Research on the impact of 5G technology on teaching behavior

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Abstract. Affected by the COVID-19, the opening of higher education institutions in China has been postponed, and the policy of "suspending classes without stopping" has become a litmus test for emergency response to the epidemic and for education informationization. Under this opportunity, the online teaching model has risen rapidly and has become a hot spot for teaching reform. This article explains the development process from traditional teaching to smart teaching, and the shortcomings of online teaching at this stage. On this basis, with the new generation of communication technology 5G as the background of the times, the future teaching is prospected from the aspects of AI teaching, holographic interactive classroom, and virtual technology teaching.

1. Introduction

In the Spring Festival of 2020, the sudden COVID-19 completely disrupted the pace of people's lives and work, allowing the majority of teachers and students in China to spend the longest "vacation" in history at home. Under the policy call of the Chinese government to "consciously isolate, not go out, and not gather", everyone is contributing to this battle without gunsmoke. The violent epidemic has brought unprecedented impact to China's society, economy, politics, and culture. In response to the impact of the new crown pneumonia epidemic on the normal opening of schools and classroom teaching in colleges and universities, the Ministry of Education of China has issued a series of "stop classes without suspension" related policies and guidance. Colleges and universities across the country actively responded to the call and made full use of teaching resources such as MOOCs and online education platforms to actively carry out online teaching activities to ensure the progress and quality of teaching during the epidemic. Online teaching broke the traditional teaching order and developed rapidly under the dual influence of the epidemic and state support.

Online teaching has emerged on a large scale in a short period of time, and a series of corresponding problems such as network freezes, low efficiency of live broadcast interaction, and slow real-time updating of teaching content have gradually emerged. Communication technology restricts the development of online teaching. 4G technology has major limitations in terms of network delay and reliability, terminal device access density, and average network bandwidth. The 5G technology with high-speed, low-latency, and super-strong connection characteristics is gradually breaking through these limitations, and can effectively solve the problem of platform "capacity imbalance" caused by online teaching super-large traffic concurrent access, data interaction, and network instability. In addition, as an emerging teaching method, online teaching can further expand the application of education through the combination with 5G technology, break the gap between online and offline teaching experience, and accelerate the integration of offline education and online.
education\cite{2}. With the development of 5G technology, there is still much room for improvement in the future development of teaching models.

2. Development of teaching model
How to "teach" and how to "learn" are the core issues in any teaching model. The Chinese teaching model has gradually changed from a traditional realistic single classroom to a double classroom model combining "real classroom" and "virtual classroom"\cite{3}. The single classroom model is composed of teachers, students, teaching materials and teaching media in a modern environment. The teaching model centered around teachers and teaching materials is characterized by instilling knowledge to students through teachers' teaching, demonstrations and the assistance of teaching media. With the development of information technology, virtual classrooms are gradually integrated into real classrooms. In the virtual classroom, everyone joins the class created by the teacher by registering a personal account, participates in the discussion of various topics posted by the teacher online, completes online homework, and the rich teaching resources on the learning platform to make up for what they miss in the classroom Knowledge. The double classroom model realizes the complementary advantages of reality and virtuality, mobilizes students' enthusiasm for active learning, and at the same time, rich curriculum resources and diverse teaching evaluations promote the overall development of students' comprehensive quality.

3. Problems with online teaching
During the epidemic prevention and control period, online teaching was surging, but the sudden increase in demand in this short period has gradually exposed the following problems.

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Figure 1 The development process of teaching mode

In addition to the double classroom model, the development of information and Internet technology promotes content dissemination and fast learning online teaching models, leading the development trend of today's education. This model breaks the fixed and rigid learning methods in the past, and everyone has more autonomy. Through the online education platform "interactive classroom" and "famous teacher lecture hall" and other functions, students can choose their favorite teachers and learning resources. The arrival of the epidemic has promoted the online teaching model to gradually replace the traditional classroom teaching methods. Driven by the continuous integration of information technology, artificial intelligence, and big data, online education is gradually developing in the direction of intelligence, and innovative models such as holographic classrooms, AR virtual experiments, and AI education continue to emerge.
(1) Low supervision. At present, online teaching in colleges and universities is mainly arranged by the students themselves. The distance between the teacher and the student makes it impossible for the teacher to directly understand the student's learning situation. The sense of distance brought by the Internet affects the communication between students and teachers, and between students and students. Online teaching lacks the learning atmosphere of traditional classrooms and cannot form classroom learning constraints [4]. In addition, online exams are also one of the issues that need to be focused on. The online test platform faces more problems than the traditional test format. In the case of no invigilator, candidates have more opportunities to cheat, and the fairness of the test is difficult to guarantee [5]. Therefore, online teaching poses new challenges to the supervision of the teaching management departments of universities. Under the new situation, schools should not only encourage teachers to actively carry out teaching innovations and comprehensively improve teachers' online teaching ability and level, but also take multiple measures to supervise the quality and efficiency of students' online learning.

(2) Single teaching form and fragmented teaching content. During the epidemic, colleges and universities did not have a solution for how to reasonably use online resources and fully guarantee the quality of students' learning. Most teachers will adopt the linear method of traditional teaching to design courses, according to the requirements of the syllabus and teaching schedule used in the real classroom, and apply the daily offline teaching process mechanically to the online through the method of recording and broadcasting. The existing teaching resources are slightly single, and the lack of excellent teaching resources has become the bottleneck of online education [6]. Some teachers will use online platforms to select existing teaching videos for students to watch and learn, but they only require students to be able to brush enough class hours, and they have very little understanding of students' learning mastery. Because there are many and complicated teaching videos on the Internet, and the knowledge points are fragmented, the teacher wants to let students learn more at a time, so the choice of teaching videos is more fragmented, which makes it difficult for students to learn and master the corresponding knowledge in a system [7].

(3) Network constraints. In online teaching in colleges and universities, a well-functioning education platform often requires the support of powerful network equipment and core technologies. Most areas of China still use 4G networks. The 4G network can meet our daily needs for information transmission to a certain extent, but under the impact of high traffic, it appears "lack of stamina". Affected by internet speed and interactive mode, students' initiative and creativity are limited [8]. In addition, during the live broadcast, there is a time difference between the client and the server, which causes the teacher to not get timely feedback when connecting with the students or asking questions, and wasting time in class. During the epidemic, students across the country study at home. Online teaching is more disadvantageous for students in remote areas not covered by the Internet. The learning environment and conditions are limited, which restricts the learning of this part of students.

4. Advantages of 5G online teaching

(1) 4K/8K clear image quality makes teaching content more realistic. The peak rate of 5G information transmission meets the requirements for high-definition video large data transmission. With 5G technology using 4K/8K ultra-high-definition resolution for online teaching, students can clearly see every detail in the teaching video screen. The realism and immersive experience brought by vision can improve students' learning interest and learning initiative. At the same time, in response to the high-definition videos, pictures, charts and other questions that students have in the classroom, the instructor can answer them in real time, and can further consolidate their teaching knowledge through functions such as playback and local clear zooming.

(2) Fast internet speed optimizes the online interaction experience between teachers and students. The unobstructed communication network is a core factor that directly affects whether online teaching can be carried out normally. The 5G network rate can achieve Gbit/s, and it only takes more than ten seconds to download a high-definition movie. The high rate of 5G network can effectively solve the problems of live broadcast jams and online real-time interaction delays, which greatly saves
information transmission time\textsuperscript{[9]}. The emergence of large traffic 5G supports large-scale education applications, such as lectures by famous teachers, online learning, holographic classrooms, AR virtual experiments and other specific remote interactive teaching application scenarios. The high-efficiency data transmission rate enhances the interaction and sense of participation between teachers and students in the process of "teaching" and "learning", thereby achieving high-quality teaching effects.

Figure 2  5G remote interactive teaching

(3) 5G promotes the improvement of uneven distribution of educational resources. 5G can improve the fairness of education to a certain extent. The emergence of "Mengmu's three relocations" and "expensive school district housing" are essentially caused by the scarcity and serious imbalance of educational resources. The 5G high-bandwidth and low-latency feature enables high-quality audio and video real-time interactive online live broadcast. The live webcast course breaks through geographical restrictions and can effectively improve the problem of excessive concentration of high-quality educational resources. In the era of "Internet + Education", the popularization of 5G can achieve a balanced distribution of regional education resources. This means that 5G, following the 4G network, has taken the issue of promoting educational equity to a higher level, making most of the children of ordinary families and the children of high-priced school districts on the same starting line, directly accessing the best quality educational resources in China or the world.

5. Prospects for the future of teaching

(1) 5G+ AI teaching. The combination of 5G and AI will surely continue to subvert the traditional teaching model. In a live class, a teacher may face thousands of listeners. With such a large number, it is extremely unrealistic for teachers to pay attention to the teaching situation of each member. Face AI technology can effectively capture the expressions of each student and analyze and feedback to the teacher, which helps the teacher to grasp the real-time expression, psychology and learning situation of each student, so as to effectively target different students according to the feedback results obtained. After the guidance and answering questions. The 5G network + AI algorithm allows teachers to call the resources they need in the classroom at any time according to the classroom situation, and at the same time analyze the actual situation of each student's knowledge to personally push related resources. "Internet +" and "smart +" have given birth to new teaching concepts and teaching methods. As a new generation of college students who are aborigines of the Internet, the demand for how to use digital technology to carry out personalized learning has become more prominent\textsuperscript{[12]}.\[12]
(2) 5G+ holographic interactive classroom. The advent of 5G makes it possible for the teacher to "clone" to preach and solve puzzles. It is the "5G + holographic interactive classroom" technology. This technology presents the three-dimensional holographic portrait of the teacher in three dimensions on the podium, making the students feel more realistic. The high-speed processing of 5G data is used to present real-person "clone" teaching in colleges and universities with a 1:1 ratio of real people. Under the 5G high-speed transmission, the high-quality user experience without stuttering and low latency enables students to watch the courseware in real time on the electronic screen. Under the technology of "5G + holographic interactive classroom", students have a more three-dimensional, vivid and vivid cognition of the teaching content.

(3) 5G+ Virtual Reality Technology Teaching. With the popularization of 5G technology and the development of VR/AR technology, 5G+VR/AR will surely bring a new teaching experience. VR can be carried around, it can break through the limitations of places and expand the teaching space. Through the VR/AR platform to create an experimental environment, students can perform virtual operations in the intelligent experimental system, avoiding the safety risks of high-risk experiments. The 5G+VR/AR technology restores according to the scene, allowing students to further understand the reasons for the failure of the experiment and improve the efficiency of training. For traditional teaching, students travel through various scenes in virtual teaching and actively explore new knowledge, thus stimulating students' initiative and innovation, which is in line with the education concept of "student subjectivity" in today's society.

6. Conclusions
As an emerging teaching mode, online teaching is still a core issue that needs to be resolved, how to ensure high-quality "teaching" and "learning". Online teaching has a series of problems such as low supervision, single teaching form, fragmentation of teaching content, and network restrictions. However, with the advent of the 5G era, by making full use of 5G's high-speed, low-latency, and Internet of Everything characteristics, it will further subvert the existing model of the education industry. The continuous collision of 5G technology with big data, artificial intelligence, Internet of Things and other technologies has resulted in important online teaching scenarios such as "online live classroom teaching, holographic classroom teaching, AI intelligent teaching, and virtual reality teaching". Online teaching in the 5G era blurs the boundaries of communication and exchanges between teachers and students and between students, breaks through the limitations of the time domain, promotes the circulation of information and knowledge, and will surely play a greater role in the era of education informatization 2.0.
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