Intelligent Teaching System of Vocational Education Based on a New Generation of Information Technology

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Abstract. With the increasing demand for technical talents in all walks of life, the status and role of vocational education have become increasingly important. The use of a new generation of information technology to accelerate the reform of the talent training model and build an intelligent teaching system for vocational education has become an urgent problem in the development of vocational education. This study analyzes the teaching and learning needs and teaching management of vocational colleges from five aspects, namely, smart classroom, teaching model innovation, teaching cloud platform, teaching evaluation, and issuance of qualification certificates. Such a teaching system uses artificial intelligence, Internet of Things, big data, and cloud. A new generation of information technology such as computing and blockchain has created an integrated intelligent teaching, management, and service system that closely combines offline physical classroom teaching and online cloud platform teaching. The system is green and energy-saving, reduces the investment in teaching equipment and hardware, and fully covers the "teaching, learning, evaluation, management, and certification" links of the vocational education process. Furthermore, this system promotes the reform of the vocational education teaching system.

Keywords: Vocational education · Artificial intelligence · Information technology

1 Introduction

The "China Education Modernization 2035" issued by the Central Committee of the Communist Party of China and the State Council focuses on the deployment of 10 strategic tasks for educational modernization. The objectives are to implement the spirit of the 19th National Congress of the Communist Party of China

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and the National Education Conference and accelerate the modernization of education. Moreover, one of the tasks for educational modernization is to accelerate the modernization of education. The educational reform in the information age aims to build an intelligent campus and coordinate the construction of an integrated intelligent teaching, management, and service platform. Modern technology is used to accelerate the reform of the talent training model and realize the organic combination of large-scale education and individualized training. Furthermore, the educational reform aims to innovate educational service formats, establish a mechanism for co-construction and sharing of digital educational resources, and promote precision management and scientific decision-making.

With the rapid development of a new generation of information technology, the increase of applications based on artificial intelligence (AI), Internet of Things, big data, cloud computing, and blockchain technology has accelerated the construction of smart campuses. Examples of blockchain technology include smart classrooms [1], online and offline hybrid teaching [2], educational data co-construction, and sharing [3]. Domestic mainstream enterprises in the education field have also successively launched corresponding smart education and teaching construction programs. For example, the "Intelligent Education Solution" launched by Tencent Cloud implements AI education scenarios in the teaching process of "teaching, testing, management, and marketing," providing AI education products and services, such as classroom quality analysis, intelligent scoring, and homework correction. The Ebbinghaus Smart Education 4.0's new teaching product starts from four systems, that is, student portrait, knowledge map, learning content recommendation, and learning path planning, officially entering the era of intelligent mode. Companies such as Baidu AI, Megvii Technology, EqualOcean, and Aidi Technology have also launched their own smart teaching and smart campus solutions and promoted and built them in key vocational colleges. However, in terms of specific solutions, almost all use "cloud + terminal" as the construction model, with hardware system construction as the main component, and product homogeneity is serious.

The vocational education intelligent teaching system based on the new generation of information technology proposed in this study has completely absorbed the current mainstream enterprises' informatization construction and development experience in the current education field. Moreover, the pain points and difficulties of vocational education, using AI, the Internet of Things, big data, cloud computing, and core key technologies, such as blockchain, have created an integrated intelligent teaching, management, and evaluation system. This system closely combines offline physical classroom teaching and online virtual classroom teaching. The direction of change in the teaching system aims to meet the needs of the current vocational education reform and development, realize the deep integration of teaching and learning, strengthen the integration of industry and education and school–enterprise cooperation, promote the integration of documents under the 1 + X certificate system, and lead vocational education to a certain extent.

2 Current Status of Development of Informatization Teaching System Construction

In recent years, relying on a sound informatization development plan, the informatization development of the teaching system of vocational colleges has been service-oriented, committed to technology and service innovation, and has made considerable progress. The first MOOC jointly developed by MIT and Harvard University in March 2012 overturned the traditional university education model. MOOC was composed of online video lectures, interactive questions, online laboratories, and forums and attracted 150,000 students to register. The course ended in June 2012, and researchers such as BRESLOW [4] began to analyze the rich data sources it generated. We check in chronological order how students use resources and how the interaction of the teaching part facilitates their learning of the course. Chunfeng et al. [5] discussed the feasibility and effect of small-scale restrictive online courses (SPOC) combined with flipped classroom teaching in nurses' professional knowledge and skills training. Experiments prove that using SPOC and flipped classroom methods to train new graduate nurses in general knowledge and skills will help stimulate nurses' interest in learning and improve nurses' technical skills and clinical application capabilities. These new online intelligent education teaching models can provide high-quality teaching resources and education consultations to the public. In addition, vocational colleges pay attention to the application of a new generation of information technology. Cloud computing, AI, and the Internet of Things break the traditional classroom boundaries, turning traditional campuses into scientific research libraries and smart classrooms that can be visited and roamed anytime and anywhere. The smart classroom lighting control system [6] is a design scheme based on machine vision. Smart classrooms based on the Internet of Things and big data [7] have a great role in improving the learning environment of universities and realizing smart teaching and management. The cloud computing-based teaching resource platform [8] can optimize and integrate the introduction of more high-quality teaching resources. This system can also enable the reasonable allocation and sharing of teaching resources and maximize the utilization of school teaching resources. Moreover, the system can meet the needs of teachers and students in teaching and learning. Demands have strengthened the integration of a new generation of information technology and teaching. The smart campus built by Shandong University of Science and Technology based on the big data ecological chain [9] has explored a set of practical and feasible models with a promotion value in the aspects of online learning space, remote teaching platform, media resource platform, and teacher information education guarantee system. The campus has achieved good results in promoting school education and teaching reform. Moreover, the smart campus of the mixed reality holographic learning model [10] builds a "ubiquitous learning system" on the basis of "5G+MR," that is, a holographic school that integrates online and offline (hybrid) time and space learning. The student status management system based on blockchain technology [11] provides a new way of thinking for the improvement of the student status management system.

In summary, the current construction of the vocational education teaching system focuses on the integration of information technology and education and teaching. However, the general lack of a unified layout makes realizing the interconnection of teaching data impossible. The direction of education informatization investment is not always clear, and the emphasis on "hard" rather than "soft" always exists. In terms of efficiency, the large investment in teaching hardware has not brought significant results that match it.

3 Intelligent Teaching System of Vocational Education

3.1 Overall Model Architecture Design

The intelligent teaching system of vocational education proposed in this study is divided into five modules: intelligent classroom, intelligent teaching mode, intelligent cloud platform, digital intelligence evaluation, and intelligent certification. Figure 1 shows that the use of a variety of new-generation information technologies, such as the Internet of Things, AI, big data, cloud computing, and blockchain, comprehensively covers the "teaching, learning, management, evaluation, and certification" links of the teaching process to create A new intelligent teaching system for vocational education. Multi-directional technology radiation to each module through a new generation of information technology can effectively support the transformation of traditional teaching models to MOOC, SPOC, and flipped classrooms, enabling accurate teaching management and scientific decision-making.

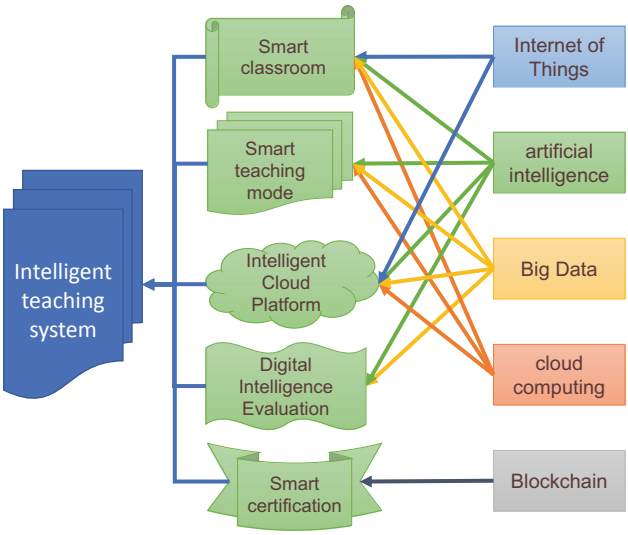

Fig. 1. Intelligent teaching system model

3.2 Smart Classroom Model Design and Application

The functional design of information-based smart classrooms should be able to meet the requirements of intelligent perception and control related hardware equipment, including wallpaper color matching, lighting and temperature control of the entire space of the classroom, and various forms of desks and chairs. This design emphasizes the harmony and unity of people, classrooms, and control systems, which should meet the teaching needs of multiple teaching modes, such as traditional teaching, micro-classes, MOOC, SPOC, and flipped classrooms. This design aims to create a full-time, flexible, and support ubiquitous learning intelligent classroom and achieve the purpose of closely connecting the intelligent cloud platform system online and connecting the actual teaching activities offline.

Figure 2 shows the smart classroom model. The smart classroom has a large LED display or projection screen, an electronic whiteboard, computer teaching aids, human–computer interaction functions, and others to present teaching content in multiple angles and ways. The classroom also has a temperature and humidity sensor and smoke sensor, and classroom temperature intelligent control and fire safety monitoring are realized through the Internet of Things technology. This classroom has a wireless network function, supports the access of various mobile terminal devices, and ensures that multiple terminal devices can access the network anytime and anywhere. Moreover, it has an intelligent sound reinforcement function and supports audio playback and classroom sound collection, teacher pickups, student pickups, speakers, student tracking cameras, teacher tracking cameras, and other equipment that can meet daily teaching, micro-classes, MOOC, SPOC, and flipped classrooms and other teaching needs. Furthermore, this smart classroom has a teaching recording and broadcasting function, provides teaching video playback resources for students' review after class, and supports daily teaching observation class, leadership tour, supervision, and evaluation class.

AI deep learning technology plays an important role in the construction of smart classrooms. Through AI based on YOLO's multi-scale parallel face detection algorithm [12], the distribution data of the class face are obtained using an AI camera, and the AI host can realize intelligent roll-calling. The AI of this classroom has the following characteristics: intelligently control the number of lights according to the number of people to achieve energy saving; detect the situation of listening to the class with faces (the face will be in front of the teacher in class), and upload the data to the cloud platform big data center as the situation of students attending class attentively, which can not only effectively prevent students from playing with their mobile phones in class but can also achieve an intelligent attendance function.

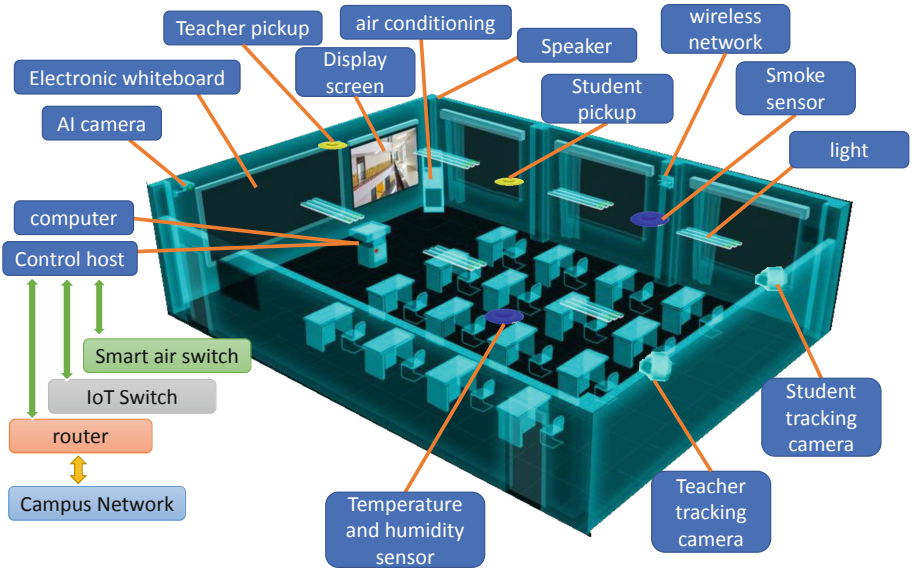

Fig. 2. Smart classroom model

3.3 Application of Smart Teaching Model

The smart teaching model based on the new generation of information technology has completely changed the traditional teaching model and formed a mixed teaching model with traditional models, MOOCs, micro-courses, SPOCs, and flipped classrooms. Figures 3 and 4 show that teachers use the cloud platform to implement intelligent lesson preparation and resource indexing, record micro-classes in the smart classroom before class, and carefully design MOOC online courses. In the course of class, the smart classroom is used to realize smart attendance, in-class evaluation, teaching recording and broadcasting, classroom interaction, and various teaching activities, such as SPOC and flipped classrooms. After class, teachers can implement online homework assignments, launch questionnaire surveys, online voting, online exams, and tutoring and answering questions through the cloud platform. This smart teaching model can help facilitate the development of teachers' teaching work, teach students in accordance with their aptitude, and improve teaching efficiency.

Students can preview online MOOC courses by logging in to the cloud platform before class. During class, students can rely on the intelligent classroom to realize the functions of group collaboration, inquiry and discussion, question raising, and answering on demand. After class, students can also use the student terminal of the teaching cloud platform to perform MOOC learning, online questioning, submission of homework, intelligent missing and filling vacancies, and other learning activities. This function allows achieving the combination of student online independent learning and precise guidance, which will greatly improve students' autonomy and flexibility of learning.

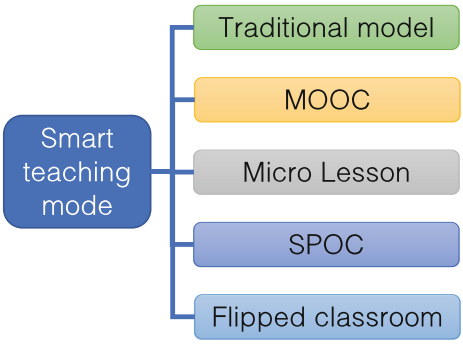

Fig. 3. Smart teaching model

3.4 Design and Application of Smart Cloud Platform Model

The intelligent cloud platform based on AI, big data, cloud computing, and Internet of Things technologies integrates platform, teaching, and management functions to build an integrated information environment and new media teaching methods. Figure 4 shows that the platform can be divided into intelligent classroom end, intelligent management end, teacher end, student end, and enterprise end. Through the application of "cloud + terminal," the seamless connection of students, teachers, schools, and enterprises, including the integration of schools and enterprises, is realized. Teachers log on to the intelligent cloud platform, make MOOCs and online teaching activities, obtain students' learning status data according to the big data analysis provided by the big data center, and provide accurate guidance to poor students. Students log on to the intelligent cloud platform to complete online previews before class and targeted reviews after class to better achieve personalized and differentiated learning. Enterprise engineers log in to the enterprise client to provide real-time guidance on students' internship plans, content, process, and situations. Teaching managers log in to the intelligent management terminal of the cloud platform to monitor the electrical equipment in the smart classrooms of the school, achieve green energy conservation, and effectively manage the teaching and learning situation through the data analysis of the big data center. The intelligent cloud platform also provides cloud storage services for various users, which can realize the storage and sharing of files on the cloud U disk anytime and anywhere in the smart campus. This function not only guarantees the safety of data but also eliminates the trouble of bringing a U disk.

3.5 Functional Design of Digital Intelligence Evaluation Model

Traditional teaching evaluation is manifested by teachers' multiple evaluations of students' knowledge level and learning performance, evaluation of teaching process and teaching effect, and on-site evaluation of experts and peers. The application of a new generation of information technology has promoted the reform

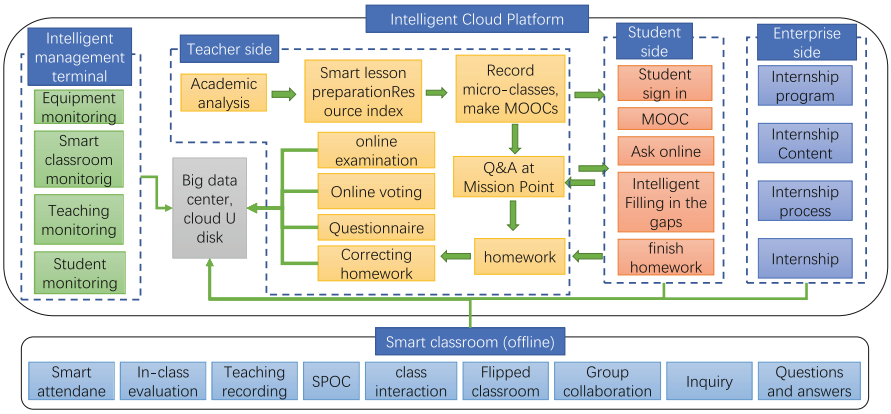

Fig. 4. Smart cloud platform model

of the evaluation subject, content, method, and result of classroom teaching evaluation. Figure 5 shows that the big data center of the intelligent cloud platform measures the learning progress of online knowledge points in the learning process of students, online participation in learning and discussion, offline classroom listening, homework scores, test scores, practical ability, and others. The academic situation data of the aspect are collected. After data analysis and data mining, intelligent analysis and evaluation of students' learning conditions are carried out, and a personalized chemical situation diagnosis for the students is further obtained. AI technology is used to provide learners with accurate learning strategy guidance through the intelligent cloud platform to push the intelligent leakage and filling of learning materials for students' personal academic conditions. The AI technology maximizes the function of stimulus and guidance of digital intelligence evaluation, helps teachers and students to complete the teaching goals, and improves the teaching effect.

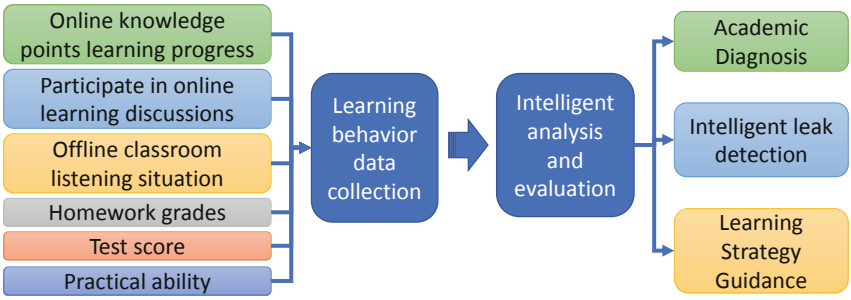

Fig. 5. Digital intelligence evaluation model

3.6 Functional Design and Application of Smart Certification

The smart authentication module is mainly implemented by blockchain technology. The blockchain is composed of multiple mutually distrusting blocks, which are decentralized, open, and transparent and cannot be tampered with. The non-tamperable feature of the blockchain can realize digital certificates, that is, the anti-counterfeiting function. At present, vocational education certificates are generally stored in paper form, and academic education information can be filed and inquired on Xuexin. However, other skills qualification certificates, such as 1+X vocational qualification certificates, may not have query services on related websites. If the blockchain is used to store academic education and training authorization certificates, including the digital signatures on the certificates, then the relevant certificate information can be permanently and safely stored on the blockchain. This case can effectively reduce the loss and damage of the certificates and can also quickly complete the verification of the certificate. Hence, the use of blockchain to save certificates not only solves the efficiency problem of learning achievement verification but also forms traceable records of students' lifelong learning achievements, which can greatly reduce academic fraud, academic qualifications, and inquiries in society. Furthermore, this blockchain can retrace the time-consuming and laborious issues and promote the integration of documentary certificates under the 1 + X certificate system.

We take the 1 + X vocational qualification certificate application for a digital certificate as an example. Figure 6 depicts that, after a student participates in

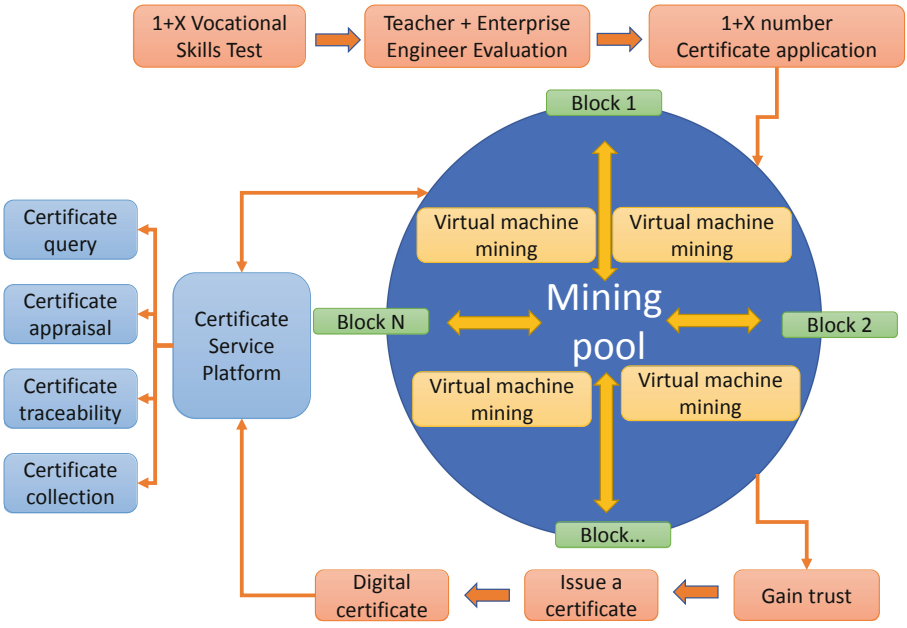

Fig. 6. Blockchain releases the model of 1 + X professional qualification certificate

the 1+X vocational skills test, teachers and enterprise engineers will evaluate the student's skill level. They will generate relevant digital certificates and digital signatures for qualified students and upload the application information to the blockchain. The mining pool and each block in the blockchain can be realized by virtual machine mining, which reduces the input of physical machines and thus reduces equipment costs. The block records information about the entire life cycle of the certificate, such as sample acceptance, testing, verification, approval, modification, and invalidation. Thus, users can query the e-certificate production process. After the key information and digital signature of the digital certificate are trusted through blockchain technology, the digital certificate is issued to the customer. The certificate service platform provides functions, such as certificate inquiry, certificate identification, certificate traceability, and certificate receiving.

4 Conclusion

Through in-depth research on the Internet of Things technology related to space environment management, big data analysis and processing technology, AI detection technology based on deep learning, cloud computing, blockchain, and other technologies, this study proposes intelligent teaching of vocational education based on a new generation of information technology system. The system strengthens the integration of offline and online teaching, with teacher–student interactive teaching as the core, service teaching as the orientation, and integration of the teaching process before, during, and after class. This system can collect teaching data in various aspects and provide multi-dimensional evaluations to realize the ubiquity of classroom learning and extracurricular learning. The system can also form a student-centered teaching environment, improve the intelligence of the intelligent classroom environment control, and realize multi-management and multi-type user terminal equipment access. The introduction of the smart cloud platform has strengthened the integration of industry and education and school–enterprise cooperation and promoted the integration of documents and certificates under the 1 + X certificate system. Therefore, the teaching system fully covers the "teaching, learning, evaluation, management, and certification" links of the teaching process. The smooth implementation of this teaching system provides a reference for the theoretical research and practical application of vocational education intelligent teaching, thereby promoting the reform of the vocational education intelligent teaching system.

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