Intelligent classroom: Concept, Systems Integration and Key Technology

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Abstract
Along with the construction and application of digital campus, we should harness digital, intelligent and low-carbon systems integration solution for technology enhanced classrooms. Based on analyzing the disadvantages of traditional multimedia classrooms, this paper described the concept and designed a graph from the systems integration perspective. At the same time, we analyzed the key technology of intelligent classroom construction. In the end, the summary and outlook were given. The purpose of this paper is to provide the new thinking in order that they will focus on the research area more.

Categories and Subject Descriptors
[Intelligent Systems: Theory and Applications]

General Terms
Algorithms, Design, Standardization, Languages, Theory, Legal Aspects, Verification.

Keywords
intelligent classroom, system integration, the Internet of things, biometric, cloud computing

1. INTRODUCTION
The classroom is the main venue for students’ learning activities, the environment of which directly affects student learning, healthy growth and mental development.

The new concept of teaching and learning requires the new teaching and learning environment to adapt. While the schoolroom is becoming the most direct form for teaching and learning exchanges and the classroom becoming the most direct place. Teaching provides the scaffolding to a meaningful learning and provides the feedback, correction and reflection opportunity for teaching practice as well.

The advancement of information technology such as the Internet of Things and cloud computing provides the support for the construction of the multimedia teaching environment, which promotes the innovation of teaching mode and teaching methods so as to improve and enhance the teaching process to a large extent.

The high attention of government to the educational informationization further promotes the process of multimedia classroom construction. Such as the NETP( National Education Technology Plan) in America, Smart Education Strategy in Korea, Decade Plan on Development of Education Informatization from 2011 to 2020 in China.

In December 2009, along with the low-carbon era, after it fully meets the premise of teaching needs in the planning design and equipment selection of multimedia teaching environment, we need to pay special attention to programs and low-carbon products.

Based on above, the planning and design of multimedia teaching environment is gradually transition from “integrated devices” to “IntelliSense” excessive.

2. THE EXISTING PROBLEMS
Multimedia teaching and learning environment is one of the major school infrastructures, which not only contains the physical space environment, but also can contain a complex system of teaching equipment and technology applications. In the construction of multimedia teaching environment engineering, there are many problems needed to solve, such as poor level of integration, low level of intelligence and low efficiency in operation and management, especially the technical weaknesses in remote operation control, remote management, and remote technical which need the teachers in higher technical requirements, thus affecting the efficiency of classroom teaching. With the increasing development technology and the growing demand of and digital campus and ubiquitous learning, the research of intelligent classroom is put on the agenda. To welcome the arrival of the era of intelligent in the future, the existing problems below need to be solved:

2.1. Equipment Listed Stuffing and With Poor Level of Integration
Multimedia classrooms basically follow a similar configuration and equipment-computers, video booth, projector, electric screen, DVD players, VCRs, audio power amplifier in the control host, strong electrical relay, teachers operator interface, microphone and speakers and so on. The connection of the devices above constructed the multimedia teaching equipment the teachers used in the classroom. There are lots of problems of this classroom units configuration program equipment, such as many complex connections increasing the difficulty of the construction and equipment resource sharing, lacking of consideration of the needs of remote management running, affecting the efficiency and future expansion.
2.2. High Failure Rate and Poor Operational Efficiency
The welded joints are required in the general solution using audio and video and VGA transmission cables, which produced the higher failure rate for the joints lose and solder joints. In addition, the teacher, who is not familiar with the equipment, will operate error-prone and affect the normal classroom teaching, and classroom administrators will face of complex multimedia devices but do not know how to manage and maintain a variety of centralized control system. So it needs a long time to train the teachers and the administrators for the use and maintenance of multimedia classroom.

2.3. Degree of Intelligence and Poor Perception
Taking the colleges and universities for example, they usually own dispersed in different campuses dozens of different teaching, or even hundreds of multi-media classrooms. The traditional management model requires the administrator to run away upstairs and downstairs, which does not embody the advantages of modern educational technology. Multimedia classroom system commonly used in the control system, but the association between a lot of audio-visual equipment standing still through analog hardware interface, increased in the control is mostly a one-way control, rather than a two-way interaction associated with more not the data level of interaction, we can say only control, intelligent management, equipment resources shared.

2.4. Layout Immobilized and Low Efficiency Activities
Multimedia teaching environment problems, including classrooms and podium fixed, limiting the ability to play and classrooms, is not conducive to the launching of various activities.

Above, the intelligent classroom with a high degree of integration, low failure rate, high degree of intelligence and interactive is ready to come out.

3. THE STRUCTURAL MODEL

3.1. Overview of Intelligent classroom Connotation
Intelligent classroom has a variety of nicknames, such as smart classroom, classroom of future and classroom of tomorrow. The definitions of the intelligent classroom are different and have yet to achieve a unified. Some scholars stressed intelligent classroom that it was enhanced learning environment, which emphasized on their physical characteristics of intelligent.

For example, Huang, R. (2012) believed that in the smart/intelligent classroom, the “smart” involves optimization of the teaching content presentation, to facilitate access to learning resources, the depth of classroom teaching interactive, context-aware detection, classroom layout and electrical manage multiple aspects. Yuan-Chih Yu (2012) thought the intelligent classroom as a visualized equipment equipped with center-control instructor station which is a computer combined with devices controller.

The characteristics of the intelligent classroom are equipment intelligent, learning environment intelligent, teaching and learning interaction intelligent, teaching and learning evaluation intelligent, teaching intelligent management and automation of lecture notes.

The research areas of intelligent classroom are including: (1) basic theory and theoretical research; (2) the spatial structure constructed; (3) functional model; (4) standards and normative research; (5) interactive research; (6) classroom practice inquiry. Recently, he study of intelligent classroom currently, which is in the basic theory and theoretical research stage, but there are some schools have put the concept into practice.

In summary, the intelligent classroom is not a new product, but is the higher stage of multimedia classrooms development, which is based on the teaching building space, the campus network, integrating the audio-visual systems, control systems, communications systems, storage systems and other integrated collection of a number of sub-systems, taking the integration platform of E-control and E-management for the management control center, achieving the operation, management and maintenance of a variety of multimedia teaching equipment, making the different sources of text, graphics images, audio and video information is presented to the students, teachers and audience in the best results, providing the support for teaching activities, such as classroom teaching, academic exchanges, courseware recording, remote live in terms of physical function.

In addition to the physical building facilities, the sensing devices are implanted to enrich classroom feedback mechanism, so that the occurring of teaching and learning is more intelligent.

In this study, the intelligent classroom is defined as an integrated environment that included both the intelligent classroom equipment and smart teaching philosophy. It is an advanced stage of the development of the multi-media classrooms, the purpose of which is that facilitating the teaching and learning occurring more intelligent.

The construction and utilization of intelligent classroom is in line with ecological principles, therefore, it is natural to consider from the perspective of Ecology for exploring the intelligent classrooms. From the current research, intelligent classroom is closely related to the future classrooms and classroom. Apart from the intelligent classroom building itself, we need to focus on the classroom activities. At this stage, the construction of the intelligent classroom is not regular enough, so that from the perspective of system integration, a high integration, integrated, interactive features, perceived performance system will be constructed, which can fully meet the needs of teaching and learning. The function of intelligent classroom is to achieve recognition context, the recording process, perception of the environment such as a series of processes.

- Researching and developing the integrated information portal operation and management, developing a unified authentication system;
- Developing the integration, intelligent and high perception control management platform;
- Achieving intelligent of the classroom quality evaluation;
- The situational identify universal.

3.2. Overview of the intelligent Classroom Structure Model and Cases
In the SMART Education Strategy in Korea, SMART is an acronym for Self-directed, Motivated, Adaptive, Resource-enriched, Technology embedded learning methods. Now, the model, constructed by Huang, R.(2012), including the showing, management, accessible, real-time interactive and testing, may be the most classic, which base on the different teaching mode, is divided into three types: high-definition, deep experience and strong interaction type. The different types of intelligent classrooms existed gaps in the classroom layout, content presentation, access to resources and timely interaction.
At different stages, the understanding to the intelligent classroom is also slightly different. Such as The Dell intelligent classrooms main to create an interactive learning environment, this provides a complete set of technical solutions. The main purpose is to promote the interaction of teachers and students.

![Figure 1. The concept model of smart classroom](image)

The excellence intelligent classroom in Shanghai is mainly manifested in: (1) identification intelligent; (2) integrated control panel; (3) provide multiple interfaces; (4) courses and broadcasting system intelligent.

McGill University in Canada, the intelligent classroom can be activated and configured the appropriate indoor equipment without manual control accompany with the teacher interaction. For example, when teachers operated the intelligent classroom computer, the intelligent classroom system inferred that it is a computer-based lectures, the indoor lighting will automatically shut down, turn on the projector, and computer signals will input to the projector. The classroom simply needs to place a document on the Video Showcase to display projection.

Chen et al. (2006) make an experiment about using a rapid feedback method and found a significant and positive effect when students received feedback to promote classroom interaction.

Intelligent classrooms are currently being put into use their own characteristics, focusing on not only integrated control of the device and the record of the classroom teaching, but also intelligent distance learning.

Accompanied by the vigorous development of the Internet of Things technology, many researchers will turn their attention to the field of Internet of Things, Internet of things is unique just for its hierarchical and structured, from the perspective of the Internet of Things architecture, and intelligent classrooms also include three levels, perception layer, network layer and application layer.

Electronic tags, reader, camera, infrared sensor, human perception, etc., mainly included in the perception layer. In the network layer, both the wired network and wireless networks is included. In the application layer, intelligent explanation, intelligent questions and answers, the evaluation of smart, intelligent feedback, microteaching, and intelligent job are included.

In light of the above, as the initial stage of the construction of the wisdom of the classroom, this article combined with the shortcomings of the existing multimedia teaching environment, mainly from system integration to build wisdom classroom.

## 4. THE SYSTEM INTEGRATION AND KEY TECHNOLOGY

### 4.1. The System Integration of Intelligent classroom

The system integration of intelligent classroom is not a simple pile of audio-visual equipment, but a integration of a variety of audio-visual equipment and business subsystems in the way of integrated using of intelligent control, audio and video, computer, multimedia, taped storage, network communication technology etc. after optimizing the combination of equipment selection. And the aim is to make the integrated system to be able to fully meet the needs of teaching, absorb the advantages of the Internet of Things in this process, and at the same time to realize the real time interaction easily in teaching activities.

Through the analysis of the problems of traditional multimedia teaching system, combined with the low-carbon era of green energy-saving requirements, plus the convenience of Things technology, system integration of wisdom classroom following indicators need to be considered:

#### 4.1.1. Advanced and Practical

On the one hand, with the development of information technology, new products and equipment continues to emerge, system integration must be own the certain advanced consciousness based on a practical basis. So we need to select advanced technology and equipment and to position the technical to the more high level in order to adapt to the higher requirements in the future. On the other hand, we should give full consideration to the practicability and ease of operation, ease of management and maintenance, easy to master and learn to use in the system integration process.

#### 4.1.2. High Performance and Reliability

We should to consider both the high performance and reliability in system integration and to make use of the reasonable technical solutions to do simulation analysis, design and testing in order to establish a high-performance applications for a variety of media such as voice, data, image, and video is an important goal of systems integration. Meanwhile, in order to ensure reliability, the system should be popular, mature and more success stories equipment and technology program.

#### 4.1.3. Low Power Consumption and Low Emissions

Under the premise that fully meet the needs of teaching, the planning and design and selection of equipment of intelligent classroom should pay particular attention to low-carbon programs and products - "low energy consumption, low pollution, and low emission". While the large energy equipment such as lighting, air conditioning, power amplifier is controlled by central control host in classroom, the motion sensor and illumination sensor combine to the central control need be configured within the classroom to improve the system and to reduce the use of equipment waste and reduce carbon emissions.

#### 4.1.4. Standardized and Expandable

Intelligent classrooms should be an open system, in accordance with international and domestic standards. Take into account future upgrade expansion, product selection, must comply with the national standards, technical solutions need to have the ability to increase or connect a new device, the new system.

In short, systems integration to the teaching needs as the fundamental starting point, not to choose the best products simple behavior, but according to the needs of selective price than most products and programs. The level of cost is the evaluation of a system integration projects the reasonable and implementation of important reference factors. Fully functional intelligent classroom systems integration is shown in the drawing below.
provide better support for the construction of the intelligent classroom. Analysis of teaching resources, learner characteristics including interactive analysis of the teaching and learning process, analysis techniques is in its infancy, the study and analysis techniques, particularly important. Network analysis in the study and analysis excellent platform for teaching and learning, the learners' analysis is far from enough. In the construction of intelligent classroom, we need to make effort in the design of infrastructure and top-level, take fully into account the future expansion of upgrade to achieve sustainable development.

This paper has lots of shortage, such as with the informationization, different countries tried to construct the intelligent classroom, there are many excellent cases, but lack of enough thinking, we can’t absorb all advantage. Except that, we expect all kinds of voice for this paper.

5. SUMMARY AND OUTLOOK

The intelligent classroom adheres to the people-oriented idea and provides the effective support for teaching activities. The construction of intelligent classroom will focus not only on the research and application of audio-visual equipment, but also the construction of the system of rules and culture in order to achieve all-round development. The development of the intelligent classroom can’t be divorced from other business systems in digital campus, such as senate system, card systems, campus network system, and building automation system etc., all of which above need to achieve interoperability and coordinated development. As a long-term system engineering in the construction of intelligent classroom, we need to make effort in the design of infrastructure and top-level, take fully into account the future expansion of upgrade to achieve sustainable development.

6. REFERENCES


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4.2. The Key Technology of Intelligent classroom

With the advancement of technology, the design and utilization of the intelligent classroom is becoming more and more obvious. Just as, learning analysis technology, sensor technology and cloud computing provide better support for the construction of the intelligent classroom.

The purpose of the intelligent classroom building is to provide an excellent platform for teaching and learning, the learners' analysis is particularly important. Network analysis in the study and analysis techniques vesting the field of artificial intelligence, our study and analysis techniques is in its infancy, the study and analysis techniques, including interactive analysis of the teaching and learning process, analysis of teaching resources, learners, learner characteristics analysis learner behavior and emotional analysis. In the construction of intelligent classroom, the learners' analysis is particularly important.

Biometrics played the good role in the construction of intelligent classroom in the old time. But the sensing technology, which takes place of it day by day, includes sensor technology, RFID technology and two-dimensional code technology. These technologies are a matter of perception layer networking technology. Apart from in addition, the Radio Frequency Identification, shorted for RFID, that is popular as well. RFID technology is an automatic identification technology, which is considered as either a device identification technology or short-distance transmission technology, and mainly consisted of three parts: RFID tags, RFID reader and the management application system.

Cloud computing is a new IT resources and service delivery models. Narrowly cloud computing refers to the delivery of IT infrastructure and usage patterns, network demand, scalable way to obtain the necessary resources; generalized cloud computing refers to the delivery of services and usage patterns, through the network to demand easy to expand access to required services. Cloud computing provides the resources and presents two major characteristics that are highly scalable and virtualized. Now, the development of mobile terminal technology, the electronic bags, the digital textbook and the electronic whiteboard are closely linked to the cloud computing, say nothing of the construction of intelligent classroom.

Figure 2. The integration of intelligent classroom