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Design and Optimization of School Educational Space in the Perspective of Future Education

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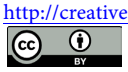

Abstract

The New Media Consortium (NMC) suggests that resetting learning has become a trend. Learning space redesign and transformation can facilitate a shift in teaching and learning styles, leading to the increasing adoption of active learning in physical classrooms. This paper starts with the research status of the future classroom, summarizes and analyzes the implementation of the future classroom at home and abroad, and proposes the vision of the future classroom based on the "iSMART" system model, which includes infrastructure, network awareness, visual management, augmented reality, real-time recording and ubiquitous technologies, in order to provide a reference for the research, construction and operation of the future classroom.

Subject Areas

Education

Keywords

Future Classroom, iSMART, Active Learning

1. Introduction

Taiwan's Launching the Teaching Revolution proposes: "The future classroom = ubiquitous learning environment + e-bookbag + casual classroom + remote laboratory + highly interactive classroom + connected classroom" [1]. At present, scholars at home and abroad mainly define the future classroom from the perspectives of education and teaching, educational function, teaching technology and teaching environment. In this study, the future classroom is a teaching environment that utilizes modern technology, guided by innovative educational concepts, with interaction as the core, and with the purpose of cultivating students' innovative skills, which can stimulate students' interest in learning, promote students'

mutual collaboration, and carry out inquiry learning.

2. Current Status of Future Classroom Research

Under the background of the deep integration of modern information technology and education, the future classroom is highly respected for its digital, intelligent new forms of education and modern teaching methods, and has become an unstoppable development trend to promote future education.

Current research on future classrooms mainly involves the following four aspects: 1) space design, including space layout and color matching, design and combination of desks and chairs. 2) Technical design, covering aspects such as classroom equipment configuration, intelligent technological innovation and learning support systems. 3) Teaching application, mainly from the perspectives of enhancing user experience, supporting learning activities and enhancing learning ability. 4) Teaching effect, focusing on aspects such as improving learning ability, increasing social interaction and improving learning effect.

3. Future Classroom Implementation

At present, many schools, enterprises and research institutions have launched research on future classrooms. Overseas research on the future classroom is earlier than that in China, and they have rich experience in practicing the future classroom.

3.1. TEAL Project

The Massachusetts Institute of Technology (MIT) launched the Technology Enable Active Learning (TEAL) program in 2000.

The seating arrangement is in the form of round tables, with the lectern located in the center of the classroom to facilitate collaborative communication between students and teachers. Eight projection screens were installed in the classroom to ensure that all students could clearly see the teaching content and the teacher's demonstration, thus effectively improving the quality of student learning, as shown in Figure 1 and Figure 2.

Figure 1. Students learn in TEAL classrooms.

3.2. KALS Project

The University of Tokyo (U-Tokyo) has developed the Komaba Active Learning Studio (KALS), a program that integrates technology and infrastructure to facilitate active learning and instant interaction between students and teachers. The classrooms are equipped with beanbag-shaped desks and interactive whiteboards that facilitate collaborative group learning, as well as tablets and feedback devices that emphasize the use of technology to enhance students' interest in learning and facilitate interaction between teachers and students, as shown in Figure 3 and Figure 4.

Domestic research on future classrooms started late, and currently there are mainly iFLYTEK Future Classroom, Seewo Smart Classroom, TEAM Model Smart Classroom, and so on. Radcliffe, a scholar at the University of Queensland, developed the Pedagogy, Space and Technology (PST) framework for designing and evaluating active learning spaces [2]. The three interact, influence and promote each other, as shown in Figure 5.

The following summarizes and analyzes the implementation of some future classrooms in China from the perspectives of teaching mode (learning mode), spatial arrangement, technology application, and application cases, as shown in Table 1.

Figure 2. TEAL classrooms at MIT.

Figure 3. Students learning in KALS classroom.

Figure 4. KALS classroom at U-Tokyo.

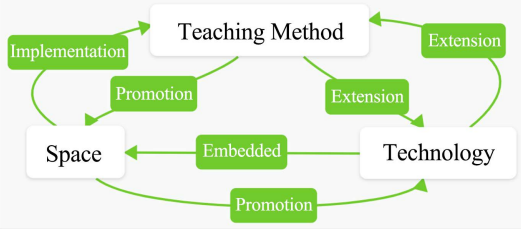

Figure 5. PST framework.

Table 1. Implementation of selected future classrooms in China.

Projects	Teaching model/ learning model	Spatial arrangement	Technical application	Application cases
Iflytek Future Classroom	Lecture method Autonomous learning Cooperative learning Inquiry method	1) Round table sitting style 2) Traditional classroom arrangement	Hardware: Infrared all-in-one, capacitive intelligent blackboard, interactive electronic whiteboard, computer, TV, speakers Software: IflyCY intelligent teaching software, IflyCY AI technology	Beijing No. 12 Middle School Hefei No. 8 Middle School Guangdong Guangya Middle School
Tencent Cloud Smart Teaching Solution	Blended learning	1) Round table sitting style 2) Formal meeting arrangement	Cloud Server, Business Server, Web Browser, Mobile Web App Client, MySQL Database	Live Cloud Education Platform
Ruijie Smart Classroom	Small-class teaching Flipped classroom Blended learning Inquiry method Cooperative learning Project-based learning	1) Round table sitting style 2) Traditional classroom arrangement method	"1 + N": "1" is the intelligent teaching interactive system, including intelligent cloud blackboard, intelligent cloud big screen, UClass teaching tools, cloud OPS; "N" is the scenario-based program subsystem, including multi-screen collaborative seminar system, intelligent audio and video system, UClass intelligent teaching platform and intelligent operation and maintenance control system	Dalian University of Technology Tsinghua University Nankai University Huanghuai Academy Tianmen Vocational College

Continued

Green Deer Smart Classroom	Interdisciplinary teaching Seminar-style teaching Case study Flipped classroom Project-based learning	1) Round table sitting style 2) U-shaped seating pattern 3) Formal meeting arrangement method 4) Traditional classroom arrangement method	Teacher side: Touch all-in-one machine, pickup microphone, sound, HD camera Student side: Touch panels, seminar cameras, tablets, laptops, cell phones System platform: Interactive recording and broadcasting host, data center platform	Beijing Institute of Technology Shanghai Jianqiao College Wuhan University Yanbian University Huazhong University of Science and Technology Xichong Primary School
TEAM Model Smart Classroom	Literacy-oriented instruction Personalized learning Problem-based learning Team learning	1) Round table sitting style 2) U-shaped seating pattern 3) Traditional classroom arrangement method	Hardware: Electronic whiteboard, physical projection, iPad terminal Software: HiTeach Interactive Teaching System, Haboard Interactive Whiteboard, ezVision Video Visualizer, Wireless Handwriting System, HiLearning Portable Mobile Terminals	Xuefeng Primary School, Wuhan Economic and Technological Development Zone Wenjiang Pengcheng Elementary School Chengdu Paotongshu Elementary School (Tianfu Campus)
Seewo Smart Classroom	Lecture method Cooperative learning Inquiry learning	1) Round table sitting style 2) U-shaped seating pattern 3) Formal meeting arrangement method 4) Traditional classroom arrangement method	Hardware: Interactive smart tablet, smart blackboard, interactive electronic whiteboard, smart learning terminal Software: Seewo teaching assistant, Seewo whiteboard, class optimization master	Shanghai Private Yingli Primary School Beijing Normal University Affiliated School Wuzhen Plant Material Primary School

4. A Vision of the Future Classroom Based on the "iSMART" System Model

Nie *et al.* proposed the "iSMART" model of the future classroom. In this model, the future classroom consists of six systems: infrastructure, network perception, visual management, augmented reality, real-time recording and ubiquitous technology [3]. Based on the "iSMART" system model, we can carry out a series of assumptions for the future classroom.

4.1. Infrastructure

The infrastructure system covers subsystems such as physical space, power supply and lighting, tables and chairs, etc. The rational design of the infrastructure system can create a healthy and comfortable environment for the classroom. The following is a brief reference for future classroom design in terms of color design, lighting, acoustic design, plane layout, etc.

4.1.1. Color Design

The classroom of the future can always achieve color changes as needed. Differ-

ent colors give people different feelings, and it is important to make full use of the characteristics of color to create a comfortable learning environment for students and promote the development of students' mental health. In order to transmit positive emotions to students and promote the realization of high-quality learning, the future classroom can be designed using the "three-layer, six-dimensional" design principle of color design. This is shown in **Figure 6** [4].

4.1.2. Lighting

Compared with traditional classrooms, future classrooms will need meet extra needs of face-to-face interaction and multiple presentations. The design of the future classroom lighting environment should start from the main learning mode of the students, and at the same time pay attention to the actual experience and feelings of the students. In order to meet the diverse learning needs, the lighting system of the future classroom can adopt intelligent control technology to automatically adjust the lighting brightness and color temperature according to the indoor light and the activities of teachers and students, so as to realize on-demand lighting, while reducing energy consumption.

4.1.3. Acoustic Design

Living recording and broadcasting, online teaching, remote interaction and many other new demands of future classroom has put forward higher requirements on the acoustic environment. Generally speaking, the acoustic design of the future classroom needs to do the following: 1) choose a reasonable location to avoid noise sources; 2) reasonably design the building profile to reduce noise interference; 3) reasonably design the classroom size and reasonably control the volume of the classroom; 4) improve the acoustic performance of doors, windows, walls and floor panels; 5) control the noise of the equipment; 6) reasonably arrange the indoor sound absorption and diffusion structure [5].

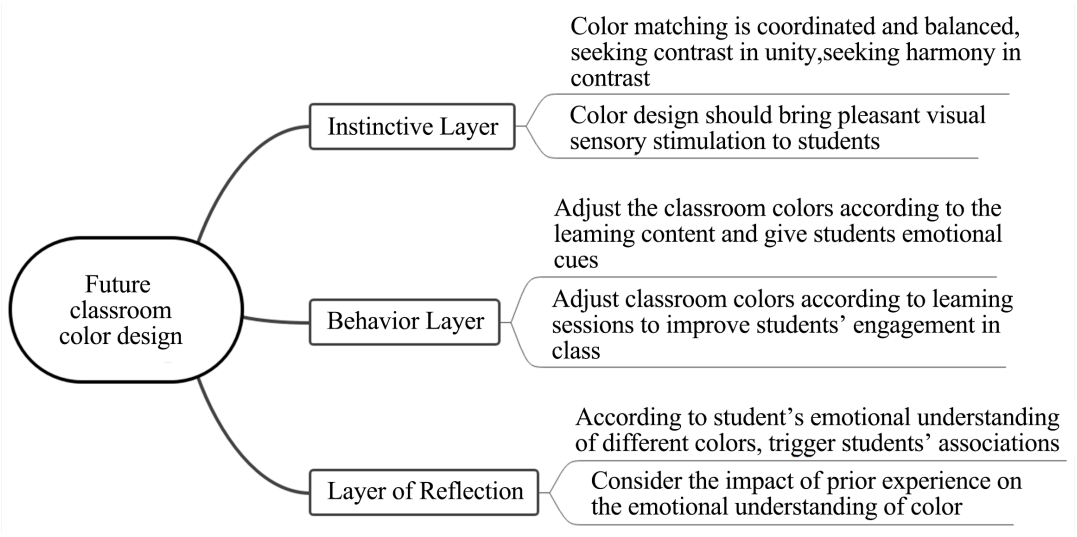

Figure 6. Color design of the future classroom with three layers and six dimensions.

4.1.4. Layout

In the future classroom, the podium can be placed in the center of the classroom. This can weaken the status relationship between students and teachers, make students feel equal, and facilitate teacher-student communication, making the teaching atmosphere more relaxing [6].

In order to adapt to independent learning, group cooperative learning, project-based learning, inquiry-based learning and other diverse learning modes, the layout of tables and chairs in the future classroom space will be changed from the traditional rice paddy arrangement to a trend to move freely and spliced flexibly. The followings are examples of round table seating style, pod grouping arrangement and U-shaped seating pattern, to introduce the common seating arrangement of the future classroom.

1) Round table seating style

Round table seating style can be well adapted to the needs of cooperative group learning, as shown in **Figure 7**. Each group table is equipped with a computer and microphone, and the tables and walls are equipped with writable whiteboards. The podium is located in the center of the classroom and can be moved.

The round table seating has many benefits, mainly including: a) It draws in the distance between group members and makes students more willing to share their views within the group; b) Working together in groups to accomplish tasks cultivates students' team spirit; c) Brainstorming between groups realizes the collision of views and cultivates students' divergent thinking; d) On the one hand, the microphone gives students the opportunity to express their views and exercise their language expression skills; On the other hand, the use of microphone enables students to listen to their peers' speeches and develop the habit of listening attentively; e) Students can utilize the whiteboard to record and display their own views, which enhances their self-confidence.

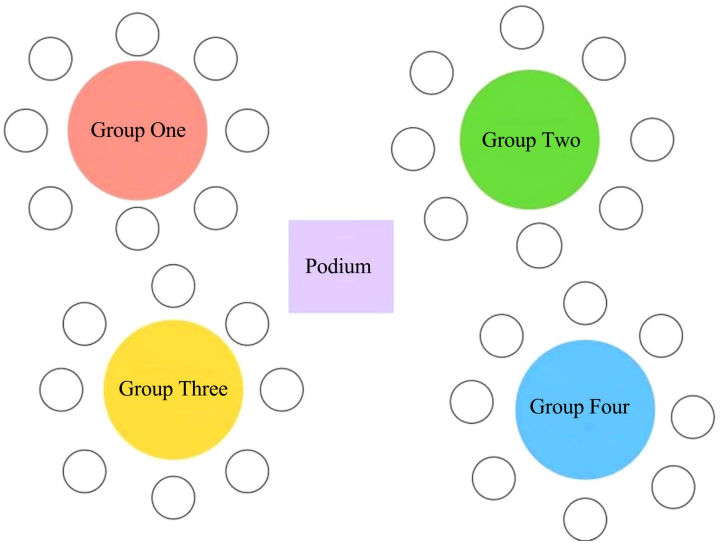

Figure 7. Round table sitting style.

2) Pods arranged in groups

Each of the two pod-shaped tables can be spliced into a small group, and each group is equipped with two chairs and a large movable high-definition display, as shown in Figure 8. The display shows instructional materials when the instructor is teaching and learning materials for each group when the group is discussing. The podium is movable and is often located at the front of the classroom or in the center of the classroom.

Two pieced together tables allow for intimate contact, promote communication and interaction, and foster learning partnerships. The display screen can play a dual role, displaying the teacher's teaching materials and ensuring a clear line of sight, but also serving as a tool for group presentations and exchanges, promoting open, cooperative and active learning.

3) U-shaped seating pattern

The U-shaped seating pattern allows all students to have a clear view of the "stage" area in the center of the classroom, with students in face-to-face contact, and with the podium located in the U-shaped openings, as shown in Figure 9.

The main advantages of the U-shaped seating pattern are: a) The teacher can walk to the center zone at any time to learn about students' learning and facilitate communication and interaction between teachers and students; b) Students can see each other when they speak, encouraging face-to-face conversations, which is ideal for large group discussions; c) The center zone is a stage for teachers and students to show off their skills. Role-playing, gaming activities, song and dance performances can be easily carried out.

4.2. Network Perception

The network awareness system includes subsystems such as network access, radio frequency identification, and human body identification. Network access can be wired or wireless, and WIFI network coverage is realized by adding a wireless router. Set up temperature, humidity and light sensors in the classroom to realize real-time sensing and regulation of indoor temperature, humidity and lighting. Face recognition system is installed at the classroom entrance, which can record the attendance of teachers and students and transmit the data to the teaching management system.

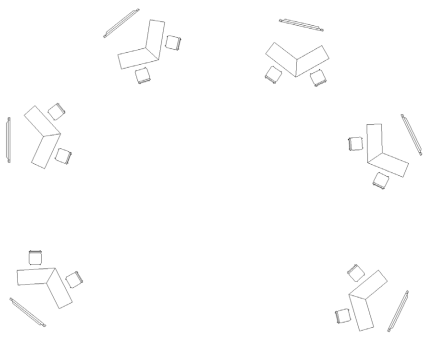

Figure 8. Pods arranged in groups.

Figure 9. The U-shaped seating pattern.

4.3. Visual Management

The visual management system includes sub-systems for monitoring, energy consumption and central control. By installing cameras and sensors, the visual management system can monitor activities in the classroom in real time. At the same time, the system can also collect and analyze the use of classroom resources in real time to help managers understand the utilization rate of resources and optimize resource allocation. The visual management system is connected to the environmental control equipment in the classroom, which can realize the automatic adjustment of indoor temperature, humidity and lighting.

4.4. Augmented Reality

Augmented reality systems include subsystems such as interactive presentations, video conferencing and wearable devices.

The Interactive Presentation Subsystem provides students with immersive learning environments, interactive teaching tools and personalized learning paths.

The video conferencing subsystem makes it more convenient to share educational resources, virtual internships and practical training off-site. Students can also conduct group discussions, work presentations and real-time Q&A via video conferencing in their daily studies.

The wearable device subsystem enables the integration of physical and virtual environments in the future classroom. Students can perceive and interact with objects and information in the virtual environment through the wearable devices. This integration will bring a new learning experience for students, making learning more intuitive and interesting.

4.5. Real-Time Recording

The real-time recording system includes subsystems such as course recording, electronic school records, and classroom response.

The course recording sub-system is able to record the whole teaching process

comprehensively, and at the same time, it can automatically identify and clip out the key contents to help students review efficiently.

The e-study file sub-system collects students' learning data, on the one hand, it builds personalized learning profiles for students and intelligently recommends learning resources and paths suitable for students, and on the other hand, it provides decision-making support for teachers to help them optimize their teaching strategies and methods to better meet students' needs.

The classroom response subsystem supports students to answer teachers' questions or participate in classroom discussions in real time through cell phones, tablets and other devices. The system can instantly analyze the data and present the students' answers in a visual form to help teachers know the students' mastery of the knowledge points and adjust their teaching rhythm and content in time.

4.6. Ubiquitous Technologies

The ubiquitous technology system includes subsystems such as cloud services and mobile terminals.

The future classroom will rely on the cloud to build a huge library of educational resources, which will be categorized according to grades, subjects, knowledge points, etc., making it easy for teachers and students to quickly retrieve and access them. Based on students' learning data, the cloud can intelligently recommend personalized learning resources. The cloud can also build a real-time interactive platform to support online Q&A, discussion and collaboration between teachers and students.

Mobile terminals such as cell phones, tablets and laptops in the future classroom will be connected to the cloud service for real-time synchronization and sharing of data. Students can use these devices to access cloud resources, participate in classroom interactions or complete learning tasks at any time and any place. In addition, the mobile terminals themselves are multi-functional learning tools, and each student can customize the learning interface of the mobile terminal according to their own preferences and needs, helping them to better organize and manage their learning resources and tasks.

5. Realistic Dilemma of Future Classroom Promotion

5.1. Large Class Sizes Are Still Prevalent

All levels and types of schools in China are characterized by swollen class sizes, large numbers of students and crowded classroom space. As a result, in terms of seating arrangement, most schools use the rice paddy style of neatly arranged vertical and horizontal rows in order to accommodate a large number of students in a small space. Under these circumstances, it is difficult to put into practice many of the designs for future classrooms.

5.2. Lack of Scientific Planning and Systematic Thinking

At present, some schools and districts, as pilots of the future classroom project,

have blindly ventured into the reform without systematic design and scientific planning, and as a result, they are only "patching" on the basis of regular teaching and learning, and fail to utilize the functions of the future classroom.

5.3. Teachers Feel Overwhelmed

The information literacy and information technology teaching skills of some teachers are inadequate. However, the training provided to teachers mainly focuses on superficial contents such as the use of the system, and teachers do not fully understand the real role of information technology in teaching and learning, which has led to teachers being at a loss as to what to do with the implementation of the future classroom project.

6. Perspective

The future classroom guides students to carry out learning freely and flexibly, improves classroom efficiency, cultivates students' independent learning ability and innovative thinking ability, and creates a new ecology of dynamic and open classrooms with continuous inquiry and generation.

The development of the future classroom is something we can foresee. First, with the development of information technology, there will be more and more types of information equipment, which will be more and more advanced, complete and interconnected. Second, the control of information equipment will be more and more simple and convenient. Third, the classroom of the future will be able to adapt to more different forms of organization of teaching and learning. Fourth, the information resources provided by the classroom system in the future will be more abundant, varied, and easy to access, and will allow for personalized intervention.

Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Zhou, Y., Qiu, X.P. and Zhao, W.L. (2016) Talking about the Future Classroom. *New Education Era Electronic Magazine* (*Teacher's Edition*), **31**, 253. (In Chinese)

[2] Radcliffe, D. (2009) A Pedagogy-Space-Technology (PST) Framework for Designing and Evaluating Learning Places. *Proceedings of the Next Generation Learning Spaces* 2008 *Colloquium*, Brisbane, 1 October 2009, 11-16.

[3] Nie, F.H., Zhong, X.L. and Song, S.Q. (2013) Smart Classroom: Conceptual Characteristics, System Model and Construction Case. *Modern Education Technology*, **23**, 5-8. (In Chinese)

[4] Zhou, C.L. and Xu, J.D. (2018) Smart Classroom Color Design Based on Emotional Experience. *Design*, **11**, 40-43. (In Chinese)

[5] Xiang, G.F. and Zhang, S.M. (2020) Acoustic Remodeling Design of Intelligent Classroom in Qiuye Lecture Hall of Zhejiang University. *Architecture and Culture*, **9**, 232-233. (In Chinese)

[6] Tang, J.H., Jiang, F.G. and Zheng, J. (2020) Designing and Reflecting on the Future Classrooms in the United States and Canada (Part 1)—Taking Case Western Reserve University and McGill University as Examples. *Information Technology Education in Primary and Secondary Schools*, **1**, 68-72. (In Chinese)