Construction and Application of VR / AR-based STEAM Curriculum System in Primary and Middle Schools under Big Data Background

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Abstract. Virtual Reality Technology has been widely used in teaching to provide learners with a real sense of learning experience. At the same time, the new educational models, such as STEAM education and Creator Education, which are strongly advocated by our country, combine the two and use visualized big data to screen and analyze STEAM education, to understand the connotation and application of STEAM education and the role of virtual reality technology in STEAM education. This paper expounds the goal and practical curriculum structure of STEAM curriculum system in primary and middle schools based on virtual reality technology, designs and integrates the curriculum structure, constructs the concrete curriculum system, and gives the thematic teaching organization form, finally, the teaching application of the course system is discussed.

Keywords: Big data; STEAM; Course system; Virtual reality.

1. Introduction
At present, VR/AR Technology has been paid more and more attention, and the research of VR/AR Virtual Reality / augmented reality is more and more mature. In recent years, educators have made more and more researches on "VR/AR+education", which has provided new teaching methods for educators' classroom teaching and created a vivid and interesting three-dimensional classroom for students, it also brings a new opportunity for STEAM education in primary and secondary schools. The introduction of VR/AR Technology has brought the means of development to STEAM education in schools, which not only increases students' interest in learning and improves the quality of teaching, but also enables repeated experiments, then, we can solve the problems such as the shortage of educational funds and the dangers brought by real experiments.

2. Research on STEAM Education
Steam was first developed in the United States in five areas: Science, technology, engineering, art and mathematics. At the content level, STEAM education can be integrated into a number of disciplines, covering science, humanities, history, physics, chemistry, biology and so on. After STEAM education is integrated into the classroom, it is helpful to improve students' innovation consciousness and ability, and cultivate students' information literacy. The combination of STEAM and virtual reality technology is of great significance to break the traditional teaching mode and enhance students' initiative in the learning process. Steam Education has gradually been accepted in China. In 2015, the Ministry of Education issued the draft guiding opinions on comprehensively and thoroughly promoting the 13th five-year plan for Educational Informatization, which explicitly states that China shall encourage the mode of STEAM education. This shows that the State attaches importance to higher education and...
trains innovative and compound talents. Virtual Reality Technology is one of the means to develop STEAM education. The effective combination of the two will promote the development of STEAM education model.

3. The Implications of Big Data
The application of big data is very broad, the connotation is also constantly changing. Up to now, big data is not only a technology, but also a method, which shows a person's retrieval ability, and can be mined from a huge amount of data to find relevant, relevant and meaningful content related to one's own direction, and the content of in-depth study, mining the law behind the data, and according to the data to predict the future development trend.

Education big data is a subset of big data, especially in the field of education. However, there are few studies on the popular education, and there is no clear definition of it. It can be roughly understood as: In the educational activities, used for educational development, and can become educators to think about issues, make behavioral decision-making starting point of the data set.

4. Big Data Observation on the Construction of STEAM Curriculum System Based on Virtual Reality Technology
Using big data to make a visual analysis of the articles about VR/AR+STEAM education, to understand the function of virtual reality technology on STEAM education, and how the two will be integrated into the normal curriculum teaching and help teachers to carry out teaching activities, make the teaching process more colorful.

![STEAM network co-occurrence analysis](image)

Figure 1. STEAM network co-occurrence analysis.

Through the visualization of big data and analysis of the documents in the database, the graph above shows the frequency of the occurrence of the topic keywords, and the circle size in the graph reflects the frequency of the occurrence of different topic keywords, it also reflects the current research situation of various educational ideas. Steam Education is at the core of the research, and has more or less contact with all the key words, the overall distribution of a network, a variety of ideas interweave and influence each other. Although some topics are not hot at present, I believe they will become the research direction of various researchers in the near future, and the more frequently they appear are the
research focuses in recent years, which have attracted the attention of the majority of researchers, reflect the direction of future research in our country.

5. The Important Role of VR / AR Technology in Primary and Middle School Classroom

5.1. Support for the Virtual Learning Environment Created by STEAM Education
VR/AR Technology is used in STEAM education mainly through creating simulation learning situation, effectively integrating virtual reality elements, enhancing interaction and Cooperation, timely and effective empirical exploration and so on. Steam education is required in the real situation, but it can not be realized in the real learning situation because of the unsafe, high cost and other factors, even such as high altitude, outer space, polar, deep sea and high temperature environment, VR/AR Technology is needed to create a virtual learning environment, in which students can experiment or operate repeatedly, thus solving the problems such as the lack of access to the real environment, insufficient educational funds, and various dangers brought by the real experimental operation.

5.2. VR/AR Technology is Integrated with Other Common Information Technology
VR/AR Technology is integrated with other common information technologies such as 3D printing, robot programming and big data in STEAM education. VR/AR Technology creates simulated learning situations Big Data monitors and analyzes the system of STEAM education.

6. The Convergence of Big Data and Virtual Reality
The processing and analysis of big data is becoming the node of new information technology fusion application. By managing, processing, analyzing and optimizing data from different sources, feedback of results will create great economic and social value. Big Data is the new engine of the information industry's sustained and rapid growth. New Technologies, new products, new services and new business forms will emerge in the big data market. In the field of hardware and integrated devices, big data will have an important impact on the chip and storage industries, and will also give birth to integrated data storage and processing servers, memory computing and other markets. In the field of software and service, big data will lead to the development of data processing and analysis, data mining technology and software products. The virtual reality technology can realize the fusion of the real world and the virtual world, and provide people with access to the "new horizon" , and can realize the scene which can not be completed in the real world, virtual reality, combined with big data advances, will open people's minds, turn previously held minds upside down, and make our dreams come true.

As Premier Keqiang Li said during the dialogue session of the China big data industry summit and the China e-commerce innovation and Development Summit, "people used to say that the Internet is a virtual world. Now with the emergence of big data, cloud computing and internet + , the virtual world and the real world are merging and we have entered a new world."

7. Construction of Primary and Middle School STEAM Curriculum System Based on Virtual Reality Technology

7.1. Objectives of the Curriculum System
Steam Curriculum System in primary and secondary schools is based on VR/AR Technology as the center of Information Technology, mathematics as the foundation and engineering as the core, in the activity of a theme, study, cooperate and communicate under the real situation, train the students' ability to solve the problem, train the students' creative ability.

7.2. Course Architecture Design
7.2.1. Types of Courses. There are three types of STEAM course: Basic Discipline Practice course, professional discipline practice course and integrated innovation practice course. In the application of the three kinds of courses in primary and middle schools, the most of them are integrated innovation
and practice courses, which aim at cultivating students' comprehensive practical ability and ensuring the cultivation of students' comprehensive quality.

![Diagram](image)

**Figure 2.** STEAM type of course.

·Practical Course on the fundamentals of STEAM. The practical activity curriculum of STEAM is an extension of STEAM curriculum in primary and secondary schools. On the basis of mathematics subject, mathematics subject is connected with other subjects through unit subject project, so as to improve students' problem-solving ability.

·Practical Course for STEAM majors. The practical activity curriculum of STEAM discipline is very rare in the STEAM curriculum system of primary and secondary schools, and some art students are involved in more

·Steam integrated innovation practice course. Steam integrated innovation practice curriculum belongs to the research, innovation and characteristic curriculum in the STEAM curriculum system of primary and secondary schools. As an independent form of curriculum in schools, it completely breaks the boundaries between disciplines, integrates the contents of STEAM disciplines into new learning areas, and no longer emphasizes the independent status of single disciplines in the process of curriculum development and implementation, instead, it organizes and integrates many subjects around different subject projects to form independent course study units, and takes engineering design projects as the core of its study, the result of the study is evaluated by the creative products designed by the students.

7.2.2. Course Architecture. According to the objectives and types of STEAM curriculum system, the disciplines will be cross-linked and reorganized to form the system. Is the school-based curriculum, is the reorganization after the basic curriculum. "Mathematics and thinking" curriculum, which is based on mathematics learning and integrates mathematics thinking training, mathematics stories, mathematics games, and research on small topics, as well as the integration of other basic disciplines, information technology, science and technology, and other elements of the formation of the "little mathematician" curriculum.

7.2.3. Course Content Design. When designing the content, on the one hand, we should reorganize the knowledge according to the question or logic, project and so on. On the other hand, we should make sure that the design question or project can cover all the subject knowledge completely and balanced. According to the different theme projects, the content design is divided into 3 types: doubt-verification type, question-exploration type and product-creation type.

·Suspect and verify type

Under the premise of knowing the operation result, the students carry on the practice operation verification in VR virtual learning environment, discover and remove the difficulty in time, and get the expected conclusion.

Case 1: The virtual lab
In order to stimulate students' interest in experiment, improve students' practical ability and promote students' independent thinking, Xining's virtual simulation laboratory and subject tool platform have been fully built and put into use nearly 350 laboratories covering science classes in primary schools and biology physical chemistry in secondary schools.

Through virtual reality technology, relying on the international advanced desktop-level portable integrated virtual reality equipment, deep integration VR, AR and other emerging technologies, students can personally operate and repeatedly observe the details. Perfect support human-computer interaction, teacher-student teaching and student interaction, completely break the boundary between virtual and reality, students in immersive self-exploration, break classroom barriers for natural exploration; Students can learn more actively, understand more deeply, remember more long-term, and realize the development of comprehensive quality and the cultivation of scientific and innovative spirit, let VR technology truly serve teaching and help the innovative development of education. Combined with the construction of the whole environment of VR Laboratory, the training of characteristic teachers and other supporting services, we can help primary and secondary schools and out-of-school education bases to enhance their school-running characteristics and create innovative brands.

Question and inquiry type
The activity or process in which students construct answers, meanings, information or understanding autonomously in a VR/AR learning environment around a given question.

Case 2: Tourism Virtual Reality Display Platform
"The third planet" is an online travel virtual reality display platform, through which learners can choose their favorite travel sites through the virtual learning space for immersive online travel, let the learner stay indoors then can experience the beautiful natural scenery. The application not only provides a perfect virtual learning environment for the learners of tourism, but also meets the demand of the tourism market.

Products and creativity type
In VR/AR Learning situation, students choose to play different roles in real society, such as Craftsman, engineer, artist, designer, etc. Students explore as if they were in the real world, and create work based on tasks, whether they are design plans or physical products. The designed products can be printed and manufactured by 3D printing technology, which not only can transform the learning results into real products, but also can help to quantify the learning evaluation and improve the learning effect and quality.

Case 3: Virtual space by Music visualization
Alpha Muse is a Music visualization tool. In Alpha Muse's virtual world, learners explore and collect creatures to create programmed music. Each creature is a musical element that can be added to a learner's custom music, and the learner can adjust and modify the song to edit the creature's flight path through space.

8. Conclusion
Through virtual reality technology, on the one hand, it can reproduce the natural phenomena or the changing process of things that cannot be observed in real life, provide learners with vivid and realistic sensuous learning materials, and make the abstract concept theory intuitive and visual, which is convenient for learners. Understanding of abstract concepts. The use of virtual reality technology for virtual experiment teaching can effectively break through the constraints of real-time conditions such as time, space, funding and danger. As large as the universe celestial bodies and as small as atomic particles, learners can enter it to observe. As an interdisciplinary integrated curriculum, STEAM teaching mode is different from traditional teaching, so it puts forward higher requirements for school resources construction and teachers' ability of interdisciplinary integration, and the implementation of STEAM education is a challenge for primary and secondary schools in China. With the support of VR/AR Technology, STEAM education will become more diversified, and with the development of liberal education, VR/AR+STEAM education will become a hot model in the future.
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