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Intelligent Learning Environment and Future Development Tendency

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Abstract: In the recent years, intelligent learning environment replace the traditional learning environment gradually. Compare with the traditional learning environment, intelligent learning environment consider more about the learning experience of students, improve the communication between students and intelligent learning environment. One of the most paramount factors is intelligent tools in intelligent learning environment. These intelligent tools contain 5G communication technology, Mobile library, artificial intelligent and virtual reality. In this paper, we will mention the impact of these tools on intelligent learning environment, and how these tools influent students learning methods as well as teaching approach during the class. Besides, we still analyze the merits and disadvantages about intelligent tools. What is more, what kind of development will the intelligent tools going to happen in the future? We should deliberate it.

Keywords: 5G communication technology; Online classes; Mobile library; Artificial intelligent; Virtual reality

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1. Introduction

In the current information era, the way of information transmission is particularly paramount. Unequivocally, in school education there is also the transmission of information. The traditional learning environment is that the teacher directly communicates knowledges and information to the students in class through verbal narration and hand-writing. Nevertheless, different from traditional learning environment, the new intelligent learning environment delivers knowledge to students through internet technology and high-end technology, such as online classroom, artificial intelligence (AI) teaching and virtual reality (VR), etc. This paper analyzes and studies the advantages and disadvantages of new intelligent learning environment and its development trend in the future.

2. The relationship between intelligent tools and intelligent learning environment

2.1. The impact of information technology on intelligent learning environments

Intelligent learning environments are a concrete form of intelligent learning environments supported by artificial intelligence technology. Researchers have created this learning environment to respond to the learning needs of the end user (student). This learning environment provides a more personalized learning experience for learners. In traditional learning environments, the designer of the learning environment places too much emphasis on objective needs such as social benefits. Compared to traditional learning environments, intelligent learning environments are more susceptible to the learning experience of students. Intelligent learning environments improve the between the learning environment and the learner [1].

The parts of a smart learning environment include six parts: learning resource, smart tools, learning

communities, teaching communities, learning styles and teaching styles. The relationship between them shown in the diagram below：

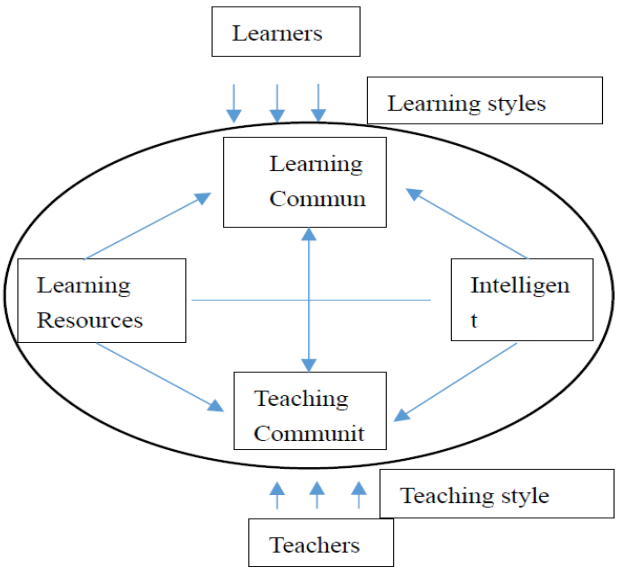

Figure 1. System model of intelligent learning environment

The diagram of this shows that learning styles and teaching styles are also needed to make up a learning environment. Learners and teachers are the main actors in a smart learning environment and they interact with the other four parts through learning and teaching styles. Learning resources and intelligent tools provide effective support for the intelligent learning environment and they are essential for effective learning. At the same time, teachers' pedagogical approaches drive to innovate resources and tools [2].
From the above discussion, we can gain an initial understanding of the concept of an intelligent learning environment, its advantages and its constituent elements. In the following section, I will focus on exploring the use of smart tools in an intelligent learning environment.

2.1.1. The impact of 5th generation mobile communication technology on smart learning environments

The smart learning environment relies on smart technologies such as 5G communications and is rapidly developing, fuelled by the informatisation of education and the fourth industrial revolution. This development will lead to the optimisation and upgrading of various elements within smart education, resulting in an innovation of the learning environment. With the development of technology and society, the main contradiction in Chinese education has now transformed into a contradiction between the people's growing need for quality education and the inadequate and unbalanced development of education. In order to solve this problem, improving the quality of education and optimising the learning environment are current reform issues worth exploring. The 5G smart technologies currently applied to smart education are basic support technology, computer analysis technology and teaching presentation technology. The foundation of smart education is the underlying support technologies (e.g., Internet of Things, Big Data, Blockchain, etc.) [3]. 5G technology enables smart education with its high speed, low latency, low power consumption, massive connectivity and high reliability [4].

5G smart technology contributes significantly to smart learning environments. Synchronous online classroom supported the suspension of classes and non-stop learning during the new crown epidemic in 2020. In an ordinary network environment, online classes inevitably suffer from poor picture clarity, video and audio delays and little classroom interaction. 5G smart technology can effectively improve video clarity

and break the barrier of network latency. At the same time, this 5G technology can also facilitate teaching and learning interaction, allowing teachers and students to share learning resources in almost real time. The optimisation of synchronous online classrooms will not only improve the quality of teaching and learning, but also optimise the learning environment for students. Smart e-textbooks are also a product of 5G smart technology. They combine text, images, video and audio. For younger students, these materials make the classroom more interesting; for older students, they are analytical, manageable and interactive. These materials reduce the time teachers spend preparing lessons and integrate knowledge more efficiently. Currently, the barrier to the development of e-textbooks is the bottleneck in intellectual property rights. The application of blockchain technology can solve the problem of intellectual property rights of electronic teaching materials [4]. As a result, the development of 5G technology has made a significant contribution to the development of intelligent learning environments.

2.1.2. How 5G technology is changing the way we teach and the way we learn

The use of 5G technology optimises teaching and learning styles. Teaching and learning are the link between teachers and students and the intelligent learning environment [2]. The 5G era is characterised by two main features of the teaching and learning approach: the expansion of the delivery location and the enrichment of the teaching and learning content. 5G technology has enabled an infinite expansion of the classroom space. In traditional schooling, the scope of interaction between students and teachers is limited only to the classroom [5]. Teachers impart knowledge to students through handwritten courseware or electronic versions of PPT. At the same time, students write notes in paper notebooks using ballpoint pens. In this model, students submit their assignments mostly in paper form to the teacher, who also gives them some feedback by writing in the paper. However, in the 5G era, the learning environment for students is no longer confined to the classroom. Thanks to the high speed and low latency of mobile networks in the 5G era, teachers can conduct teaching and learning activities via internet platforms. What is more, 5G network technology supports the availability of a large, efficient and at the same time inexpensive amount of data and materials for teaching and learning in the cloud. Thanks to this advantage, students can receive learning materials from all over the world. Some children in remote areas can receive learning materials from the city [6]. As a result, learning is no longer limited by geography.

The second feature of the 5G era teaching style is the enrichment of teaching content. In the 5G era, the mobile online classroom is no longer a supplement to the offline classroom. Instead, online classes become the main form of teaching and learning. The teacher will impart a complete body of knowledge to the student through online education, etc. However, offline classes are mainly focused on solving problems in the lecture. The teacher will interact with the students during the offline lectures. In addition, the interconnectedness of everything is a distinctive feature of 5G technology applications [5]. Under the influence of this feature, the teacher only needs to press a shortcut key on the computer and the computer will be connected to the online learning platform or to the students' feedback reports. In this way, teacher-student interaction is no longer limited to the offline classroom either.

2.1.3. The challenges of education development in 5G era

However, the 5G era brings more than just benefits to the smart learning environment; there is a negative side to the impact of 5G on the development of education. 5G technology's high speed and mass connectivity makes it possible to transmit large amounts of educational data in a high speed and multimodal manner. However, this also increases the risk of personal data leakage. In the process of teaching and learning, large amounts of data are collected, included, analysed and exported. This data can be leaked, manipulated and misused. Some unscrupulous individuals may use their authority to sell this data. Therefore, the security of 5G networks needs to be addressed. The relevant authorities need to establish a

5G network security defence system and strengthen the protection of personal privacy and data security. In addition, while 5G helps people address the spatial limitations of teaching and learning, the separation of time and space created by online education can affect the interaction between teachers and students. In a traditional classroom, teachers and students can interact face-to-face. Students can ask the teacher questions and the teacher can answer them in real time, anywhere and anytime. In the future, 5G technology will enhance the immediacy and interaction of online education. Because of its high speed, high capacity and low latency, 5G technology can be used to create a high-speed interactive information channel for teachers and students [7].

2.2. The contribution of mobile libraries to smart learning environments

2.2.1. The mobile library concepts

University libraries bring together different areas of knowledge as well as different learning tools. The wealth of learning resources in the library gives students a resource base for their learning environment. The learning environment for students has changed due to the development of advanced technology and the information age. The way students learn is changing from traditional paper-based learning to paperless learning. At the same time, mobile libraries have come into being. This change in the learning environment has brought about a sea change in libraries [8]. 5G technology is an important factor driving the development of digital libraries [9]. Mobile libraries rely on wireless networks, the Internet and multimedia technologies to provide the public with access to library resources regardless of time and space. Students can access the literature they need through their laptops or mobile phones [10]. For example, university students use mobile libraries when they write their graduation theses. Due to the distance factor, many students are unable to complete their thesis in the library. Moreover, the search function of traditional libraries is complicated and students spend a lot of time in searching for books. Therefore, the development of mobile libraries has brought convenience to students' studies.

2.2.2. Key features of the mobile library

The main functions of the mobile library are unified search function of literature resources, intelligent recommendation function, advisory service function and reader location function [11]. The unified search function for documentary resources is an essential feature of mobile libraries. There are two ways to implement this function, one is cross-library searching and the other is a knowledge discovery system based on the creation of a meta-database. The second method is generally used in mobile libraries. This is because the second method is an efficient and accurate one-stop search. This method can better address the integration of various databases. The enquiry service includes form enquiry, real-time virtual enquiry and subject librarian service. This feature provides a personalised service experience for students. Among them, the intelligent recommendation function can provide personalized services for readers. The mobile library analyses students through their behaviour. For example, a user's download frequency, length of time spent reading articles and reading preferences are all data that can be observed and analysed by the mobile library. By observing this data, the mobile library will recommend different resources to different users to meet their personalised reading needs. In addition, mobile libraries can locate readers in real time. Through the location of the signal emitted by the wireless network, the mobile library will capture the user's location, thus providing the user with a path to find books or literature from nearby libraries.

2.2.3. Problems with mobile libraries

However, there are certain problems with mobile libraries. Firstly, the service platforms of mobile libraries are poorly positioned in terms of their objectives and lack mechanisms for collaboration and interaction. The reasons for these problems are as follows: each library has a different positioning of itself and the

services it provides, and therefore a different understanding of the needs of its users. The current mobile libraries only have an overall target orientation and do not clearly distinguish between different types of mobile service platforms. In the future, it will be important to establish a specific targeting of service platforms and to clarify the system. Secondly, mobile libraries provide a smart learning environment for students, there are still some shortcomings in the personalised and differentiated services provided by mobile libraries. Currently, mobile libraries focus on providing users with book resources for their needs, while users seek personalised services. Although the smart recommendation function of mobile libraries reaches some of the personalised needs, there is still homogenisation of services. In addition, the mobile library's service platform places emphasis on construction, but neglects the importance of promotion. Some users have high access to the platform only at the initial stage of use, with a lack of attention at a later stage [11].

In the future, mobile libraries can be developed with the help of 5G technology, which can automate the organisation of resources, personalise the content of services, make services available everywhere and virtualise the service space [11]. It is important to look at how 5G technology can be integrated with mobile services to provide an intelligent and seamless service environment.

2.3. The influence and trend of artificial intelligence (AI) on education

Artificial intelligence (AI) extends human physical and mental power "Alpha dog" has successively defeated two world champions Li Shishi and Ke Jie, setting off a new round of upsurge in the development of global artificial intelligence [12]. From the perspective of technological development, the development of artificial intelligence can be divided into three stages: computational intelligence, perceptual intelligence and cognitive intelligence. Among them, computational intelligence is the initial form of artificial intelligence and the basis of its continuous development; Perceptual intelligence is the development stage of artificial intelligence at home and abroad; Cognitive intelligence is an advanced form of artificial intelligence and a breakthrough in the future development of artificial intelligence [13].

Table 1. Different stages, characteristics and cases of artificial intelligence

Development stage	Characteristic	Educational application cases
Computational intelligence	Storage and calculation	Storage and transfer of massive learning resources, intelligent student information management system
Preceptive intelligence	Listening, speaking, watching, recognizing	Language teaching, oral testing, image searching
Cognitive intelligence	Understand students and think independently	Individualized learning, autonomous learning

At present, artificial intelligence will revolutionize education. Every educational reform is actually driven by the technological revolution in some special circumstance. For example, Artificial intelligence technology is the one of the representative and revolutionary technological reform. With the rising of deep learning and big data, other industries are driven by AI technology in revolutionary reform, but the biggest impact of AI technology will be in education. The combination of artificial intelligence and education is constantly promoted with the continuous improvement of social needs.

At present, educational informatization is faced with the problems of teaching method innovation, educational resource balance and teachers' professional development. People expect a new generation of artificial intelligence technology to promote education equity and improve the quality of education to a greater extent. The purpose of this paper is to review the development history of artificial intelligence, analyze the driving force of the development of artificial intelligence, examine the characteristics and laws of the application of artificial intelligence in education from the perspective of technology and education, and try to answer the potential, possible challenges and main research trends of the integration of artificial intelligence into school education, so as to promote the development of new generation of artificial intelligence in school education, So as to contribute wisdom to the construction of intelligent, networked, personalized and lifelong education system [14].

Artificial Intelligence are steady coming into our life, the integration of AI technology and school education has gradually become a trend. It provides technical support to personalized and customized learning, which is different from the traditional learning. As we all known, the education in school is to put a certain amount of student into a classroom together, teachers then having class for those students. It seems that every student can learn subject knowledge in the same extent. However, it is hard to ensure every student can learn the same things during the class. The ability and extent to which each student absorbs knowledge is different, so personalized and customized learning are paramount in some special situation.
The society generally expects artificial intelligence to bring new development power to improve the teaching quality, improve the teaching service process, and innovate the teaching evaluation methods. According to Yu, through learning analysis and user portrait technology, collect learners' learning data, realize comprehensive analysis of students' behavior and accurate judgment of knowledge point mastery, so as to draw a learning development map suitable for students' characteristics; With the help of emotional robot and natural language processing technology, it can accompany learners to grow up and increase the care and company for people; Combined with the knowledge map, the domain knowledge base is established to assist teachers to generate different test questions according to students' different abilities and correct their homework; Using intelligent sports equipment, such as intelligent bracelet, intelligent vital capacity and other evaluation tools, we can collect students' health data in depth, so as to find the problems of students' physique, sports skills, health degree and so on [15].

To be specific, first of all, Artificial intelligence will acquire the data of students' study behavior, using big data and study analyzing technology to provide suitable study resource and approach to learner. Second, Artificial intelligence needs a specific environment to provide immersive study to learner. For instance, using VR glasses and high- performance computer processing system, these devices can support technology during AI classroom. What is more, AI will encourage students to participate in studying with positive mood, understanding the emotional changes of students which ensure students can invest in learning deeply. As we can see, artificial intelligence technology provides new developed opportunity to education. Nevertheless, there are some challenges still impact the ability of educational service, so it needs the researcher of AI to face it reasonable. These challenges include educational value of intelligence technology, useful cooperation of government, enterprises and school, technical management of harmonious development of man machine.

2.3.1. Educational value of intelligence technology

Education is a special activity, 'to ensure the development of human' is the most essential part of education. Apparently, we should give full play to the educational value of artificial intelligence. Therefore, the combination of artificial intelligence and education should increase the development and growth of people, putting artificial intelligence into school education.

2.3.2. Useful cooperation of government, enterprises and school

It is quite certain that combining artificial intelligence into school education is not only need the maturity of technology, but also the driven by enterprise and government. According to Xu, In the future, the market scale trend of educational robots may reach tens of billions of dollars. Educational robots will become the third kind of robots after industrial robots and service robots. In the scene of meeting welcome, restaurant service and remote customer service, service robot has been accepted by the public, which will promote the combination of robot and educational scene [16]. Government, enterprise and school should cooperate together and integrate into school education, the complement of colleges and universities and enterprises should provide support for the integration of AI into the school in the aspects of algorithm improvement and teaching method research.

2.3.3. Technical management of harmonious development of man machine

The application of AI technology needs a lot of education data query, integration and sharing. There are various third parties involved in these industrial chains, such as software developers and providers. These entities have the ability to access, upload, share, modify, trade and even use customer data, who can protect these data suffer from damaging and infringing? These problems should be considered in the security deployment of artificial intelligence system. It is necessary to ensure that artificial intelligence can make decisions in line with social norms and ethics to ensure public safety.

2.4. AR scene and teaching

In recent years, with the continuous improvement of virtual reality (VR) technology, especially the breakthrough of VR equipment, the education method based on VR is full of vitality. VR education is of great significance to the subversion of traditional teaching, which can effectively improve the learning effect. VR education is the application of VR in the field of education **[17]**. It can build a virtual learning environment, create virtual learning partners, and provide learners with an interactive, interesting and safe learning environment. It can be said that the combination of VR and education subverts the passive learning in traditional teaching methods, which is one of the main trends in the development of education [18].

VR education is of great significance to the subversion of traditional teaching, which can improve the learning effect. According to the learning pyramid theory in the figure below **[19]**, it is inefficient for students to be heard in the classroom, and only 5% of the content can be remembered at most; If students take the initiative to read, the effect is better, with 10% effect; If the audio-visual process is added, the learning effect will be improved to 20%; If students participate in classroom performance or role play, the effect will be better, up to 30%; If students are organized to exchange and discuss their views, the learning effect will reach 50%; The more ideal is to let the students practice, learning effect can reach 75%; The most ideal is to let students teach others what they have learned on the basis of learning. The learning efficiency is as high as 90%, and it is not easy to forget. Traditional teaching methods are often passive learning, and augmented reality, virtual reality and game can make students get immersive feeling and interaction through graphic simulation, so as to achieve active and experiential learning effect.

The chart above displays the average retention rate of what students learned (how much they remember after two weeks). The top half is passive learning and the bottom part is active learning. Among them, passive learning has a low retention rate of what students learned. Nevertheless, active learning has a higher retention rate of what students learned on the whole. To be specific, teaching others will make students more likely to remember what students have learned with highest proportion in the retention rate of what students learned (90%). So active learning is more suitable for students.

VR education can not only provide students with vivid and lifelike learning environment, but also save education costs, avoid practical operation risks, stimulate students' knowledge learning and innovation

potential, solve and break through the difficulties and bottlenecks in traditional teaching, which will bring an important educational reform. VR technology not only brings immersive experience for education, but also has the characteristics of 3I (immersion, interaction, imagination) [20].

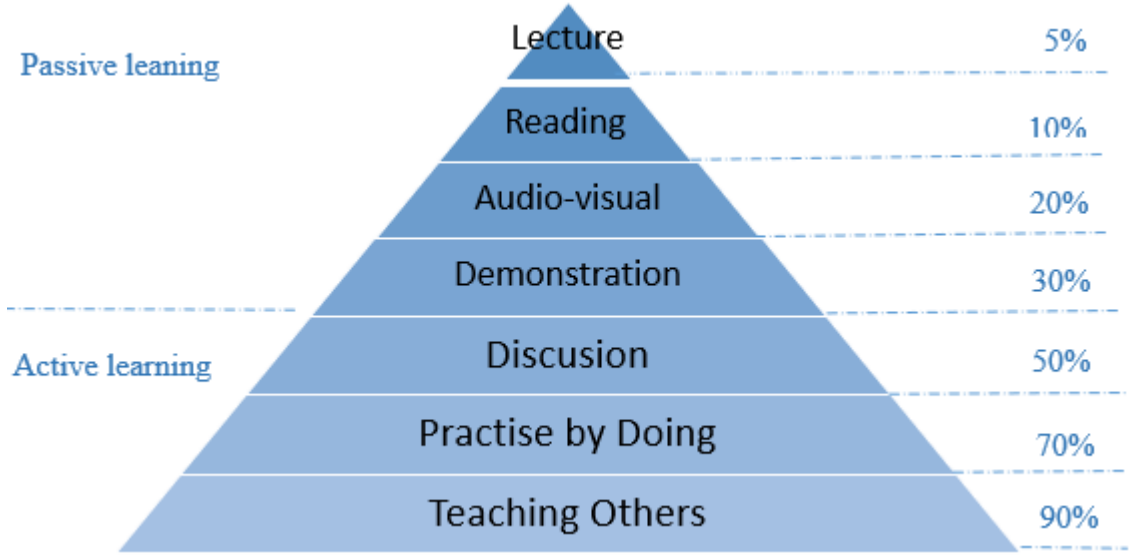

Figure 2. Average retention rate of what students learned (indicating as to how much they remember after two weeks)

More immersive Education: different from passive audio-visual experience, VR technology enables students to experience realistic virtual scenes, such as world-famous spots, historical scenes, deep space, disaster scenes, and actively explore and observe.

More interactive education: VR environment provides more natural interactive ways, such as action, gesture and voice. Students can realize the experience similar to the real world with the scene, teachers and students, so that students can learn various operations and skills in the virtual space, which is also conducive to students' rapid integration into learning and communication [21].

More imaginative Education: In VR environment, both teachers and students can integrate into the learning environment through avatar virtual roles, such as using more lovely cartoon characters, historical figures in historical events, and wearing special clothes for target occasions, so as to enhance students' sense of substitution and make them more interested and imaginative [22].

From the perspective of the number of patentees, VR education has a large number of patentees and a small number of patents. This shows that VR education industry is still in the early stage of development. At the present stage, VR education patents are mostly in the application stage, and the patent layout space is large. It is suggested that China's VR education enterprises should strengthen the research and development of new products and new technologies, and carry out the patent layout as soon as possible. From the perspective of patentee types, University applicants are far lower than enterprise applicants **[23]**. As one of the important forces of scientific and technological innovation and technological and economic progress, universities have inherent advantages such as scientific research talents and teams, scientific research funds, instruments and equipment, and scientific research environment. However, these advantages are not fully reflected in VR education patent research. In addition, as one of the main application scenarios of VR education, colleges and universities are most aware of the needs of users and the shortcomings of VR education products at this stage. It is suggested that colleges and universities should cooperate with enterprises to investigate the needs of schools, and jointly develop VR education systems or solutions for different education stages and disciplines, so as to effectively promote the in-depth

integration of VR technology and education industry in China.

Therefore, it is suggested that VR education enterprises should carry out product research and development and technological innovation from the perspectives of product design, cost reduction, user demand and experience, and apply for patent protection for innovative achievements as soon as possible, so that VR technology can be popularized in the education industry as soon as possible.

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Disclosure statement

The author declares no conflict of interest.

Author contributions

Liu SY and Shi ZX looked up the information about 5G communication technology, Online classes, Mobile library; Artificial intelligent and Virtual reality with the real case. Shi ZX responsible for the layout of the paper, Liu SY proofread the paper for typography and fluency.

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