality field and the educational metaverse field. Science teaching activities are different from teaching activities of other subjects. The intuitiveness of presenting scientific phenomena and the operability of experimental instruments require learners to directly observe, contact and operate in teaching activities to obtain cognitive results. In traditional classroom teaching activities, due to the limitations of practical technology or ideas, many aspects of teaching design cannot be fully implemented or the implementation effect is not ideal. With the development of metaverse-related technologies, in the educational metaverse field, the learning environment that overlaps the real world and the virtual world enables the participants of teaching activities to integrate the teaching resources of the real world and the teaching resources of the virtual world. It can make up for the problem of teaching understanding caused by the lack of real situations in traditional classroom teaching, and can further enrich the learning experience brought by educational activities.

Therefore, the metaverse is of great significance to science teaching: creating a virtual environment to provide rich teaching resources for teachers and students; changing teaching methods to bring a new experience of teaching activities to improve the results of teaching; innovating teaching interaction, new interactive methods are used in teaching activities to improve teaching efficiency.

3.1. Create an Immersive Science Teaching Environment

In the context of the current epidemic, along with policy adjustments, primary and secondary schools and colleges and universities have generated a large number of long-term online teaching needs. The current online network teaching mainly adopts the form of video or teleconferencing, using video and voice resources for teaching activities, lacking the learning atmosphere and personal experience in traditional classroom teaching activities, and reducing the number and quality of teacher-student interaction. Especially in the teaching process of science subjects, it is difficult to leave practical teaching activities for the operation skills of experimental instruments, the intuitive impression of observing the reaction of substances, and the practical activities of exploring objective facts to gain scientific knowledge. In the metaverse, the teaching environment created for the development of scientific teaching activities is deeply integrated with reality by using virtual reality technology, which can combine different individuals in different time and space into one scene through computer technology. Teachers and learners enter the online environment as an avatar. [9] This environment is not only virtual, the virtual images of teachers and students move together in the same teaching scene, and digital resources are obtained through the Internet for simulated operation and embodied display; it is also realistic, teachers and students carry out activities according to the

teaching goals set in reality and setting up in the classroom environment. No matter where you are in the real world, you will enter the metaverse at the same time, and conduct immersive teaching and learning in a teaching environment based on the appearance of the real world. In the teaching environment created by Metaverse, more convenient and individualized teaching activities can be carried out due to the physical limitations that are different from the real space. When teaching activities involving experimental operation and observation, the virtual teaching provided by the Metaverse space can be used, so that every learner can carry out independent practical operations under the remote guidance of teachers, observe the experimental results at close range, and obtain a more intuitive teaching experience, in an aim to gain scientific knowledge and master scientific skills profoundly.

3.2. Altering the Traditional Science Teaching Method

The teaching methods adopted in the traditional classroom teaching are conducive to the collective interaction between teachers and learners, which aims to convey scientific knowledge and skills to as many learners as possible. In most cases, teachers describe scientific knowledge and scenes through language, or guide students to observe scientific phenomena through personal demonstration, or guide students to conduct experimental operations, and try to present abstract knowledge to learners in an intuitive teaching method. However, such teaching methods lack the care and guidance for each student, and it is difficult to utilize sufficient teaching resources to help students understand intuitively, and it is not conductive to learners with weak abstraction ability to understand complex scientific knowledge. Especially in the online teaching era, this problem of lacking intuitive teaching methods has gone worse. In the metaverse environment, sufficient virtual learning resources can be visually and vividly displayed to students through augmented reality technology, the teaching environment can be set as the actual scene of scientific phenomena, and the natural environment and substances in the real world can be observed in the virtual world to form knowledge. In the process of experimental operation, teachers can demonstrate the operation steps in the teaching environment through mixed reality technology, and learners practice after observing and imitating, and display their operation actions as virtual images. [10] It can demonstrate the learner's understanding of the technical operation. Both teachers and learners can watch the scene repeatedly and put forward their own opinions on the process of the experimental operation. Each learner can get the full attention of the teacher and obtain a personalized learning experience. In the process of applying this teaching method, teachers intuitively show each student the actual environment and action process of the scientific knowledge they have learned, which is of less physical limitations and less dangers from experimental operations, comparing to in-person demonstration in traditional teaching environments, such as classrooms and laboratories.

3.3. Science Teaching Interaction in Innovative Classrooms

In traditional classroom teaching activities, the interaction between teachers and learners and between the teaching environment have many limitations. Whether in classrooms or online teaching, learners mainly interact with teachers through words and actions, to imitate and practice the knowledge and skills taught by teachers, lack of concern for the learner's own subjectivity. Similarly, in this process, the interaction between teachers and students and the teaching environment is difficult to encourage them to explore in classrooms or online meetings, and it is impossible for teachers and students to actively interpret and process knowledge and skills. In the metaverse environment, the interaction between teachers and learners and between the teaching environment are all carried out in a virtual environment with virtual images. [11] The virtual image's domination of virtual resources is realized through computer technology. Teachers and students can build a realistic environment related

to the knowledge and skills involved in science teaching in the metaverse, and use natural and experimental situations in a way that teachers and students can experience. The interaction process between teachers and students and the environment is recorded in real time, which is presented as data for reference in subsequent teaching activities, and can be edited in real time such as retraction, copying, etc., to help teachers and students give full play to their initiative in the virtual space. Teaching objectives are vividly explored. At the same time, the interaction between teachers and learners will no longer be limited to words and actions, but can use virtual resources to display their understanding and operation of scientific knowledge and skills through virtual images. Process and feedback to strengthen students' scientific knowledge and skills. [12] Through the digital twin characteristics of the Metaverse, students' autonomy can be further cultivated, and the creative ability of teachers and students in teaching activities can be exerted, so that the scientific teaching activities themselves can be further developed.

4. Construction of Metaverse Science Teaching Model

The educational metaverse environment derived from metaverse technology is a new opportunity in terms of replacing the shortcomings of traditional classroom teaching and existing online network teaching. In the new teaching space-time dimension developed by this mixed virtual reality, new breakthroughs will be made to overcome difficulties in the traditional scientific teaching design and the use of teaching environment. The exploration and prospect of a new teaching model is very important and urgent. In the construction of the metaverse teaching model, it is necessary to take into account not only the theoretical factors that conforms to the laws of science teaching, but also the new goals established with the change of the teaching model, the new conditions to be adapted to, and follow the procedures that is reasonable and viable, and finally a comprehensive evaluation of this teaching mode is carried out. In order to truly achieve that teachers and learners can interact with the environment as individuals, so as to learn deep knowledge, build a knowledge system, and apply it to practical links to solve problems, and achieve innovation in teaching theory and teaching practice.

4.1. Science Teaching Interaction in Innovative Classrooms

4.1.1. Constructivism

According to the learning concept put forward by constructivism, what learners experience in the teaching process is not a simple process of passively accepting information, but what they have received in the teaching process based on their own experience gained in the background experience. External information is actively selected, processed, and constructed, in which knowledge is obtained, and specific problems in the actual situation are further solved, thereby recreating knowledge. In the metaverse field, the experience of learners before the start of teaching activities will play a more important role, which can help students quickly adapt to the differences with the real world after entering the virtual world, and provide necessary cognition for virtual teaching activities premise. In the process of science teaching, teachers should pay attention to helping students combine the content of teaching activities in the virtual world with the relevant knowledge and experience that learners have in the real world, and use the resources provided by the virtual environment to replace situations that are difficult to create in the real world, so that learners can carry out meaningful knowledge construction by using their existing experience to conduct autonomous learning, cooperative exploration and other activities under the condition of complex environmental information.

4.1.2. Embodied Cognition

Embodied cognition theory is a new cognitive theory born with the development of the information

age. The current mainstream definition is: cognition depends on various sensory movements of different types of bodies, and each individual's sensory movement ability is included in the comparison. within the broader biological, psychological, and cultural context of the individual. Its core view is that cognition is formed under the interaction of brain, body and environment. The sensorimotor system, morphological structure and acquired experience and experience contained in the concept of body will affect the formation and development of cognition. According to the theory of embodied cognition, in the process of science teaching, learners' physical participation in the cognitive process, embodied interaction with the environment, etc. can bring the conceptual content related to scientific concepts and the experimental skills related to scientific operations in special situations. Explicit cognition is formed through the learner's physical perception and dynamic interaction. The field of the Metaverse can provide learners with a broad and interactive virtual environment, including rich and diverse social and cultural situations. In the teaching process, teachers need to actively encourage students to use virtual reality technology equipment to collect body movement signals and participate in the metaverse. In the scientific teaching environment provided by the universe, the sensory-motor system of the body is fully mobilized, and the cognitive formation of learners is better promoted through the embodied interaction in the environment.

4.1.3. Immersion Theory

Immersion theory, also known as "flow theory", is a description of the psychological state of people when they perform tasks. Under this condition, a person can achieve a psychological state of extreme joy. The main factors that affect psychological immersion are the difficulty of the task and the proficiency of the skills. When people master the skills needed to solve problems and are very proficient, they can deal with challenging tasks and experience immersion. In the metaverse field, when faced with challenging learning tasks, learners can freely invoke virtual resources and communicate with teachers and other learners. Set up virtual tools and things in the situation to adjust the operation, carry out an immersive interactive experience, acquire knowledge concepts and operational skills in the process of independent exploration, and solve practical problems in the situation.

4.2. The Teaching Objectives of the Metaverse Science Teaching Model

4.2.1. Immersion Theory

The latest version of the compulsory education science curriculum standards in 2022 defines the scientific concept formed through scientific teaching activities as "the general understanding of objective things formed on the basis of understanding scientific concepts, laws and principles."

From this definition, it can be seen that scientific concepts are the primary goal of science teaching, involving the understanding of specific concepts and the nature of science. Before conducting scientific teaching activities in the metaverse field, teachers and learners should fully mobilize virtual resources, carry out teacher-student activities, and use the observation and operation of virtual resources to enable learners to form an overall objective understanding of things, and understand the scientific concepts, laws, principles, etc. reflected in the changes of things. Focus on the cultivation of teaching objectives to the understanding of matter, energy, structure, function and change, as well as the understanding of the relationship between human and nature, science, technology, society and the environment, and ultimately help students establish correct scientific concepts to explain various natural phenomena and solve scientific problems in real life.

4.2.2. Cultivate Scientific Thinking

Scientific thinking refers to the way of understanding the essential attributes, internal laws and interrelationships of objective things from a scientific perspective. Learners need to establish a scientific way of thinking and habits, and avoid subjective assumptions and guesswork. Specifically, it includes the model construction thinking of abstracting and generalizing objective things based on empirical facts; the reasoning and demonstration of thinking methods such as analysis and synthesis, induction and deduction based on evidence and logic; the ability to analyze and think about problems from different angles, and propose novel ideas. Innovative thinking with valuable ideas and problem-solving methods.

In the metaverse field, teachers should set up virtual tasks, throw scientific problems in reality to learners, and set obstacles that need to be solved based on reliable evidence, orderly logic, and changing perspectives, so as to help learners subtly. In the process of operation, cultivate a way of thinking that uses evidence and logic, and attaches importance to empirical facts, and can flexibly change perspectives to innovate while conducting induction, deduction, analysis and synthesis.

4.2.3. Encourage Inquiry Practice

The goal of inquiry practice is to cultivate the scientific inquiry ability, technical and engineering practice ability and self-learning ability of learners in the process of understanding and exploring nature, acquiring scientific knowledge, solving scientific problems, and technology and engineering practice.

In the scientific teaching activities in the real world, limited by the environment and resources, many practical activities are difficult to carry out, which is very unfavorable to the development of learners' ability to explore and practice. Science teaching in the metaverse field can fully utilize virtual resources and set specific practical tasks, so that learners can understand the general process and methods of scientific inquiry in the process of completing tasks, and can further ask scientific questions and carry out reasonable conjectures and assumptions. In the process of verifying their own hypotheses, learners can develop the ability to determine learning goals, choose learning strategies, monitor the learning process, and reflect on the learning process and results, conduct scientific study independently, and solve real scientific problems.

4.2.4. Clarify the Attitude and Responsibility in Studying

The goal of attitude responsibility is to cultivate students' scientific attitude and social responsibility on the basis of understanding the nature and laws of science and understanding the relationship between science, technology, society and environment.

In the virtual teaching environment, learners should always be given the opportunity to think about scientific attitudes and responsibilities in different environments, understand the real situation in the development of science, and clarify the curiosity and enthusiasm for inquiry that scientific role models have in the historical process. The love of nature and the establishment of a high sense of responsibility for promoting ecological sustainable development and making correct value judgments on social trends. In the cooperative activities of science teaching, gradually cultivate learners to establish an emotional attitude of respecting others, a mentality of being good at cooperation and sharing, and a sense of responsibility to abide by the public norms, laws and regulations of applied science and technology, and ethics, and develop a sense of self-protection in scientific activities. and the legitimate rights and interests of others, and the awareness of defending national interests.

4.3. Conditions for the Realization of the Teaching Model of Metaverse Science

4.3.1. Technology

The prerequisite for the realization of the Metaverse science teaching model is the sufficient technological maturity, including the further popularization of the mobile Internet, the infrastructure construction required for virtual reality, mixed reality, augmented reality, and the further development of the metaverse simulacrum, making teaching activities more effective. The process is closer to reality.

Specifically, the first is the further optimization of the network environment. With the rapid development of the 5G era, the impact of the new generation of communication networks on human society has gradually deepened. The interaction between people brought by intelligent technology cannot be separated from the development of network technology. The metaverse field is a communication field that integrates cloud computing, information collection, etc., and requires a further optimized network environment to realize the deep integration of "information-physics-society". The second is resource output. The teaching resources required for teaching activities in the metaverse field need to be provided through careful design, but also need to be dynamically generated at the technical level. According to the individual needs of teachers and students and the homomorphic production in interactive operations come out to further produce new teaching resources. In addition, it also involves the improvement of the interaction technology of the metaverse. The final effect of this field is human-computer interaction based on reality. Through interactive devices, the learners' movements, touch, gestures, bioelectricity and other information are collected. In the metaverse field Interaction in the middle, realizing human-machine collaborative learning activities. [13-14]

4.3.2. Environment

The realization of the metaverse science teaching mode also needs the support of environmental conditions. It includes not only the environment constructed by teaching activities, the psychological environment of teachers and students in teaching activities, but also the information environment in which the metaverse field itself is located.

The environment constructed in teaching activities is the field of direct perception and interaction between teachers and students, including realistic learning resources as teaching content or learning objects for teachers and students to interact and create, and in the virtual learning environment, the digital twin of teachers and students Image, as a fixed place for the close interaction between teachers and students in the teaching process. The second is the psychological environment of teachers and students in teaching activities, which should be provided in the metaverse field to fully meet the overall psychological needs of teachers and students, so as to gain a sense of physical participation and at the same time recognize the value and the effectiveness of teaching activities in this field. Thirdly, the information environment required for the operation of the metaverse field itself, including the user's wearable devices, can enhance the perception experience of teachers and students in the metaverse, and conduct immersive learning through a strong sense of presence; The world's interconnected information technology, through the integration of teachers and students' behavior and other signals, feeds back to the system and teachers and students as analysis data to further dynamically optimize the teaching process.

4.3.3. Ethics

The problems involved in educational ethics are represented in different environments in different times. The metaverse era is no exception. The educational ethics conditions that need to be discussed

in this field include the individual information of teachers and students, as well as the interaction between virtual information and real people.

The first is the individual information ethics of teachers and students. Similar to other online learning platforms in the information age, teachers and students need to provide personal-related data to others and the platform during the teaching activities for the evaluator or system to sort and analyze. Therefore, it is necessary to ensure the safety and transparency of data collection, as well as controllable storage and confirmation of rights. The second is about the interaction between virtual information and real people. Since teachers and learners are faced with virtual resources and virtual people in the metaverse environment, it is easy to rely on virtual creations and lose subjectivity. For this problem, it is necessary to create preconditions before carrying out teaching activities, help teachers and learners to have a correct view, understand the resources and self in the virtual environment with an open and positive attitude, and realize the inevitability and importance of teaching finally returning to reality.

4.4. Operational Procedures of the Metaverse Science Teaching Mode

The operation procedures of the Metaverse teaching mode are different from the traditional teaching mode and the current online teaching mode. The main difference is the intersection of virtual and real teaching activities. In the metaverse field, both teachers and learners can use virtual reality technology to enter the metaverse teaching environment at different places as virtual avatars to participate in teaching activities, and they can also enter the teaching environment at different times to conduct asynchronous virtual learning. The intersection of reality and virtuality is reflected in the interaction between teachers and learners and learners through virtual images among peers. In addition, it also includes interaction with learning resources such as virtual objects and virtual environments through gestures and body movements. By interacting with the virtual environment that simulates the real scene, the real teacher and the learner jointly complete the learning task and achieve the learning goal. In this process, the subjectivity of the learner is fully highlighted, especially the autonomy of learning will have an important impact on the teaching effect.

In order to adapt to the science teaching in the metaverse field, the specific operating procedures can be divided into three levels: the framework layer, the interaction layer, and the data layer. Seven links: formulate teaching goals, determine content methods, structure interactive environments, exploration and interaction with teachers and students, knowledge and skills training, data collection and storage, analysis and evaluation feedback (as shown in Figure 1).

According to the order in which the teaching activities are carried out, the architecture layer involves the clear purpose of the activities that need to be carried out in the teaching activities and the environment and previous preparations that should be set in advance. Clarify the scientific knowledge and skills that final learners need to master through teaching activities; secondly, determine the content and methods, rationally organize the content involved in the current course according to the teaching objectives and students' characteristics, and select effective teaching methods; To highlight the interaction, set up the teaching environment in the metaverse field according to the teaching objectives and content, including the virtual classroom environment, the virtual projection of the real interactive objects required for teaching in the metaverse field, and the virtual image of the digital twin of the teachers and learners.

After completing the link of the framework layer, the virtual environment for scientific teaching tends to be perfected, and teachers and learners can enter and carry out the link of the interactive layer. Carry out exploration activities in the virtual teaching scene, give full play to their autonomy, and jointly construct scientific knowledge and skills through the operation and practice of learning resources and mutual cooperation with peers; secondly, teachers help learners to acquire scientific

knowledge related to the current course skill-related learning resources can be downloaded and cached by learners to practice and digest them repeatedly in the virtual classroom or after class.

After the interactive layer is completed, the learner has mastered certain scientific knowledge and skills. Next, it is necessary to analyze the teaching effect of the teacher, that is, the degree of mastery of the learner, and analyze it by visual data in the metaverse field. In the operation procedure of this data layer, the first is the collection and storage of the data generated in the teaching activities. With the help of wearable devices in the real world, the physical behaviors of teachers and learners, VR software data, EEG data, etc. are carried out. The second is to analyze and evaluate the collected data to understand the learners' understanding of scientific knowledge and the practical ability to use scientific skills to solve practical problems. It is confirmed that learners can apply scientific knowledge and skills in the real world after learning in the virtual environment, and finally evaluate the overall teaching effect and give timely feedback.
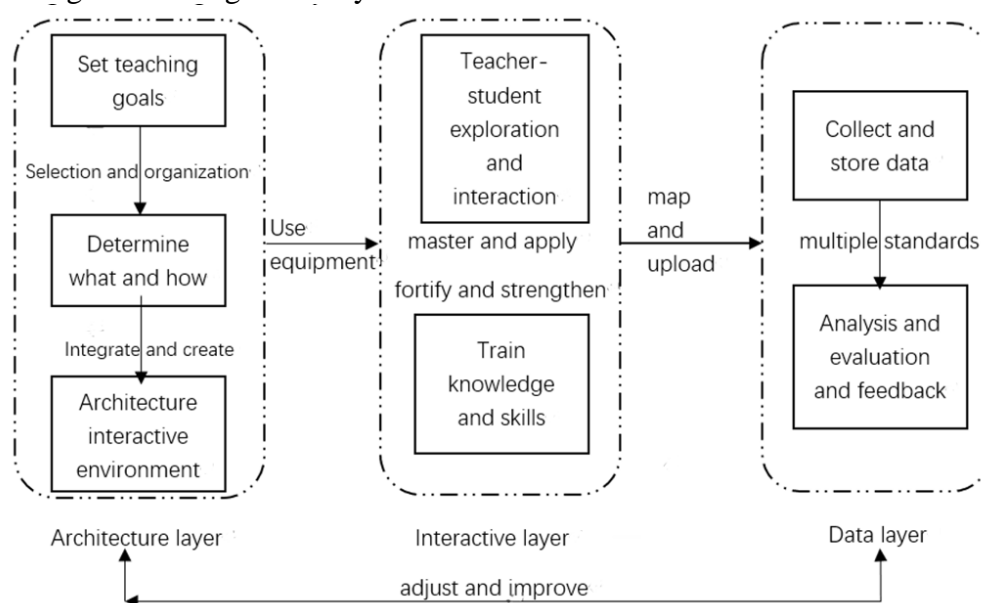

Figure 1: Operating procedures

4.5. Teaching Evaluation of Metaverse Science Teaching Model

With its combination of virtual and reality, the metaverse field makes it very convenient, intuitive and reliable to ask questions, test, observe, evaluate and other activities in the teaching process. With the help of artificial intelligence, big data and other technologies involved in the metaverse field, precise and comprehensive data collection can be carried out for the teaching process, and accurate and multivariate analysis and evaluation can be carried out. The teaching evaluation has the following characteristics:

The first is that information collection is efficient and comprehensive. The information collection involved in teaching evaluation in the metaverse field is carried out along with the teaching activities. The behaviors and actions of teachers and learners in the virtual classroom can be collected in real time by the data acquisition system and uploaded to the server for further storage. For analysis, there is no need to conduct a separate test or an additional evaluation presentation class, which greatly improves the collection efficiency of evaluation information. At the same time, using data collection technology, teachers and students can obtain biological information and feedback actions when they interact in the metaverse field through their wearable devices in the real world, and can collect data more comprehensively.

The second is the continuous and general use of evaluation. In the metaverse field, the interaction between teachers and students in teaching activities can be transformed into virtual data and recorded and stored, so that it is possible to longitudinally examine how teachers and students have changed after participating in long-term scientific teaching activities, especially for learners. Groups, whose personal information identifiers can accompany their growth, further studies, and ultimately determine the effectiveness of their learning, can better reflect their efforts and achievements in different learning stages, and are more in line with the needs of procedural evaluation. Continuous evaluation from before class to after class, from class to family to society. The results of the evaluation are certified by authoritative organizations, confirming that teachers and learners have mastered the ability to apply scientific knowledge and skills in the real world after long-term virtual science teaching activities, can solve practical problems and carry out new teaching activities. , to what extent and level. This evaluation result can be widely used in the real world as a basis for its participation in science teaching activities.

The last is the multi-aspects and multi-dimensional evaluation. The evaluation of teaching activities in the metaverse field is a process of openness and development, which involves the participation of multiple subjects. There are not only self-evaluations made by teachers and learners after understanding their own virtual data, but also objective evaluations obtained by schools or third-party evaluation agencies authorized by schools, after obtaining server data and interpreting them according to certain standards and basis. In addition, the evaluation subject can use virtual reality technology and the collected data to play back the situation of a specific teaching activity, and enter the teaching environment as a specific evaluation subject without affecting the effect of the actual teaching activity. Interactions made by learners in virtual situations. Such evaluations focus on various dimensions, focusing on interaction in virtual situations, understanding the development of teachers and students' thinking ability, practical skills and ability to solve real problems, so that the feedback of evaluation results can be accurate and comprehensive.

5. Conclusion

With the continuous development of science and technology, teaching activities are the direct beneficiaries of scientific development. In the current educational metaverse field, many new problems and opportunities are attracting people's attention, and science teaching, the teaching activity most directly related to science, should discuss new development directions, especially with online teaching gaining popularity and continuity, normalized online learning has become a clear trend, and it is feasible and inevitable for scientific teaching activities to enter the metaverse field. The science teaching model in the metaverse field breaks out of the constraints of objective environmental factors, it attaches great importance to the real experience of immersion, helps teachers and learners to gain a personal understanding that is conducive to mastering scientific knowledge and skills, highlights the subjectivity of learners and enhance their self-learning ability. This teaching mode makes full use of cutting-edge technology to make scientific teaching activities pay more attention to the role of people in teaching activities, which is conducive to the further innovation and development of scientific teaching activities.

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