



“5G + VR” Technology Enables the Construction of Smart Classrooms in Universities

Wenwen Zhu^(✉) and Siyue Wang

School of Finance, Nanjing University of Finance and Economics, Nanjing 210023, China
9120211049@nufe.edu.cn

Abstract. In recent years, with the acceleration of the informatization process of higher education in China, the construction of smart classrooms has become a research hotspot of current higher education. At present, the functions of smart classrooms in Colleges and universities are gradually improving, but the user experience in actual operation still needs to be improved. The rapid development of "5g + VR" technology has brought new opportunities to the construction of smart classrooms in Colleges and universities. It is very necessary and feasible to introduce it into the construction of smart classrooms in Colleges and universities, which is conducive to the development of educational informatization in Colleges and universities.

Keywords: Education Informatization · Smart Classroom · "5G + VR" Technology

1 Introduction

With the development of higher education, the demand for talent training is increasing day by day. Traditional education can hardly meet the needs of national talent strategy, and education reform is imperative. Educational informatization is the only way to educational reform. According to the report of the 19th National Congress of the Communist Party of China, it is necessary to speed up the modernization of education and the construction of an educational power, and promote the development of educational informatization in the new era [1]. In order to accelerate the modernization of education and the construction of an education power, as early as 2018, the Ministry of Education issued the action plan for education informatization 2.0, which pointed out the direction of action for the development of higher education informatization. As an important position for personnel training, Universities should actively respond to and implement the "2.0 action plan" and accelerate the process of higher education informatization construction. Among them, the construction of "smart classroom" is a necessary link to implement the "2.0 action plan" and also a key step in the development of higher education informatization.

2 Concept and Function of Smart Classroom

The smart classroom originated from the traditional multimedia classroom. The multimedia classroom began to develop in the 1990s and gradually changed the teaching mode of the school. The new mode of "projection + PPT" was introduced into the original single "blackboard + chalk" teaching mode. [2] However, the application of multimedia classroom has not brought about a revolution in teaching mode. The traditional multimedia classroom has been unable to meet the teaching needs of Universities. On the basis of traditional multimedia classroom, smart classroom uses advanced technologies such as Internet of things, big data and cloud computing to break the gap between time and space, let science and technology release kinetic energy to serve teaching, create a new teaching environment integrating online and offline, indoor and outdoor, virtual and reality, and provide teachers and students with a diversified, intelligent and personalized teaching platform. Intelligent classroom is a typical materialization of intelligent learning environment. [3].

The functional evolution trend from traditional classroom, multimedia classroom to smart classroom can be seen in Fig. 1.

According to the author's investigation, the traditional multimedia classroom has been transformed into a smart classroom, which has realized the interactive function and feedback function of teaching. The interactivity is mainly reflected in three aspects: teacher-student interaction, group interaction and human-computer interaction. [4] The smart classroom software can realize the functions of signing in, roll call, answering questions, and issuing questions. In terms of teaching feedback, the smart classroom software supports online distribution of in class tests and after-class assignments, automatic correction and generation of preparation rate reports. Students can also evaluate the classroom content after the course is completed. In addition, supporting excellent recording and personalized learning is another important function of the smart classroom. Therefore, the smart classroom solves the problems of poor interaction and low

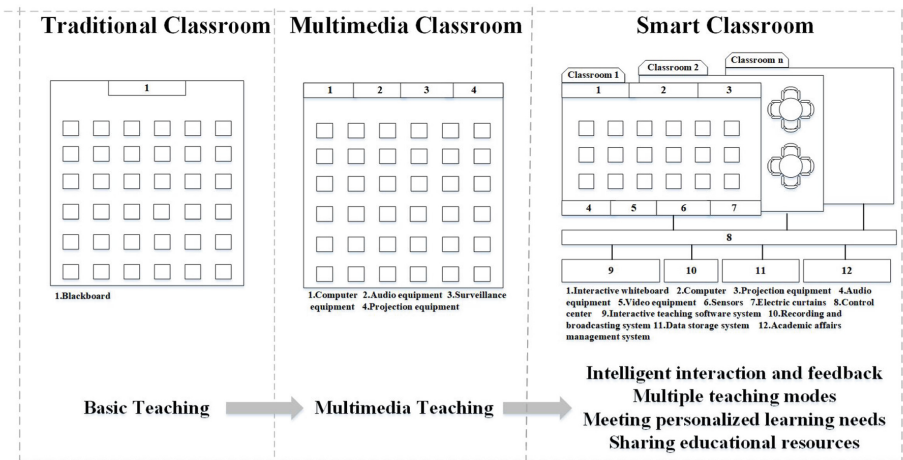


Fig. 1. Evolution of classroom function [Owner-draw]

feedback ability of the traditional multimedia classroom, and better meets the teaching needs of schools in various forms such as discussion, live broadcast and video recording, as well as the personalized learning requirements of students, which helps to improve the quality of education.

3 Problems in the Construction of Smart Classroom

Smart classroom introduces emerging technologies into the teaching process, which provides material support for improving teaching quality to a certain extent. However, according to the author’s research, after the smart classroom was put into use, the feedback of students was not unanimous. Students generally believed that the smart classroom was not "smart" enough to bring ideal teaching experience. According to the author’s questionnaire survey of 256 students, students’ feedback on the smart classroom can be summarized in the following aspects, as shown in Fig. 2.

3.1 Attaching Importance to the Construction of External Environment While Neglecting the Promotion of Connotation is Unconducive to the Intellectualization of Teaching

The construction of smart classroom aims at enriching teaching resources and improving teaching quality. However, at present, the application of smart classroom has not changed the traditional teaching mode. It only adds online teaching, teacher-student interaction, classroom feedback and other functions on the basis of multimedia teaching, and the improvement of teaching effect is limited. Many students believe that the construction of smart classrooms pays too much attention to the design of lighting, temperature control and door and window systems, which brings more improvement to the teaching environment. However, there is no breakthrough in the design of the most important teaching system, and it is difficult to achieve the expected results.

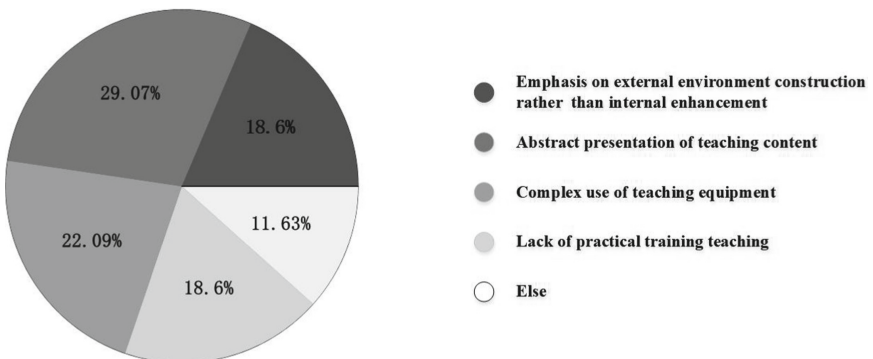


Fig. 2. Chart of feedback in smart classroom [Owner-draw]

3.2 Abstract Presentation of Teaching Content is Unconducive to Humanization of Teaching

The construction of smart classrooms should introduce modern means to help students understand abstract teaching contents, but the reality of smart classrooms has not reached the expected ideal state. In the traditional teaching process, knowledge is mainly presented in the form of words, pictures or videos. Students need to make it three-dimensional and dynamic through their own thinking process, and then understand it. Abstract teaching content makes students lack of intuitive feelings, like blind people touching elephants, and it is difficult to fully understand and grasp all aspects of knowledge. The smart classroom should be smart enough to make a difference in presenting the teaching content in an image.

3.3 Complicated Teaching Equipment is Unconducive to Immersing Teaching

In order to meet the needs of teaching, students in smart classrooms need to use mobile devices such as mobile phones and tablets to interact with teachers and students in a timely manner. However, some students do not recognize this teaching mode. On the one hand, this kind of teaching mode requires high self-control of students, and the attention of learning is easy to be dispersed; [5] On the other hand, too much interaction interrupts the continuity of learning, and students cannot achieve immersive learning.

3.4 The Lack of Practical Teaching is Unconducive to the Practice of Theoretical Knowledge

The classroom practice of the smart classroom is still based on the theoretical knowledge in the books, and does not provide the necessary material and technical basis in the classroom practice. The school is unwilling to carry out experimental teaching. On the one hand, it has limited resources and is limited by financial and material resources. On the other hand, it is also to avoid uncontrollable factors in experimental teaching. For some students of application-oriented majors, teaching requires the integration of theory with practice, while the lack of practical teaching is not conducive to the cultivation of practical ability, and the role of smart classroom in this respect is very small.

4 "5G + VR" Technology Empowers the Construction of Smart Classrooms in Universities

Based on the existing problems of the smart classroom, the author believes that introducing "5G + VR" technology into the construction of the smart classroom can effectively make up for the shortcomings in the above four aspects. The fifth generation mobile communication technology is referred to as "5G", which is a new generation of broadband mobile communication technology with high-speed, low delay and large connection. 5G communication facilities are network infrastructure to realize human-machine and physical interconnection. VR, that is, virtual reality, refers to a three-dimensional virtual environment built by a computer. Users can observe the surroundings at any point in a

certain range of three-dimensional space. The system conveys information in the form of video and audio. Users can interact with virtual objects with the help of necessary equipment. In recent years, with the popularization of "5G + VR" technology, its application in the field of education has gradually deepened.

4.1 Necessity of Applying "5G + VR" Technology to Smart Classroom

At present, the three major operators have opened 5G commercial services in more than 50 cities in China, mainly including first tier cities such as Beijing, Shanghai, Guangzhou and Shenzhen and major provincial capitals. The signal coverage is mainly in major urban areas and hot spots. Taking Jiangsu Province as an example, most universities have realized 5G network coverage. At the same time, VR technology has three typical characteristics, that is, immersive, interactive and imaginative. Immersive means that users can fully perceive the existence of the virtual world and produce an immersive feeling; Interactivity means that the user can deal with the surrounding virtual objects in the virtual environment as in the real world, and the virtual objects will respond accordingly; Conceptualization means that virtual reality technology can not only realize the reappearance of the real scene, but also build the objective nonexistent or even impossible scene according to the designer’s ideas, which can broaden the scope of human cognition.

In the case of insufficient bandwidth, VR equipment can work, but the image resolution often fails to reach the pass line. The video quality threshold of VR deep immersion level is full view 12K 2D video, which requires network bandwidth of 200 m–1 gbps/M and network RTT of less than 20 ms; The video quality threshold of VR full immersion level is full view 24K 3D video, which requires 2G-5 Gbps/M network bandwidth and less than 10 ms network RTT. 5G technology has the characteristics of high speed and low delay. Its initial technical indicators have been able to meet the requirements of VR deep immersion level, ensuring that users have a better experience in the use of VR. The immersive, interactive and imaginative nature of VR technology makes it possible to make up for the shortcomings of smart classrooms. The coverage of 5G commercial networks on college campuses has laid a material foundation for introducing VR technology into smart classrooms. Therefore, "5G + VR" technology is a necessary supplement to the construction of smart classrooms. See Fig. 3 for the advantages of this technology in various indicators.

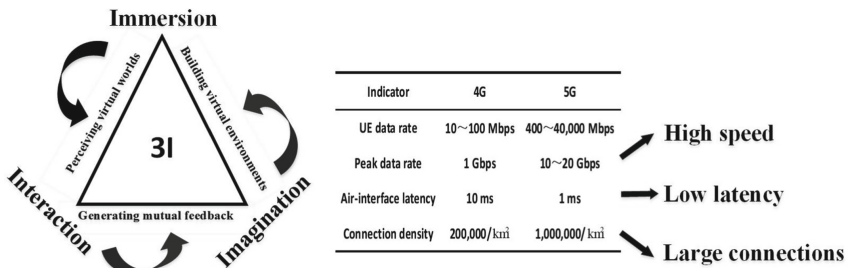


Fig. 3. Index advantage chart of "5G + VR" technology [Owner-draw]

4.2 Feasibility of "5G + VR" Technology Applied in Smart Classroom

4.2.1 "5G + VR" Technology Makes Virtual Reality Seamlessly Connected

Under the coverage of 5G network, VR technology is applied to the smart classroom. On the technical level, VR should be integrated into the teaching management software and hardware system of the smart classroom to build a basic VR application platform and provide a unified and friendly user interface for the smart classroom. The original functions of the smart classroom and the new functions brought by VR should be integrated into one system, rather than simply adding a set of VR equipment in the classroom. In actual use, it is also necessary to combine specific teaching plans to build VR teaching processes, and customize VR teaching processes according to the teaching objectives of different majors. This is not only to transform the real-time explanation process of teachers into VR video through the VR equipment of the smart classroom, but more importantly, to call and display the prefabricated VR materials that can help students understand at the right time. "5G + VR" technology organically integrates the high-speed transmission of 5G network and the immersive virtual reality environment created by VR technology, so that they can be seamlessly connected in the teaching process.

4.2.2 "5G + VR" Technology Makes the Teaching Process More Vivid

Compared with the traditional smart classroom, the VR smart classroom introduces a real-time VR teaching module to create a virtual teaching scene integrating viewing, listening and touching. It simulates and stereoscopically presents scenes that are difficult to appear or observe, and allows learners to conduct interactive exploration in the virtual scene. For example, when studying a complex three-dimensional scene, it is difficult for students to build a full picture of three-dimensional geometry in their minds through text description and video picture introduction. However, VR can directly present three-dimensional geometry in front of students in three-dimensional form, and students will have more intuitive feelings, Deepen the understanding of knowledge. [6].

4.2.3 "5G + VR" Technology Enables Students to Achieve Immersive Learning

The traditional teaching mode in Universities is relatively simple, and students passively accept the infusion of knowledge. The application of VR technology improves the interest of the classroom and stimulates the initiative of students. In the smart classroom supported by "5G + VR" technology, students will be in a rich and colorful virtual world, without the interference of real world information, and can immerse themselves in the teaching experience. Such immersive learning is efficient. Students can find their interests in the VR experience and conduct more in-depth learning with the help of the massive resources provided by the smart classroom.

4.2.4 "5G + VR" Technology Brings Teaching into Practice

Restricted by many factors such as financial resources, material resources, human resources and safety, the smart classroom attaches importance to theoretical teaching

and neglects the training of practical ability. However, the use of "5G + VR" technology can solve these concerns. Through the "5G + VR" technology, the teaching practice can be transferred to the virtual space, where the cost can be disregarded, the operation can be repeated, and the safety can be guaranteed. In particular, for some majors that cannot carry out large-scale practical cooperation with enterprises, not only does the laboratory environment differ greatly from the real environment of the industry, but also it is difficult to ensure that each student's mobile phone can be used. At this time, virtual reality technology can be used to present the actual experimental scene as realistically as possible.

5 Conclusion

The development of higher education is inseparable from the informatization of education, which must be supported by advanced technology. In the current situation where smart classrooms have many shortcomings, the support of "5G + VR" technology will become a necessary supplement to the construction and development of traditional smart classrooms. [7] This provides strong technical support for further accelerating the process of educational informatization in China, and brings new opportunities for high-quality talent training.

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