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An Intelligent Management Method for Distance Education Based on the Internet of Things

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Abstract:

People's existing educational content and methods are facing great challenges. The increasingly mature technology makes people's information resources highly shared, fundamentally changing the previous mode of information exchange, and providing very favorable conditions for education. The network is more and more popular because of its rich information resources, friendly interactive performance, and excellent openness. It has become a development trend in education to carry out distance teaching on the Internet. This has been better applied in the network education system, enabling teachers and students to achieve real-time online collaboration and interaction, enabling real digital management of video and audio resources, enhancing learners' initiative and controllability of video and audio resources, and better meeting learners' learning needs. The main purpose of this subject is to research and design a network teaching interactive system based on the Internet of things, which can directly exchange and share the resources and services on the computer, realize the efficient use of the existing limited resources, and solve the system bottleneck problem. At the same time, streaming media technology is applied in the network to realize the live broadcast of network courseware, so that students can listen to lessons synchronously through the network, and break through the problem of low efficiency of synchronous learning in distance education. The validity of this model is verified by experiments.

Keywords: Internet of things; Distance intelligent education; Information technology

1. Introduction

In the last century, because most ordinary users connected to the Internet were limited by computer performance, resources, and other factors, they were unable to provide network services. As a result, a client-server architecture centered on a few servers has been gradually formed, which leads to the centralization of the flow of resources. A large number of public resources are provided on the Internet in the form of servers, and network applications also provide services in a centralized manner. It can enable users to connect to the Internet at a very low cost, thus promoting the popularization and application of the Internet [1]. However, there are many technical drawbacks to the service mode of architecture. One of the most important problems is that resources cannot be fully utilized. With the development of the hardware level, the performance and function of today's personal computer have gone far beyond the original definition of a computer. Many computers have large storage capacity and high-speed computing power. Although the network bandwidth has doubled in recent years, the popular sites are still overwhelmed, and the idle link bandwidth has been wasted. The distributed structure provided by the computer can effectively balance the load and make full use of the bandwidth [2]. On the other hand, the computing power of computers is growing rapidly according to Moore's law, but the increased computing power has not been fully exploited. The computer makes it possible to

fully exploit the idle computing power of computers. computer technology is based on this goal. Both control flow and data flow interact between peers without the role of the server [3]. With the increasing amount of information contained in these media forms, the amount of storage required is also increasing. Computers in the content sharing system can directly exchange and share their own resources, including stored files, data, and storage space [4]. The general steps of IoT work are shown in Figure 1.

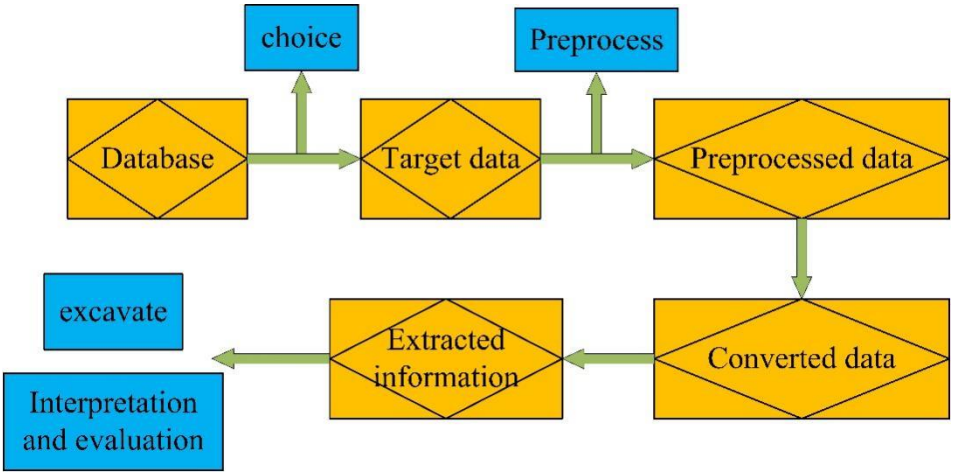

Figure 1 The general steps of IoT work are shown

The Internet of things has attracted wide attention in recent years. Human beings will gain a communication connection between people at any time. This paper discusses the application of the Internet of things in distance open education [5]. The Internet of things (IoT) emphasizes the interconnection of objects and is regarded as a network formed by connecting various objects in the real world through various information sensing devices. The Internet of things will solve the networking problem of information exchange needs in a wide area or a large range. The Internet of things uses various technologies to connect various intelligent objects and sensors in the physical world to the network [6]. Nowadays, the main economic form of human society is the knowledge economy. In the era of the knowledge economy, lifelong education and building a learning society have become a consensus. Open and distance education is considered an educational form that applies information and communication technology to realize lifelong education, accelerate the development of human resources and promote the development of the knowledge economy [7]. The third is the stage of online distance education through the combination of computer, multimedia, and remote communication technology. The development of each form of distance education is closely related to the development and application of information and communication technology at that time. At present, the main problems of these three forms are as follows: the class hours of correspondence and face-to-face teaching are short and the contradiction between work and study is prominent. The network teaching part solves the problem of teacher-student interaction, but the virtual learning environment it provides is mainly human-computer interaction [8].

The theory of distance education has developed accordingly. With the rapid development of the Internet, network education based on cognitive learning and constructivist learning theory has been popularized [9]. Ubiquitous learning means that any

learner can obtain any information he needs at any place and at any time. The theoretical basis of ubiquitous learning is situational cognitive learning theory. Situational cognitive learning theory holds that the essence of learning is the process of cooperation and interaction between individuals, others, and the environment. Knowledge and concepts can only be fully understood through socialized application [10]. The fundamental mechanism for learning is the interaction between individual participation in practical activities and the environment. Learners are affected differently by specific situations. The main purpose is to research and design a network teaching interactive system, which can directly exchange and share the resources and services on the computer, realize the efficient use of the existing limited resources, and solve the system bottleneck problem.

2. Related work

2.1. Application of the Internet of things in Distance Open Education

The implementation of Open Distance Teaching Based on the Internet of things can be divided into two modes: one is that the school directly faces learners and can use the business platform provided by mobile communication operators. The school is only responsible for building relevant teaching content based on the Internet of things platform. Learners can learn at any time using intelligent mobile communication terminals. The intelligent mobile communication terminal of the Internet of things can provide more intelligent and comprehensive communication services. As long as it is connected to the network, it can realize intelligent effective communication between people, things and things, and people and things [11]. Therefore, the Internet of things can better support the realization of ubiquitous learning and mobile learning, and thoroughly solve the work-study contradiction of traditional distance open education. The second is to organize teaching through the network teaching point. At this time, the status of the network teaching point is equivalent to the correspondence Station and the network university teaching point in traditional distance education [12]. For complex teaching contents that cannot be solved by an intelligent mobile communication terminal, such as entity remote experiment and research-based learning, it can be carried out in this way. Interactive feedback is an important link in the teaching process, which helps teachers timely understand learners' learning and adjust the teaching process accordingly. The poor interaction between teachers and students in the teaching process is just one of the main problems in traditional distance education. Distance teaching based on the Internet of things can use the intelligent terminal in the hands of learners to carry out real-time teaching evaluation, such as statistics of learners' listening, answering questions, evaluation voting, etc [13]. Analyze the real-time evaluation results on the teacher’s side and adjust the teaching progress and content. With the development of technology, the sensors of intelligent terminals of the Internet of things can also be used to monitor a variety of physical signs of learners in real-time. According to this feedback information, teachers can timely adjust teaching, truly realize personalized teaching and learning, and effectively help teachers modify teaching plans, adjust teaching activities, and promote communication and interaction among learners. The distance open education based on the Internet of things is shown in Figure 2.

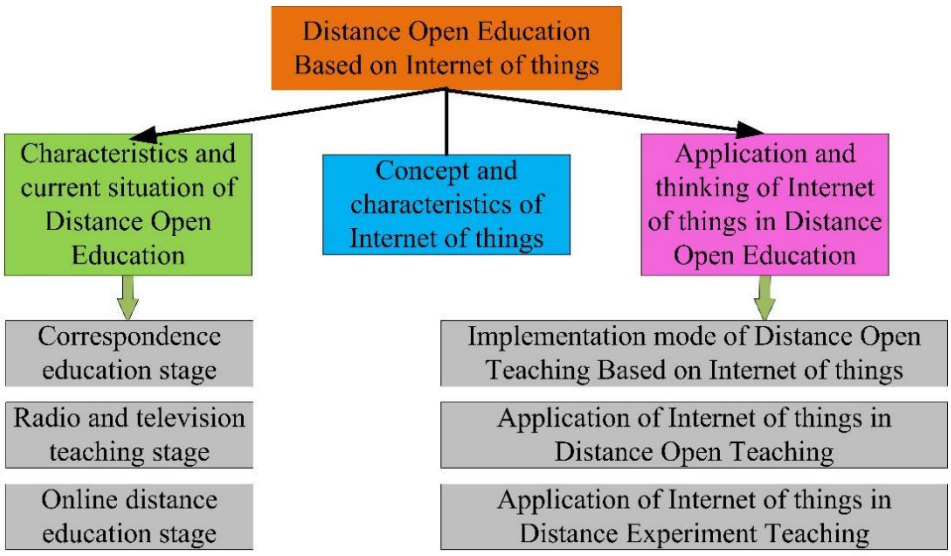

Figure 2 The distance open education based on the Internet of things

For students majoring in science and engineering, experimental teaching is an extremely important link. Many science and engineering courses are boring. Without corresponding experiments, it is difficult to stimulate students' interest in learning. Moreover, some courses of science and engineering are difficult to understand, and some theoretical knowledge can only be understood through certain experiments. It can be said that experimental teaching plays an irreplaceable role in improving students' practical ability and developing students' creativity [14]. However, in the field of traditional distance open education, the problem of distance experiment teaching can not be effectively solved. For some experiments that need to be completed with large-scale precision and valuable instruments and equipment or large-scale experiments with security problems, it is impossible to provide students receiving distance open education with the conditions to do experiments by themselves [15]. At present, although many colleges and universities have built open laboratories, there are widespread problems with decentralized management, closed use, and the inability to provide remote experiment services [16]. The experimental process and results are too stylized and idealized to truly and effectively reflect the various situations and problems that may occur in the experimental process. Therefore, the effect of experimental teaching is greatly reduced. At present, most distance experimental teaching methods are not very ideal in teaching effect, and it is difficult to achieve a breakthrough in effectiveness [17]. The reason is that in addition to the shortcomings of lack of intuitiveness, authenticity, and interactivity in the teaching process, the main problem of distance experiment teaching is that students do not have the feeling of hands-on operation and real experimental experience, and lack of practical experimental experience.

2.2. Development of Distance Education

Distance education is a new form of education compared with traditional education. Distance education refers to a teaching mode in which specific educational organizations make comprehensive use of various educational resources, purposefully and systematically transfer courses and knowledge to one or more students outside the classroom, realize the separation of teachers and students in time and space, and promote and help students' distance learning.

Distance education belongs to education [18]. Therefore, distance education has educational commonness. However, distance education has changed from the initial public product provided by the government to the private product invested by educational institutions. In the process of such a change, the industrial nature of education gradually shows up. At the same time, the most essential feature of distance education is the relative separation of teachers and students in space [19]. In order to overcome the space constraints and realize the reintegration of teaching and learning, distance education needs to support two important processes through curriculum development and learning, and usually needs the help of various technologies.

After more than 30 years of development, distance higher education has become one of the important educational achievements since the reform and opening up. The characteristics of running a school and management of distance higher education determine that it plays an experimental role and exemplary role in the process of China's education industrialization. It is the most innovative form of education in China's current education system [20]. Distance higher education has huge market demand. With the improvement of the requirements of the employing units for the quality of employees and the improvement of employees' enthusiasm for autonomous learning, there is a huge market demand for academic education and non-academic education. The enterprise operation of distance higher education institutions. In the environment of market competition, the original colleges and universities that carried out distance education and some colleges and universities specialized in distance education gradually began to try the near enterprise operation [21]. In recent years, more and more distance higher education institutions specialized in distance education have completely adopted the enterprise and market operation. Distance higher education institutions have conducted a detailed market survey before running schools and selected the appropriate school running mode on the basis of fully understanding the market demand. In terms of the management of internal employees, the management mechanism of fair competition and post-competition is implemented, and the salary and bonus are linked to the benefits of getting more for more work [22]. The enterprise operation of distance higher education institutions is an inevitable choice for distance education.

Distance higher education implements the system of self-funded education. Distance higher education mainly includes various forms of development, but they all belong to the category of higher education and are non-compulsory education. It has become the consensus of the whole society that students should bear the tuition fees themselves and learners should bear all or most of the education costs [23]. It is also the main direction of China's noncompulsory education reform. The essence of the self-funded education system in which learners bear all or most of the education costs is not only the requirement of education industrialization but also the result of education industrialization. Internet of things distance higher education has a huge market network [24]. With the involvement of radio and television networks, computer networks, and modern communication networks in the field of distance education, and the application of Internet of things technology in distance higher education, China's distance higher education system has been gradually established as a social open education system, with more obvious connectivity and intelligence characteristics, and a more sound network system [25].

2.3. Current situation of distance education platform

Distance education platform, also known as distance education teaching support platform, can be divided into broad sense and narrow sense. The broad sense of distance education platform includes both hardware facilities supporting distance education and software systems supporting network teaching. In other words, the broad sense of distance education platform has two parts: hardware teaching platform and software teaching platform [26]. In a narrow sense, a distance education platform refers to a software system that is built on the basis of a network and through modern information technology and modern education theory to provide comprehensive support services for distance network teaching. This article refers to the distance education platform in a narrow sense [27]. Transmit teaching content, implement teaching and manage teaching on the Internet, and conduct online testing and online communication. It can overcome the limitations of traditional distance education, form an active, collaborative and open learning mode, fully consider the two-way teaching environment, and adopt the teaching methods of questioning, feedback, and communication [28]. It not only retains the advantages of traditional distance education, such as vividness and freedom from space restrictions but also has the advantages of mutual access, two-way communication, learning resource sharing, extensive learning content, and so on [29].

However, these distance education platforms do not pay enough attention to the teaching feedback information. There is a lack of contact between subsystems. It is difficult for teachers to carry out personalized teaching and evaluate and improve their teaching according to the feedback information of students. In general, there are the following problems [30]. The supporting platform of online teaching generally focuses on online course development systems and online teaching management systems and does not pay enough attention to the teaching feedback information. The development of a teaching feedback module is not enough. The processing of teaching feedback information is not deep enough, only the statistical analysis of information, but not the deep processing of information with data mining and other technologies. The role of feedback information is limited [31]. Because the online teaching platform does not have the ability and mechanism to automatically analyze and process feedback information, teachers feel unable to use it, and the role is limited.

3. Related theory and technology research

Distance education has changed the traditional teaching mode with teachers as the main body. It emphasizes students' autonomous learning, takes completing one or more specific tasks as the learning goal, and cultivates the ability to solve practical problems. Although the teaching scene of distance education is very different from that of traditional teaching, the normal factors of teaching teachers, students, teaching content, and teaching resources have not changed qualitatively. Therefore, teaching feedback in distance education environments and traditional classroom teaching feedback have not changed in essence. The model view controller is a software design pattern that appeared in the 1980s. It is the first design pattern that separates presentation logic from business logic. Its structure is shown in Figure 3.

Figure 3 Structure diagram of the model view controller

They are still based on sampling the output of learners' information to obtain feedback information to regulate the whole teaching process. Compared with traditional teaching, teaching feedback in a distance education environment is much more complicated. First, the collection and processing of teaching feedback information are more complex. Due to the loose teaching organization of distance education, the separation of teaching and management, the difficulty of identifying and judging feedback information increases, and the transmission of feedback information are disturbed by uncertain factors. Second, the space-time separation of distance education increases the difficulty of teaching feedback. Due to the separation of time and space between teachers and students, distance education cannot be face-to-face education, and the information interaction between teachers and students all depends on modern communication media. model view controller requires application layering. Although it takes extra work, it makes the structure of the system clear, and the application of the system can be better reflected through the model. The advantages of the model view controller design pattern can be clearly seen through the model view controller component type relations and function diagrams: model and view are separated so that multiple views can use the same model, components can be highly reused, and the software is easier to maintain and expand. The model view controller development mode separates the flow control and data representation in the mode, which makes the programmer's division of labor clear and the program design process easier to control. Separating the control layer from the model layer provides users with the possibility of implementing a high availability model.

Its function is to make a mapping between relational databases and objects. In this way, we don't need to deal with complex SQL statements when we operate the database. We just operate it as usual. After successfully receiving the returned data from the server, the browser page content is dynamically modified by calling the corresponding callback processing function to complete the entire asynchronous interaction process. This asynchronous interaction process is independent of the traditional interaction between the browser and the server, avoiding page refresh, thus solving the shortcomings of processing waiting in the process of network interaction. At the same time, it can transfer some of the work previously undertaken by the server to the browser, balance the load between the browser and the server, and thus reduce the burden of the server and the transmission pressure of the network. The relationship and functions of the model view controller components are shown in Figure 4.

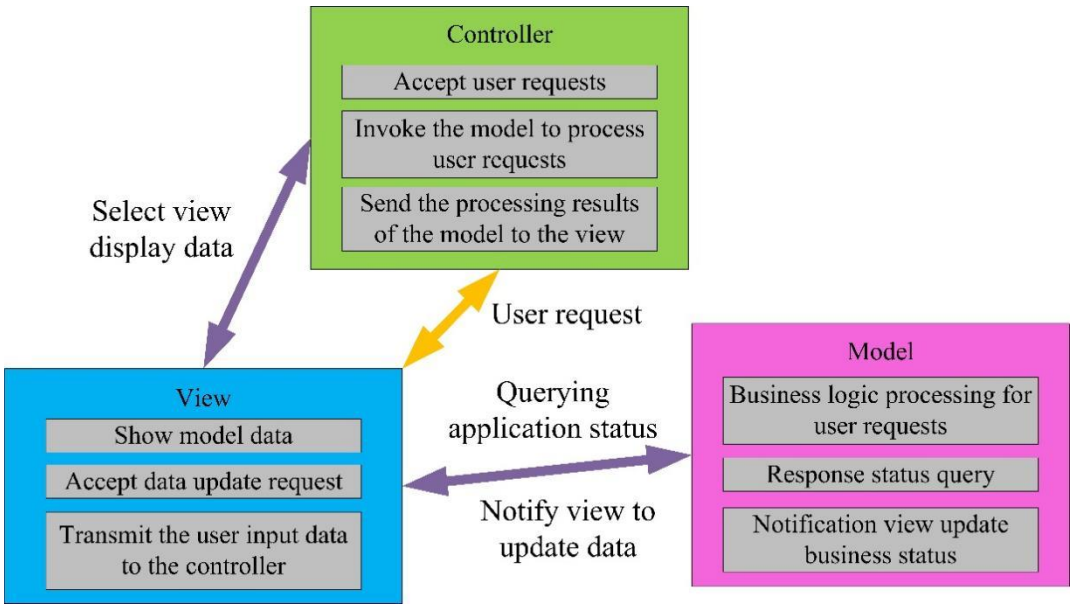

Figure 4 The relationship and functions of the model view controller components

Object persistence is to save the information encapsulated in objects on physical media such as hard disks, tape, etc. This information can exist for a long time in the case of program interruption or even power failure and can be restored to objects with the same information and similar structure in an appropriate way. As the relational database has become the industry standard data storage device, in most project development, the implementation process of object persistence is mostly completed through various relational databases. Therefore, object persistence mostly saves data synchronously to the relational database. In our system architecture, there should be a relatively independent logic level, focusing on the implementation of data persistence logic. Compared with other parts of the system, this level should have a clear and strict logical boundary. The purpose of the persistence layer is to separate the database storage from the service layer through the framework of the persistence layer.

4. Design of application model

In long-distance teaching, the network teaching platform, that is, the construction of the web-based long-distance teaching system plays a key role. Many educators at home and abroad have done a lot of research on how to build the online teaching platform. Students log in to the distance learning website, pass the identity authentication, enter the online learning environment, and choose the courses to learn to start learning. The available online learning contents include text course learning, video course learning, online examination, discussion, online homework, and test. Students ask questions and put forward their own views through posting, get answers through reading posts and understand the learning status of other students. This paper designs and implements a web-based distance education platform model, as shown in Figure 5.

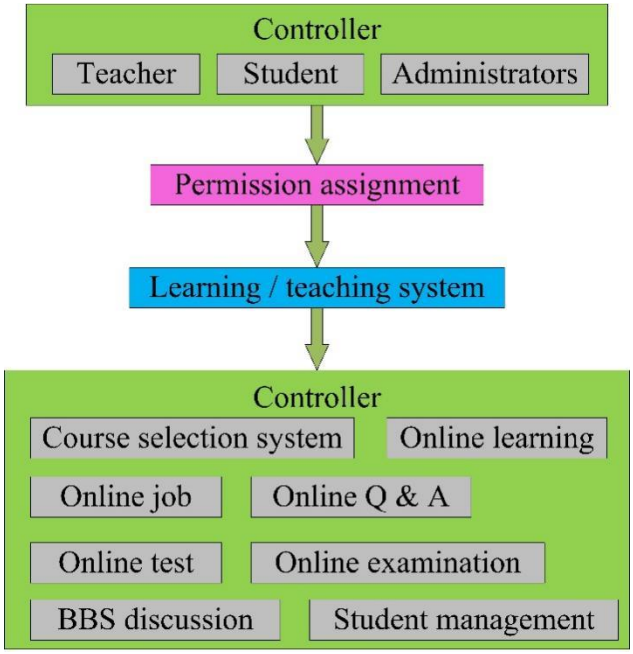

Figure 5 Model of distance education platform based on Web

Online testing provides students with the opportunity to conduct self-test. Students can know their mastery of knowledge through online testing. The collection of teaching feedback information refers to the process of tracking and recording students' online learning in real-time, quantifying the learning process, and storing the quantified data in the database for subsequent module processing. Due to the particularity of E-learning behavior, it is difficult to collect teaching feedback information. The collection of teaching feedback information in distance education should make full use of the advantages of information technology and network resources, comprehensively collect all kinds of teaching feedback information, and input all kinds of feedback information into the teaching feedback information database according to the standard requirements of the database entry. The collection of learning behavior and effective feedback information is shown in Figure 6.

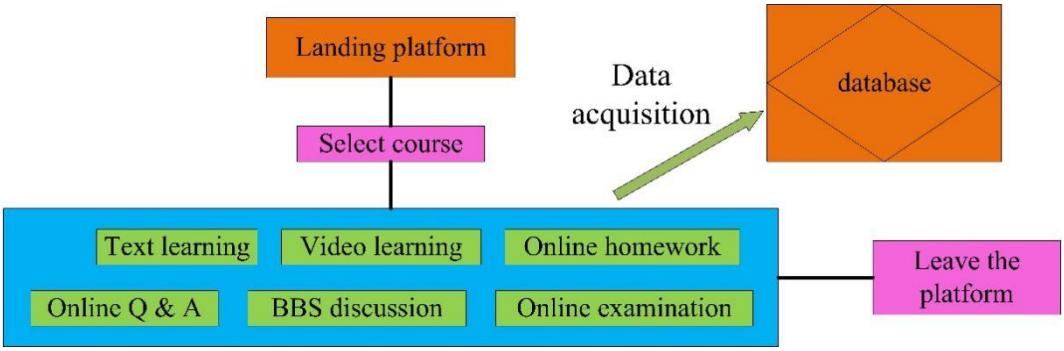

Figure 6 The collection of learning behavior and effective feedback information

The learning system records students' learning, the tutoring, and Q & A system records students' questions and teachers' answers, and the online discussion system records students' discussions and replies. The homework system will record the student's completion of homework, and the online

test system and examination system will record the students' online tests and examinations in detail. This learning behavior information is recorded in the basic unit of the curriculum. Teaching evaluation information mainly includes students' evaluation of teaching content and resources, teachers' guidance and Q & A, and the evaluation of the whole network learning platform. This chapter describes the specific implementation of the system in detail. Firstly, the system development environment and some tools used are introduced, and then the specific implementation processes of the persistence layer, business logic layer, control layer, and view layer are given. In the implementation process of each layer, a specific example is applied to explain each layer, making the whole development process clear. The collection mechanism of teaching feedback information in distance education mainly refers to the methods and means of information collection. When a user accesses the distance education platform, some user learning behavior information will be recorded on the site server and the user's personal host. The server records the information of a large number of users accessing the site, which is recorded in the log, while the client (the user's host) records the information of a single user accessing the site. Accordingly, the collection of teaching feedback information can be carried out on the server-side and the client-side.

5. Experiments and results

To deal with the feedback information, the first thing is to statistically analyze the data, form an intuitive statistical chart, and express the quantitative relationship in an intuitive and visual form, so as to display the overall picture of things and their distribution characteristics for reference in teaching decision-making. Reflecting on students' learning behavior data in the form of charts can not only make them intuitively and in detail understand the progress of their learning courses, but also facilitate their self-monitoring. When the total time of students' online learning does not meet the online learning requirements, the system will warn or assign tasks to them according to their learning time and in combination with the pre-determined strategies in the system. Evaluation and analysis of the teaching effect of a reaction layer are shown in Table 1.

Table 1 Evaluation and analysis of teaching effect of a reaction layer

variable	Weight	Mean value	Significance	Rate of change
Teaching organization	8.20%	3.62	0.965	0.11%
Teaching supervision	8.14%	3.63	0.531	0.83%
Teacher satisfaction	7.85%	3.83	0.101	4.18%
Training Methods	7.99%	3.83	0.103	3.39%
Teaching attitude	7.90%	3.89	0.214	4.88%

Learning resources mainly include text courseware, video lectures, learning materials, etc. The teacher resource evaluation chart is used to show the evaluation results of learning resources in each

chapter of the course. Teachers can obtain the overall evaluation of learning sources. In this way, teachers can know the deficiencies and shortcomings in teaching. For courseware or video teaching with very poor evaluation, teachers can carry out compensatory teaching in combination with the specific opinions or suggestions of students' evaluation. The effect of online teaching is shown in Figure 7.

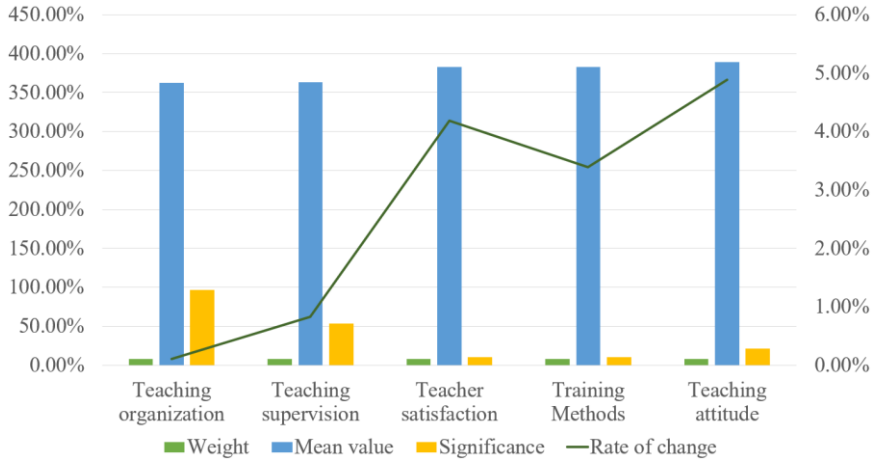

Figure 7 The effect of online teaching

The student's homework completion chart can be used to count the completion of each chapter of a single student's homework, as well as the completion of all students' homework. By analyzing the completion of all students' homework, teachers can intuitively find out which knowledge and information output in class are really understood by students, which have not been mastered or are not firmly mastered, and whether the problem is an individual phenomenon or a common phenomenon. For the chapters with poor homework completion, teachers can analyze and find the omissions in students' cognitive structure, and remedy and improve them. Students can also analyze whether their cognitive structure is correct through the completion of homework and teachers' comments, and modify and improve their cognitive structure according to teachers' feedback. According to the evaluation system indicators formulated by the Ministry of education, distance education students' online learning should reach an average of more than 2 hours per person per week. Table 2 shows the evaluation and analysis table of learning level teaching effect.

Table 2 Evaluation and analysis table of learning level teaching effect.

variable	Weight	Mean value	Significance	Rate of change
Knowledge acquisition	6.87%	3.41	0.105	5.57%
Knowledge mastery	6.79%	3.40	0.031	4.71%
Professional knowledge	6.88%	3.41	0.278	4.69%
Autonomous Learning	5.64%	3.40	0.319	3.53%
Cooperative learning	7.72%	3.38	0.145	4.14%

The learning level evaluates the learning effect of students, that is, whether students have improved their knowledge, skills, attitudes, etc. at the end of learning. This link is a crucial link in the teaching evaluation of the online teaching mode, which can effectively reflect the implementation and effect of this teaching mode. The teaching effect of the learning layer is shown in Figure 8.

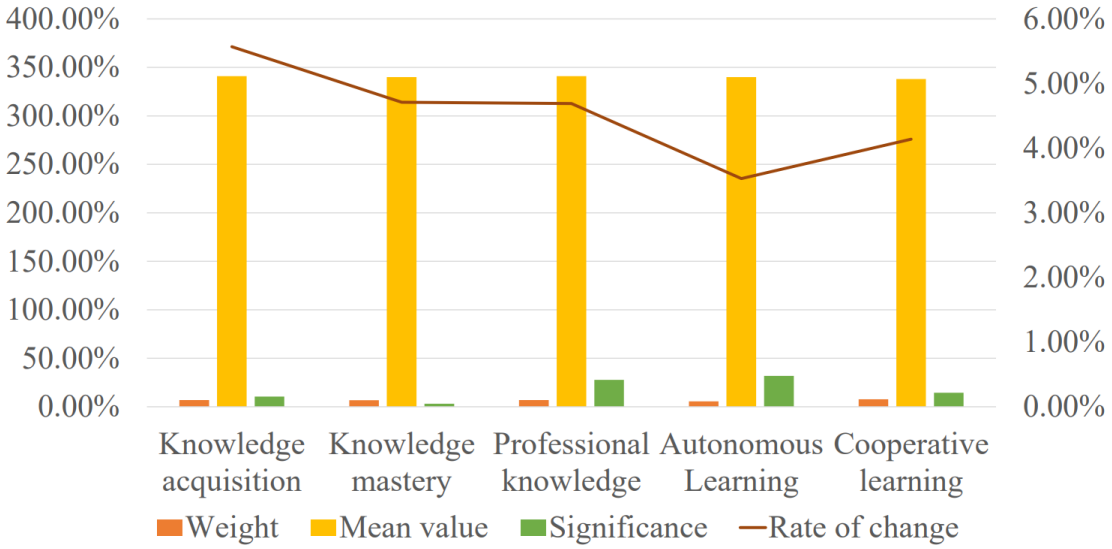

Figure 8 The teaching effect of the learning layer

In the effect evaluation of the result layer, the comparison of the experimental group was evaluated by setting up a control combination. Under the conditions of the same course, the same teacher, the same major, the same grade, the same homework, and test content, the traditional teaching class is taken as the control group, and the online teaching class is taken as the experimental group. By comparing the homework and test scores of the students in the control group and the experimental group, it is taken as the basis for the effective evaluation of the resulting level.

6. Conclusion

The quality control of distance education is the key to the sustainable development of distance education. With the progress of technology and the continuous improvement of evaluation methods, good conditions have been created for the quality control of distance education. It is an important way for the quality control of distance education to establish an evaluation index system through the data collection of effective monitoring points to realize the evaluation and analysis, and then regulate and control the deviations. The main purpose of this subject is to research and design a network teaching interactive system based on the Internet of things, which can directly exchange and share the resources and services on the computer, realize the efficient use of the existing limited resources, and solve the system bottleneck problem.

Each module of the distance education quality control model proposed in this study contains many specific implementation steps. The paper only analyzes the control points and key algorithms, which are limited to the relationship between space and time. This study does not conduct in-depth research on the monitoring methods and evaluation algorithms of each link but only puts forward a framework. Although the evaluation process has been objectively quantified, it can only give a fuzzy evaluation result,

and can not accurately point out the inadequacies of the evaluation. Therefore, with the deepening of the pilot work of distance education, the evaluation methods of distance education quality control need to be further discussed. Distance education quality assessment is a very practical work, which develops to the needs of the practice. Therefore, in the practice of evaluation, we should constantly strengthen and improve the evaluation methods and theories, strengthen the dynamic control of distance education, and improve the quality of evaluation.

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