Construction and Research of Short-Term Training Smart Classroom

Chao Zhang[1](✉), Chunxiao Song[2], Huiyan Yin[2], Yang Han[1], and Qiang Luo[1]

[1] Educational Administration Management Center, State Grid of China Technology College, Jinan, China
278659120@qq.com, sddzdjzx@sina.com

[2] State Grid E-Learning Service Center, State Grid of China Technology College, Jinan, China

Abstract. Most of the current construction models of domestic mainstream smart classrooms are for full-time ordinary colleges and universities, which do not match our short-term technical skills training needs. To solve this problem, this paper summarizes three mainstream models of current domestic smart classrooms, compares and analyzes the differences between our college and other general colleges and universities in training and teaching, designs and builds smart classrooms that meet our own training and teaching needs according to our actual needs.

Keywords: smart classroom · short-term training · intelligence

1 Introduction

With the wide application of information technology in training and teaching, the classroom form supported by traditional classrooms is increasingly mismatched with the current training and teaching needs. As a product of the deep integration of technology and education, smart classrooms organically integrate the Internet of things, intelligent interactive audio and video and interactive teaching. Through professional module deployment, intelligent interaction and centralized management, the smart classroom has created a brand-new smart learning environment. At present, many colleges and universities have built smart classrooms that meet their own teaching needs, but there are very few smart classrooms built for the short-term technical skills training trade with the characteristics of short training time, high frequency of use, and high teaching environment requirements. This paper takes the Technical College of an energy service industry as an example, according to the design idea of "strategic guidance, business driving, system planning and strict demonstration", high-quality learning and efficient operation and maintenance are realized.

2 Overview of Smart Classroom

At present, there are no clear standards and requirements for the construction of smart classrooms at home and abroad, but they are generally composed of the Internet of

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things, cloud platform and Internet as the core technologies, together with smart terminal devices such as mobile phones, tablet PC and touch screens. Based on field research and comparison with major products in the industry, this paper briefly summarizes the construction mode of domestic smart classrooms into the following three categories [1]:

2.1 Recording and Broadcasting Smart Classroom

This kind of classroom aims at developing curriculum resources. The system mainly consists of front-end video acquisition equipment, audio acquisition equipment and back-end image, audio and data processing equipment, control equipment. It has the characteristics of automatic recording, simple editing, excellent recording effect, practicality and ease of use.

2.2 Intelligent Smart Classroom

This kind of classroom is based on the Internet of things technology to realize the intelligent classroom environment. It mainly includes lighting, curtain control, automatic temperature and humidity regulation, door and window monitoring system, ventilation system, video monitoring system and other Internet of things systems.

2.3 Teaching Application Smart Classroom

Starting from teaching, this type of classroom creates a teaching environment that supports new teaching modes such as inquiry teaching, small class teaching, mixed teaching and flipped classroom. It can realize various application modes such as course management, task management, student attendance, mobile teaching, classroom questioning, discussion wall, multi screen interaction, course report, data statistics, etc.

3 Smart Classroom Design

At present, many universities in China, such as Tsinghua University, Xi'an Jiaotong University, Zhejiang University, Shandong University, Zhongnan University of economics and law, Fujian Normal University and other ordinary colleges and universities, have built smart classrooms [2]. The users of smart classrooms in these universities are college students aged between 18 and 22, with relatively fixed personnel, these students have strong learning ability and a high degree of acceptance of new things. On the other hand, most of the users of our smart classroom are company technicians, with different levels of education, large age span and low acceptance of new things. Therefore, when planning and designing our smart classroom, we should not copy the existing smart classroom construction model of various colleges and universities, but start from our unique training methods, training contents and users [3].

At present, the main business of our college is short term technical skills training service. The service population is all employees of our company aged 22–60. Table 1 shows the details of the comparison between our college and other universities in terms of service population, study time, age, etc.

Table 1. Comparison of teaching characteristics between our college and other universities

Category	Teaching in our college	Teaching in other universities
Service population	All on-the-job employees of the company	Undergraduate student
Learning duration	1–2 weeks	4 years
Age of students	22–60 years old	18–22 years old
Characteristics of Teachers	Temporary employment of internal experts of the company	Full-time teachers
Needs of learning environment	have high requirements for seat comfort, lighting, decoration grade, IOT system, equipment performance and other hardware facilities	The classroom is used frequently and requires high software functions such as preview before class, discussion in class and communication after class

In view of the specific needs of the above training business, and making the best use of the limited funds at the same time, in the design and planning stage, we identified three major needs for the construction of smart classrooms in our college:

3.1 Simple and Convenient and Easy to Operate

Since most of the teachers are temporary internal experts of the company, and the training is characterized by short cycle and wide age distribution of trainees, which leads to high training manpower cost and learning cost of smart classroom. Therefore, the operation of the intelligent classroom equipment system should not be too complicated. The fast equipment switch mode and simple software operation method are the primary needs of the construction of the intelligent classroom in the short-term training class of our college.

3.2 Audio Visual Clarity and High Equipment Stability

The newly-built smart classroom undertakes the training task of 30000 person times a year. Frequent startup of equipment, long-term startup, and students' random touch put forward higher requirements for the stable performance of software and hardware equipment in the classroom. In addition, the size of classrooms is generally large (120 m^2 - 200 m^2). Therefore, it is necessary to reasonably plan the size, position and quantity of screens, speakers, seats and lights according to the structure of each classroom, the position of the platform and the distribution of seats, and strive to build a software and hardware equipment environment with clear viewing and high stability [4].

3.3 Suitable Light and Comfortable Environment

All kinds of training inside and outside the company are the main business of our college. All kinds of hardware facilities in the smart classroom, such as seats, light, temperature,

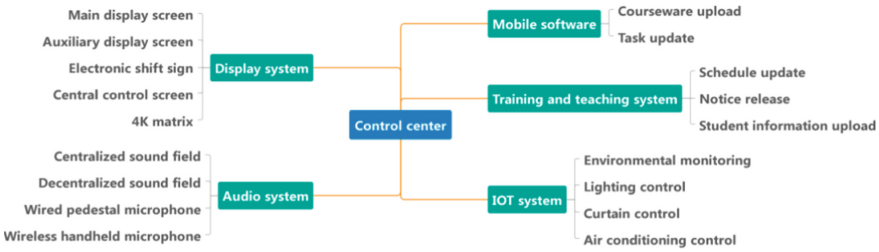

Fig. 1. Overall architecture of smart classroom

decoration, etc., have a vital impact on the overall satisfaction rate of training services. Therefore, in the process of building the smart classroom, we can not only consider whether all kinds of information equipment can meet the needs, but also consider the style and comfort of seats, the color rendering index of lights, carpets, wall coverings, curtain and other decoration have higher requirements.

4 Construction of Smart Classroom

Taking into account the three major teaching needs of our college and the size and type of each classroom, the main implementation in the construction phase is shown in Fig. 1. The screens, speakers, lights, curtains and air conditioners in the display system, audio system and IOT system can be controlled separately through the central control screen. The training and teaching system and mobile software can realize real-time operation of classroom electronic class card display, course adjustment, task update and other information at multiple points [5].

4.1 Control Center

The control center is the "central system" of all the smart classroom software and hardware equipment in our college, providing services such as remote equipment switching, IOT system control, usage analysis, remote assistance, etc. to minimize the user's operation difficulties and create a "ready to use, easy to operate" multimedia software and hardware environment for teachers and students.

4.2 Display System

(1) Main display

The smart classroom display system is composed of main display screen, auxiliary display screen and electronic class card. According to the actual needs of the training business and the size of the classroom, the large ladder classroom adopts the scheme of double 98 inch screens and blackboards on the left and right sides for the main display screen, while the ordinary classroom adopts the scheme of single 86 inch screens and blackboards on the left and right sides. This design scheme not only retains the

convenience of blackboards being ready to write and easy to wipe, but also takes into account the scientific and technological sense of the many types of existing electronic display tools and high writing efficiency.

(2) Auxiliary display
In order to ensure the viewing quality of the people at the back of the classroom, the auxiliary display system uses a 75 inch high-definition smart screen, which supports 4K high-definition display. It also has an intelligent system and a lift camera. Each auxiliary display can independently carry out remote meetings and thematic discussions. 4K high-definition matrix and optical fiber high-definition cable are used to connect the main display screen and the auxiliary display screen, which has strong convenience, expansibility and stability.

(3) Electronic class card
The electronic class card is located on the left side of the door. It is connected with the mobile terminal of the mobile phone and the training and teaching system of the college. It can display the number of the classroom, the name of the course, the weather, all kinds of notices, the photos of teachers and other contents in real time, so that students can quickly, conveniently and accurately obtain all kinds of information.

4.3 Audio System

(1) Design of centralized sound field
Sound is an important part of the teaching process. The sound system is responsible for reproducing and restoring the sound information of various teaching courseware. During the construction of the smart classroom, we adopted a centralized sound field sound design in the small classroom (120 m^2). The power amplifier and audio processor amplify and process the audio signal of the computer, and then transmit it to the left and right channel loudspeaker boxes. The loudspeaker boxes are installed at both ends of the wall where the main display screen is located, and the direction is at an included angle of 60° with the wall. This design method has the characteristics of unified sound and image, less sound sources, pure and clear sound, etc.

(2) Design of distributed sound field
The large classroom (200 m^2) adopts a decentralized sound field design. According to the placement of the platform, tables and chairs in the classroom, ceiling loudspeaker boxes are installed every 2.5 m in the ceiling to ensure the sound quality of every part of the classroom. In addition, in order to solve the echo problem in the large classroom, we have posted high-density sound-absorbing cotton above the main display screen and on the rear wall of the classroom, It can effectively solve the problem of sound field chaos caused by the excessively long length of the classroom [6].

4.4 Mobile Software

The smart classroom supports advanced teaching and learning interaction methods such as classroom interaction, group discussion, interactive answers, learning evaluation,etc.

between teachers and students through smart terminals such as computer tablets and mobile phones. Before class, teachers upload courseware, videos, pictures and other course materials through the one click import function of courses. Students can log in and browse resources in advance by scanning QR codes to complete preview; In the classroom, through different forms of scheduling, multiple screens allow interaction and sharing throughout the whole teaching process [7].

4.5 Training and Teaching System

Through the transformation of software and hardware, we have connected the central control system of the smart classroom with the existing training and teaching system of our college, which can automatically import and display the class name, course name, course time, lecturer and other information in the system to the electronic class boards of each classroom, And it can collect the electronic shift card information without perception, such as: Expected and actual number and the statistical analysis of attendance rate.

4.6 IOT System

(1) IOT equipment
The smart classroom can control the lighting, air conditioning, curtains and other IOT equipment in the classroom through the control panel. Due to the large area of the classroom, in order to save electricity and provide a better use experience, during the construction of the IOT system, we divided the classroom lights, air conditioners and curtains into three groups: front, middle and rear. Through the touch control panel, we can realize the functions of full opening, full closing, front, middle and rear independent switches of the corresponding IOT equipment [8].

(2) Environmental monitoring
There are many people in the classroom, when the doors and windows are closed for a long time, especially in winter, it is easy to cause the concentration of indoor carbon dioxide, formaldehyde and other harmful gases to rise, which seriously affects the learning efficiency of students. In order to solve this problem, we have installed an air quality monitor at the middle and top of each classroom, which can monitor the indoor environment in real time and display TVOC, formaldehyde and PM2.5, temperature and humidity and other environmental indicators. When any environmental indicator exceeds the normal range, an alarm will be given and a window will be opened for ventilation.

5 Problems After Construction

Building a smart classroom that meets the training and teaching needs of the college with high quality is only the first step. How to use and manage the new classroom is the most important thing.

5.1 Equipment Training

(1) Training of maintainers
The maintainers of multimedia equipment have rich experience in operation and maintenance of traditional multimedia classroom equipment such as projectors, computers and power amplifiers, but in the face of the new intelligent classroom with a high degree of intelligence and integration, the maintainers do not have the corresponding professional abilities in network configuration, program writing, IOT equipment maintenance, etc. [9]. In the actual use of the smart classroom, It is often unable to solve the fault quickly and accurately, which seriously affects the normal training and teaching order. Therefore, it is very important for the training of maintainers. After the completion of the construction of the smart classroom, we specially organized the equipment manufacturer to train the maintainers, including the system architecture composition, system basic maintenance and troubleshooting, system networking, the function and use of software systems, and the use of remote teaching systems.

(2) Training of full-time teachers
We organize centralized technical training and on-site guidance, so that the faculty members of the college can be familiar with and skillfully use the basic functions of platform lifting, screen switching, volume adjustment, remote teaching, and the use of the IOT system in the smart classroom. At the same time, the training opportunities have been used to improve teachers' educational technology capabilities, cultivate information literacy and teaching concepts in the smart classroom environment, and help teachers quickly adapt to the new teaching methods in the smart classroom.

(3) Training of part time trainer and trainee
Part time trainers and trainees have short learning time and high mobility. It is often embarrassing for teachers and students to graduate just after they master and are familiar with the operation methods of various software and hardware equipment, the training cost is high. To this end, we have specially made a clear paper for the use of smart classroom equipment, and tried to use simple language and flow chart for training on a piece of A4 paper.

5.2 Equipment Management

(1) Management of daily teaching
In order to ensure the continuous, stable and normal use of the software and hardware equipment of the smart classroom and ensure the orderly development of training and teaching activities. We have set up a smart classroom technical support group to provide comprehensive technical support from the whole process of closed-loop before, during and after class. Members of the group turn on the relevant multimedia equipment in the classroom 30 min before class to test whether the microphone power is sufficient and whether the mouse and keyboard can be used normally; We cameras in the central control room to monitor the audio and video of classroom teaching, and solve problems

as soon as they are found; We check and close all kinds of multimedia equipment in the classroom in time after class to ensure normal use next time.

(2) Management of major meetings and activities
In addition to training and teaching, the new smart classroom also undertakes the organization of major conferences and activities of our company. Therefore, the stability of the equipment in the classroom is highly required. The management of the equipment by the maintainers can not be limited to simple use and handling of common faults, but also requires a deeper understanding of the whole equipment software and hardware system, In the process of operation and maintenance, it can gradually get rid of the dependence on the technicians of the equipment manufacturers, independently handle various complex equipment faults, establish relevant technical documents, and write down the fault handling process, equipment parameter commissioning and other operation and maintenance experience, so as to improve the efficiency of operation and maintenance of relevant equipment in the smart classroom.

6 Conclusion

In the process of building smart classrooms, we started from the unique training and teaching environment, student conditions, classroom characteristics and other practical needs of our college, avoided the utilitarian idea of "building for the sake of showing", Adhere to the principle of "simplicity, convenience, stability and comfort". We should not only build it well, but also manage and use it well, let the smart classroom truly serve the college's purpose of building an international first-class enterprise university [10].

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