Construction of Online Distance Three Dimensional Teaching Platform for Industrial Design Major in Colleges and Universities

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Abstract. Aiming at the problems that the traditional classroom teaching method cannot update the database in real time, resulting in incomplete data transmission and low efficiency of tutoring, a remote online 3D teaching platform for industrial design major in colleges and universities is designed. According to the framework of online distance stereoscopic teaching platform, the infrastructure layer, database layer and application service layer are designed. The information is stored in the SQLite lightweight database of memory to provide students with the required course information of industrial design. From the exhibition three-dimensional teaching mode, competition three-dimensional teaching mode, training three-dimensional teaching mode and project driven three-dimensional teaching mode four methods, design online distance three-dimensional teaching platform mode. The experimental results show that all the black box test contents of the system are passed, and the highest counseling efficiency is 99%, which has a good counseling effect.

Keywords: Industrial design major in colleges and universities · Online distance · Three-dimensional teaching · Platform construction

1 Introduction

Distance education is a kind of education mode where the training courses are transmitted to distance (outside the campus) through audio, video (live or video) and computer technology including real-time and non real-time [1]. Its emergence has changed the traditional education space, time, work and family relations, economic constraints, which are the requirement of the development of the times, but also the social demand for a variety of forms of education [2]. It is a new component of the existing higher education system and a supplement [3]. Industrial design is a comprehensive design of the function, material, structure, shape, color, surface treatment, decoration and other elements of mass-produced industrial products from the perspectives of society, economy, technology and art, so as to create new products that can meet people's growing material needs [4].

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At present, domestic colleges and universities attach great importance to the practical teaching of industrial design. The core of industrial design is product design. If it is separated from enterprises, design will become the water without a source. It is an indisputable fact that industrial design can develop only when it is combined with enterprises. Therefore, colleges and universities now choose to cooperate with enterprises to complete the practical teaching of students. There are professional practice teaching links in the training programs of various colleges and universities. Due to the accommodation of enterprises and the internship funds of schools, students generally choose to visit the enterprises for internship, or directly contact the internship site nearby by themselves, so as to guide students to understand the actual design process and practical teaching knowledge. This can play a certain role, but due to the short time and other reasons, students can not better integrate into the practical teaching link, and the pertinence is poor. In the traditional classroom and satellite TV teaching process, students' learning time and place are limited, and the course content presents a linear display mode, which can not be updated in real time. In the traditional classroom, when the server sends and returns files to the client, the data is centralized, but the file is large, which is easy to cause network congestion and data loss. However, the use of satellite TV teaching method is affected by the quality of the floppy disk, which is prone to the loss of course data.

For this reason, this paper puts forward the construction of online distance three-dimensional teaching platform for industrial design major in colleges and universities. Aiming at the problem that the traditional classroom teaching method can not update the database in real time, the infrastructure layer, database layer and application service layer are designed. The information is stored in SQLite lightweight memory database, which provides students with the required course information of industrial design. Starting from the four methods of display three-dimensional teaching mode, competition three-dimensional teaching mode, training three-dimensional teaching mode and project driven three-dimensional teaching mode, the online remote three-dimensional teaching platform mode is designed to optimize the teaching efficiency. Experimental results show that the proposed method has good application performance.

2 Industrial Design Major Framework Design of Online Distance Stereoscopic Teaching Platform

To establish an online distance three-dimensional teaching platform for industrial design major in colleges and universities, the construction of the platform needs to integrate and apply information technology in combination with new information technologies such as big data, cloud computing and mobile Internet, so as to meet the needs of all parties as much as possible [5]. Information collection is very important for the construction of the platform. By strictly controlling the collection mode, we can realize the strict control of the course teaching mode. On the basis of hierarchical structure design, the platform has certain expansibility and adaptability at all levels [3]. Figure 1 shows the framework of online distance stereoscopic teaching platform.

As can be seen from Fig. 1, the online distance stereoscopic teaching platform can be divided into three levels: Infrastructure layer, database layer and application service layer. The three do their best and each do their best to provide students with the necessary information on industrial design courses.

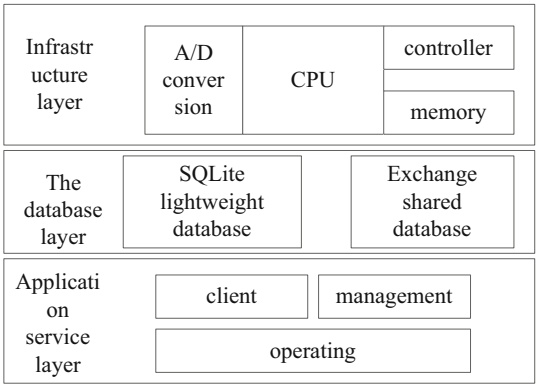

Fig. 1. Framework of online distance stereoscopic teaching platform

2.1 Infrastructure Layer

The digital sensor used in the infrastructure layer is to add or modify the A/D conversion module of traditional analog sensor to make its output signal digital (or digital coding). It mainly includes function realization, A/D conversion controller, single chip microcomputer (CPU), memory, communication interface, temperature detection circuit, etc.

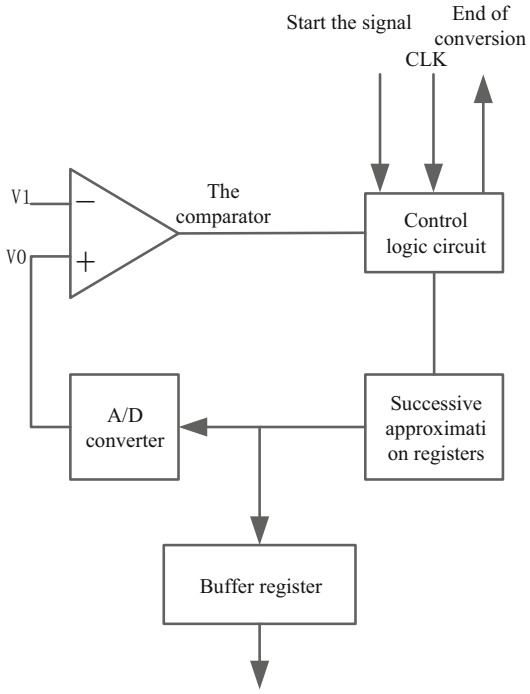

Fig. 2. A/D conversion structure

[6]. Through software design, comprehensive compensation is performed on the sensor's linearity, zero point, temperature drift, creep and other performance parameters, eliminating the influence of human factors and improving the accuracy and reliability of compensation [7]. The output compatibility error is more than 0.02%, the characteristic parameters are identical, and the interchangeability is good. The A/D converter with successive approximation method is composed of a comparator, D/A converter, buffer register and control logic circuit, as shown in Fig. 2.

Adopting A/D conversion is to convert analog signal into digital signal, and convert analog quantity into digital quantity through certain circuit. From the high position to the low position, the trial comparison is like using a balance to weigh the object, and the weight is gradually increased or decreased from heavier to lighter. [8]. The conversion process of successive approximation method is as follows: During initialization, all bits of successive approximation register are cleared; At the beginning of the conversion, the highest position 1 of the successive approximation register is sent to the D/A converter, and the analog quantity generated after the D/A conversion is sent to the comparator, which is called vo. Compared with the analog quantity VI to be converted, the optimal one is selected to complete the A/D conversion [9].

2.2 Database Layer

The collection of a large amount of industrial design professional course information needs to be classified reasonably and in accordance with the prescribed data format and technical specifications. The database layer can transmit, store, and divide the basic structure of data information processing and sharing into three levels, and examine the database from three different perspectives.

Using SQLite lightweight database, its internal structure is shown in Fig. 3.

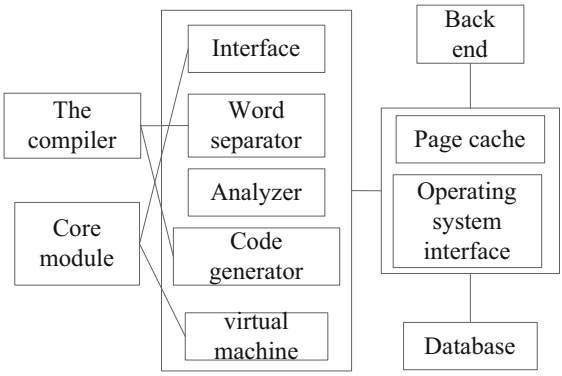

Fig. 3. Internal structure of SQLite database

As can be seen from Fig. 3, SQLite lightweight database adopts modular design, which is composed of eight independent modules. Each module divides the complex query process into several small tasks. This interface is composed of SQLite capi, which

is used to interact with SQLite. Whether it is a program, script language or library file, it needs to compile the program to process the relevant code. The word segmentation program and the word segmenter cooperate to process structured query sentences in text form, analyze their grammatical validity, and convert them into hierarchical data structures that are easier to process at the underlying virtual machine. Virtual machine, also known as virtual database engine, is mainly used to interpret and execute byte code. SQLite is used to realize the version management of database in the system. In addition to software, users can create database table structure for application, add some initial records, and update the data table structure. The system also provides SQLiteDatabase class, which encapsulates some API interfaces to manipulate the database. This class can be used to add, query, update and delete data.

The database using internal model as framework is called physical database; the data using conceptual model is called conceptual database, and the database using external model is called user database.

(1) Physical data layer
The innermost layer of the database is the data collection actually stored on the physical storage device. The data is the original data and objects processed by the user, including bit strings, fields and fields, which are used to process the commands described in the internal mode.
(2) Conceptual data layer
Conceptual data layer is the central layer of database, which is mainly represented by logical attributes. Each data type has a logical relationship, that is, a group of data record relationships. In different data levels, all the logical relationships are not physical states. For database managers, it is a platform to store all the data.

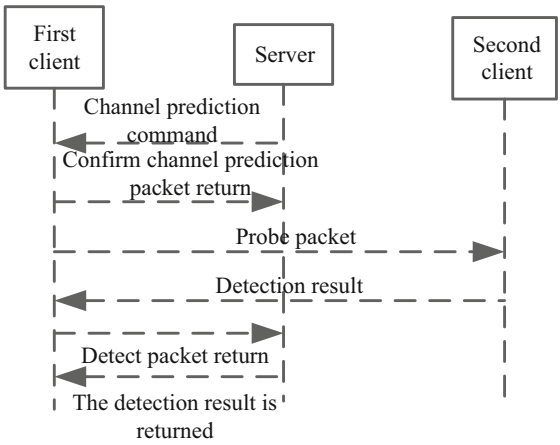

Fig. 4. Client design

2.3 Application Service Layer

The user data layer is the data layer for the convenience of users to view, which represents different data sets. With the help of the logical relationship of the concept data layer, the data mapping is transformed into different databases for hierarchical connection. The client design of this level is shown in Fig. 4.

The client module can accurately reflect the students' learning ability and skill level, and provide the basis for the online remote three-dimensional automatic tutoring of the system. The module is composed of collaborative teaching agent and other agents. Each teaching subject has the necessary knowledge to solve the problem independently. As an independent individual, artificial intelligence is mainly responsible for displaying specific teaching materials, solving problems and guiding students' views. It combines the knowledge of curriculum structure, answers students' questions and supervises students' learning behavior. It is a specific measure to realize students' personalized interactive learning. In the teaching process, teachers can collect students' feedback information through the network to improve the teaching strategy library, and use their own reasoning mechanism to solve the problems encountered in the teaching process. The interaction between teachers and students can supplement students' knowledge at any time in the classroom. The personalized data collection method is adopted to add the interactive information of teachers and students to the basic content of the basic courseware displayed by teachers, which can be stored in the database after being supplemented by students themselves.

3 Mode Design of Online Distance Stereoscopic Teaching Platform

In daily teaching, design practice teaching is an important way to cultivate the practical design ability of industrial design students. Whether the design practice teaching mode and scheme design are reasonable or not is the key to whether the design practice teaching can achieve the expected teaching objectives. In order to achieve the expected effect of practical teaching of industrial design major, and ultimately meet the requirements of the outline of the design personnel training requirements, and meet the needs of enterprises and society, the online remote three-dimensional teaching mode of industrial design major in colleges and universities is proposed. The three-dimensional practice teaching mode in the research mainly includes the design practice mode based on exhibition, the design practice mode based on design competition, the design practice mode based on internal and external training base, and the design studio practice mode based on project driving, as shown in Fig. 5.

3.1 Three-Dimensional Teaching Model of Exhibition

The basic goal of the design practice teaching ability of the exhibition is to cultivate the user research ability of industrial design students. The basic process of this mode is described as follows: First, according to the requirements of the course, the teacher assigned the students specific design practice theme; Second, after understanding and understanding the theme tasks of design practice, students will find out the theme and

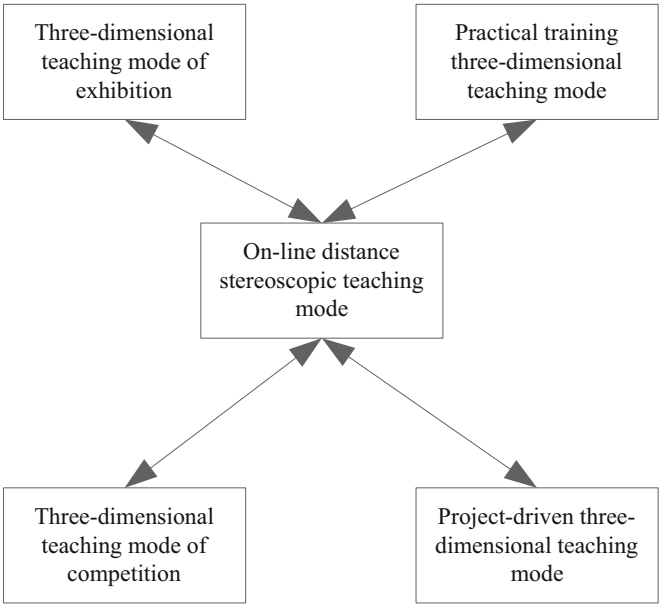

Fig. 5. Framework of online distance stereoscopic teaching platform

go to relevant exhibitions to conduct serious market research and user analysis research, so as to form a more detailed user analysis research report. These reports must include the division of target users, consumption characteristics of target users, physiological and psychological characteristics of target users, aesthetic cognition and values of target users, etc.; Third, according to the user report, students design and conceive the sketch scheme; Fourth, screen and optimize the sketch scheme; Finally, determine the final scheme and carry out the detailed design.

3.2 Competition Three-Dimensional Teaching Mode

The basic goal of design practice teaching based on design competition is to train students' innovative design ability and initially establish the idea that design needs to solve practical problems. The basic process of the model is as follows: First, according to the requirements of teaching tasks and time, teachers collect relevant design competitions that meet the requirements of course time and theme; Second, teachers analyze the requirements of relevant design competitions and assign design tasks to their students; Third, students choose the design competition theme according to their own actual situation; Fourth, the conception and optimization of design power; Fifth, design refinement; Finally, design feasibility analysis.

3.3 Three Dimensional Teaching Mode of Practical Training

The basic goal of design practice teaching based on off campus training base and on campus experimental platform is to cultivate students' engineering consciousness. As an

engineering major, students of industrial design must strengthen the training of engineering knowledge such as materials, structure and processing technology, so that their design works can be quickly transformed into products and commodities. The basic process of the model is as follows: First, according to the curriculum requirements and the existing conditions of the experimental teaching demonstration center's existing on campus experimental platform and off campus training base, the teachers select the appropriate design theme and give it to the students; Second, after receiving the design task, students are familiar with the various properties of materials on the campus experimental platform, especially the surface texture of materials including vision and touch; Thirdly, we should be familiar with and master the structure principle and realization force of similar products on the campus experimental platform; Fourth, innovative design or improved design of materials and structures; Fifth, go to the training base inside and outside the school to further understand the material and structure, and discuss and exchange the material, structure and processing technology with the enterprise engineers, so as to make their own design more in line with the reality; Finally, the design of a case of improvement and improvement.

The practice site includes the practice site inside the school and the practice site outside the school, as shown in Table 1.

Table 1. New engineering foundation practice site

Serial number	1	2	3
Name	Industrial Design (Mechanical) principle and innovative design experiment	Mechanical parts and mapping design training room	Metal technology training base
Basic conditions	There are 2 groups of mechanical principle display cabinet, 2 groups of mechanism innovation design platform and 1 group of hydraulic experiment platform	There are 10 small reducers, one group of experimental platform for car engine, chassis and gearbox, and several parts inspection tools	Mechanical processing, mechanical assembly, plastic products processing, casting, forging, welding, heat treatment and other production conditions
Practice teaching content	Mechanical design basic course training, mechanical innovation design experiment	Mechanical design, professional cognitive practice, mechanical mapping practice	Cognitive practice of industrial design, cognitive practice of professional basic courses
Practice site	Campus experimental site	Campus experimental site	Off campus experimental site

3.4 Project Driven Three Dimensional Teaching Mode

The goal of the project driven design studio and the practice mode based on industry university research cooperation is to cultivate students' ability to solve practical problems in design from works to products and commodities. The ability involves online automatic question answering function. Community seminar is a community place for teacher-student exchange activities. It should provide services for students, teacher-student exchange, teacher organization, seminar, community management, etc. In order to let more student users participate in the discussion, maximizing the interactive teaching function is the basic goal of the design of the discussion and answering community. When the user enters the discussion reply community, the registration, login, community classification, publish list, and online automatic question answering process will be displayed, as shown in Fig. 6.

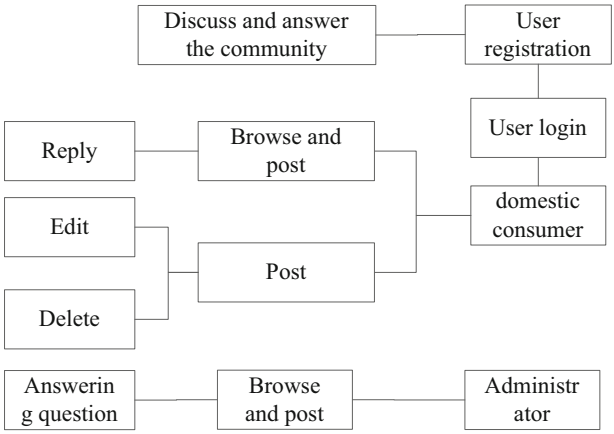

Fig. 6. Online automatic question answering process

Online automatic question answering has the basic function of posting. Students can express their personal questions, learning experiences and opinions in the learning process through the organization, guidance and management of teachers; Teachers can reply according to students' posts (answer questions, adjust teaching ideas and strategies). Community users can be divided into two categories: Ordinary users and moderators (administrators). Students are ordinary users, teachers are managers, users can be classified according to teaching category, and can participate in the teaching discussion of this course. As the manager of the classroom community, teachers have the right to answer questions and delete classroom posts.

The implementation process of practical teaching mode: First, the teacher team undertakes the design project; Second, the design task decomposition, a group of students engaged in product appearance design; Third, the second group of students design the material and structure of the product; Fourth, the first group and the second group of students carry out the coordinated design of modeling and structure; Fifthly, make product model and prototype in professional factory; Finally, the manufacturing and marketing of products.

4 Experiment

Experimental testing is an important process in software engineering, which is the key step to ensure the rationality of the research on the construction of online distance three-dimensional teaching platform for industrial design major in colleges and universities.

4.1 Test Content and Method

The test content includes the platform program running and platform security, and is tested on Pentium (R) 4cpu 2.0 GHz processor, Windows XP SP3 operating system and MySQL 4.1 database.

The test method is as follows: Black box test is used to check whether each function works normally. In the process of testing, the program is regarded as a box that can not be opened. Regardless of the internal structure, the program interface is tested to check whether the program function is in accordance with the requirements and specifications, and whether the program can properly accept the input data and generate correct information.

4.2 Experimental Results and Analysis

Black box test is carried out for the system, and corresponding operation is carried out for the designed system, traditional classroom and satellite TV teaching. The content of black box test is shown in Table 2.

Table 2. Black box test content

Test time	Test content
2019–03-05 9:00	Log in the tutoring interface and use the system
2019–03-05 9:05	Online automatic question answering
2019–03-05 9:10	Using the system without login
2019–03-05 9:15	Online automatic tutoring

The content of the black box test is as follows: 200 students are selected for the test, of which 50 are correct information and 30 are error information. The main reasons for the error information are interface login number error and data submission error.

According to the actual needs of users, the black box test results of the three systems are shown in Table 3.

Table 3. Black box test results of three systems

Content	Tradition classroom	Satellite TV teaching	Distance stereoscopic teaching platform
Can members register normally	Can	Can	Can
Can non members register normally	Can	No	Can
Can you register information normally	No	Can	Can
Can teachers and students communicate normally	No	No	Can
Can teachers organize normally	No	Can	Can
Can the seminar go on normally	No	Can	Can
Can the community be managed normally	Can	No	Can
Can the course be browsed normally	No	No	Can
Can I access online normally	Can	No	Can
Can I submit questions normally	Can	Can	Can
Can the problem be solved normally	No	No	Can

It can be seen from Table 3 that most of the black box test contents failed in the traditional classroom counseling method, and five of them passed; Most of the contents of black box test failed in the satellite TV teaching method, and five of them passed; All black-box test contents using the remote three-dimensional teaching platform have passed.

Taking the practical training of mechanical design foundation course as an example, three methods are used to compare and analyze the counseling efficiency, and the results are shown in Fig. 7.

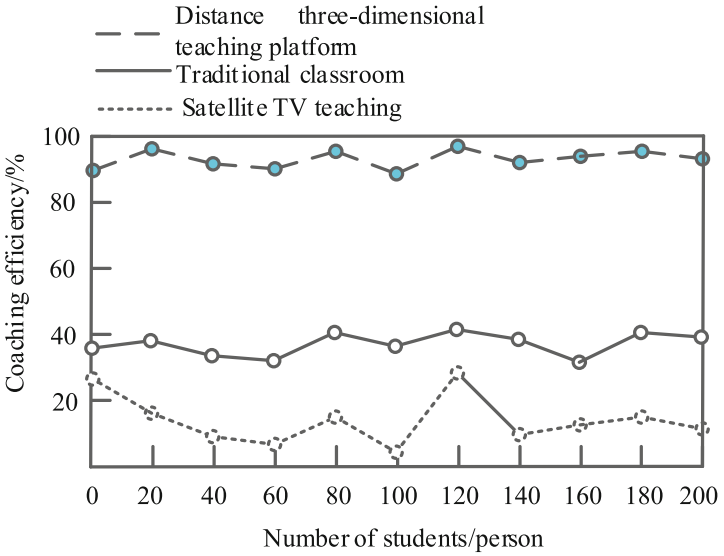

Fig. 7. Comparative analysis of the efficiency of three kinds of counseling methods under the practical training of mechanical design foundation course

As can be seen from Fig. 7: Using traditional classroom, the highest counseling efficiency is 42%, and the lowest is 35%; The highest efficiency of using satellite TV teaching method is 30%, and the lowest is 5%; The maximum tutoring efficiency using the remote three-dimensional teaching platform is 99%, and the minimum is 88%. From this, we can see that the use of the platform is more efficient.

Taking the mechanical innovation design experiment as an example, three methods are used to compare and analyze the counseling efficiency, and the results are shown in Fig. 8.

As can be seen from Fig. 8: Using traditional classroom, the highest efficiency was 49%, and the lowest was 26%; The highest efficiency of using satellite TV teaching method is 18%, and the lowest is 8%; The maximum tutoring efficiency of using the remote three-dimensional teaching platform is 92%, and the minimum is 80%. From this we can see that the use of the platform is more efficient.

4.3 Empirical Conclusion

We should adhere to the combination of theoretical teaching and practical teaching, scientific research and experimental education, project-based curriculum reform and project-based practical teaching, deepen the reform of practical teaching, and strive to improve the teaching contents and methods of experimental training. This paper introduces the basic knowledge of industrial design, design projects and design innovation topics into the field of practical teaching, and constructs a practical teaching form integrating teaching, learning and doing with theory and practice.

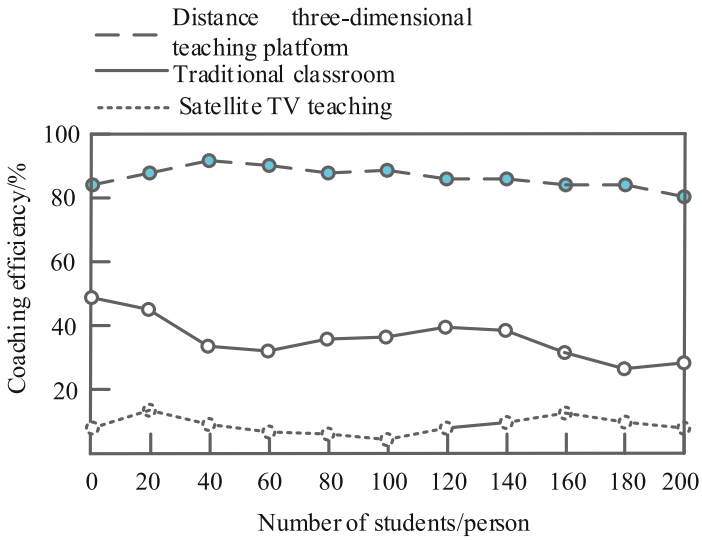

Fig. 8. Comparative analysis of the efficiency of the three methods under the mechanical innovation design experiment

(1) To develop and cultivate the practical teaching project of the integrated teaching and learning, whether it is the basic course of art design or the basic course of mechanical design, all the teaching contents that need to enter the practical teaching link are designed according to the project requirements, and the experimental training instructions are compiled to test the students' learning effect according to the project requirements.

(2) Create a training environment similar to the actual enterprise culture, and establish a practice environment according to the actual enterprise culture. The rules and regulations of the practice site are "imitated" by the enterprise to ensure that the practice teaching is not divorced from the actual production.

(3) To build a highly skilled and high-level experimental and practical training teachers team. We should strengthen the training of practical teaching teachers, cultivate and bring up a group of practical teaching teachers with professional teaching ability, practical innovation level and hard work ability. Practical teaching teachers should have academic qualifications and skills requirements. For practical teaching teachers, we should establish enterprise rotation training system, keep in touch with enterprises, and constantly improve the level of practical teaching. Teachers should often go to enterprises to learn about the progress of technical skills of relevant courses, and constantly update the practical teaching content. Professional teachers should continuously obtain practice projects and design projects from society to provide new resources for the integration of theory and practice teaching.

5 Conclusion

The idea of three-dimensional practical teaching mode of industrial design major solves the problem of training students' practical design ability at all stages in theory, and plays an important role in promoting students' comprehensive quality and improving their employment competitiveness after graduation. Distance design education has the flexibility and diversity of teaching, at the same time, it needs modern scientific and strict management to protect high-quality teaching and graduation standards. The course setting should be reasonable and orderly, and the top and bottom should be consistent, especially in the guidance link. After the courseware of each course is played, it is necessary to help students digest in time, so as to ensure the progress of learning and the quality of teaching. For the teaching situation, the teaching center should have detailed information records, especially the students' homework, credits obtained, and examination results, which should be input into the students' electronic files respectively for the basis of inquiry and final graduation evaluation. The teaching center communicates with the students regularly, discusses the situation of teaching and learning, sums up experience, and communicates with the host school in time, so as to continuously improve the teaching and make the students' achievements reach the established training standards. However, the practice mode of design studio based on project driven and the practice mode based on industry university research cooperation are still in the stage of exploration and practice, and we hope to continue research and practice in the future design practice teaching.

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