Exploring the Use of Visual Instructional Design in a Smart Classroom Environment

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Abstract: Smart classrooms are becoming increasingly common in the current information society. This paper explores the "wisdom" of smart classrooms and the characteristics of visual teaching, discusses the visual analysis methods of different knowledge types, and discusses the five stages of the visual teaching model on this basis. The visual instructional design is then carried out for different classroom models. Learning and flexibly using visual instructional design is significant for improving educators' educational skills.

With the rapid development of information technology in education, the teaching space has been changing, and increasingly teaching environments with rich online learning resources and advanced hardware and software facilities have emerged, forming smart classrooms with different characteristics [1]. At the same time, schools have begun to focus on improving teachers' teaching ability and education quality by applying the concept of knowledge visualization to teaching, and the rich technological environment in smart classrooms has created conditions for the widespread application of visual teaching methods. By visiting major universities in Sichuan Province, I found that the use of smart screens in universities is now the norm, and online interactive platforms such as Learning Pass and Ruijie are also being widely used. How can we make better use of the smart classroom, how can we make technology integrated into teaching, and improve the quality of teaching, which is a problem we are anxious to solve. This paper will discuss the use of visual instructional design in the smart classroom environment accordingly[2].

1. Concept Definition

1.1 Smart Classroom

Smart classroom is an open and intelligent interactive learning environment centered on learners, consisting of corresponding hardware and software facilities, course materials, video resources, teachers, learners, etc. Many studies have been done on the impact of smart classrooms on teachers and students, and the results show that teachers and students will evaluate the effectiveness of smart classrooms, including "interest in learning", "independent learning", "interaction" and "motivation".

"Participation", "innovation" are frequently mentioned, showing the value of smart classrooms in the teaching process[3].

1.2 Visual Teaching and Learning

Visual teaching is a discipline that studies how to use visual representations to promote knowledge transfer and innovation, and its development trend is changing from traditional static forms to dynamic and interactive forms and from two-dimensional to multi-dimensional [4]. With the development of visualization technology, visual representation forms are constantly enriched, from tables and images in the past to animations, simulation, and now interactive visualization. Visual teaching as a way to characterize things facilitates the visual display of various results. With the development of educational technology and the support of computer software, visual teaching gradually shows the developmental changes and processes of things in a simulated and visualized way. At the same time, the human-computer interaction ability brought by technology is also improving, and some interactive visualization techniques begin to be applied in the teaching field [5].

1.3 Ways of Visualization

(A)Concept diagram
Concept diagram generally consists of concept nodes, connections, and connecting words. The concept nodes represent a knowledge concept, which can be composed of graphics or text, and the same level of concepts are represented by the same symbols[6]; the connections represent the interrelationship between different knowledge concepts, and different shapes of lines can be used to represent different relationship characteristics; the connecting words can be a specific description of knowledge concepts, and can also show the specific relationship between concepts. For example, a concept map can be used to explain several ways in which substances enter and exit cells in biology classes, as shown in Figure 1.
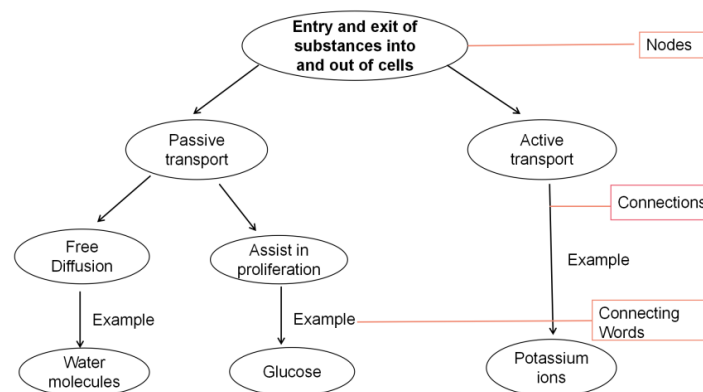

Figure 1: Concept diagram using in biology

In figure1, nodes are concepts placed in circles, connecting lines indicate the meaningful relationships between nodal concepts. Connecting words are meaningful linking words between two concepts placed on a connecting line.

(B) Mind map
A mind map is a way to visualize human thinking. The natural way of human brain is to think in a diffuse way. When each thing enters the brain, whether it is a feeling, a memory, or an idea, it can

become a core theme of thinking, and from this core, multiple nodes are dispersed outward, each level of nodes represents the connection with the previous level of theme, spreading from the center to the surrounding, like a large number of roots and branches[7]. Through the use of mind, maps can clarify ideas, organize information, enhance memory, improve learning efficiency for students, and provide powerful help for teachers to grasp the progress of the course, figure out the key points and difficulties of teaching, improve classroom efficiency, and enhance the effectiveness of student learning[8]. Therefore, with the help of this feature, people use it in education. Thinking maps simplify students' learning, teachers' teaching, and communication between teachers and students, and are more creative in solving complex problems, and are often used in visual teaching.For example, when introducing the history of Qin Shi Huang to students in a history class, you can use a mind map, which is more conducive to students' understanding and memory. See Figure 2 for details.
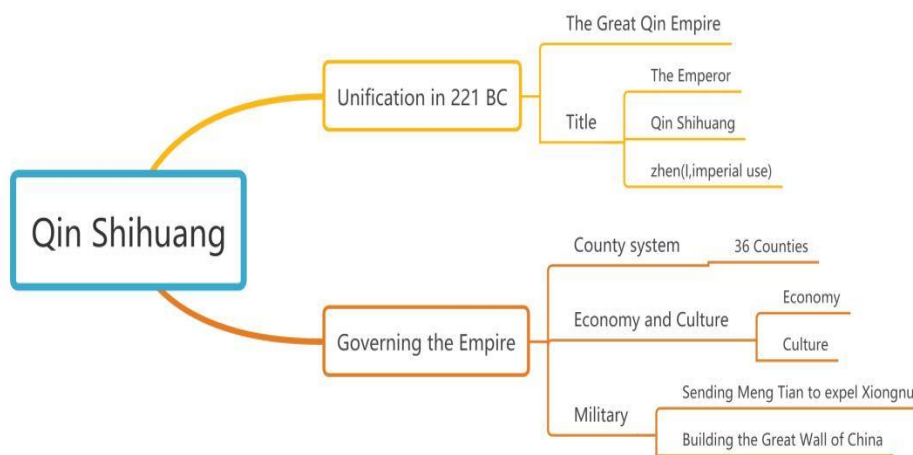

Figure 2: Mind map in history class

(C) Animation Simulation

Animation or simulation is a popular teaching method at present. Along with the development of multimedia technology, schools pay increasingly attention to the use of multimedia to assist teaching, and the use of unique animation or simulation technologies to improve the quality of the classroom has become a popular teaching method for students.

2. Visual Analysis of Knowledge Types

2.1 Visual Analysis of Conceptual Knowledge

As the first teaching arrangement, the introductory part of the preschool child development psychology will introduce the content of the course as a whole, which is a kind of conceptual knowledge. The teacher can make the corresponding concept maps and mind maps by hand or use visualization tools in the classroom, and then display the teaching through the electronic double board with the corresponding text descriptions. Certain templates and contents to be emphasized can be marked with colors. This way, the knowledge system and important contents of preschool child development psychology can be displayed visually and completely in the classroom through the electronic double board. As shown in figure 3.
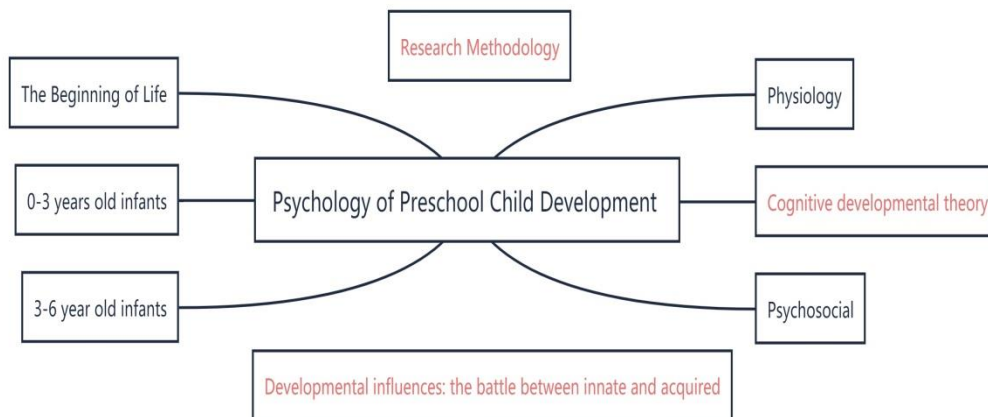
Figure 3: Visual design of conceptual knowledge

2.2 Process Knowledge

Process knowledge is knowledge that reflects how things happen and how they change. This kind of knowledge is more abstract and complex, so students cannot feel and learn it intuitively, and it is also difficult for teachers to prepare descriptions directly with words, which leads to many obstacles in the process of cognition, understanding and mastering related knowledge. Therefore, appropriate visual representations need to be designed for visual teaching. The visual representation of process knowledge can be done by knowledge modeling, i.e., establishing a representative model among knowledge to make a simplified and clear representation of knowledge principles. And in the process of visual representation, we should apply the viewpoint of system theory to combine and link the relevant knowledge with some basic visual elements, and finally realize the visualization of such knowledge as a whole. See the knowledge structure chart for the 9th grade English reading discourse to the South Pole, as shown in Figure 4.
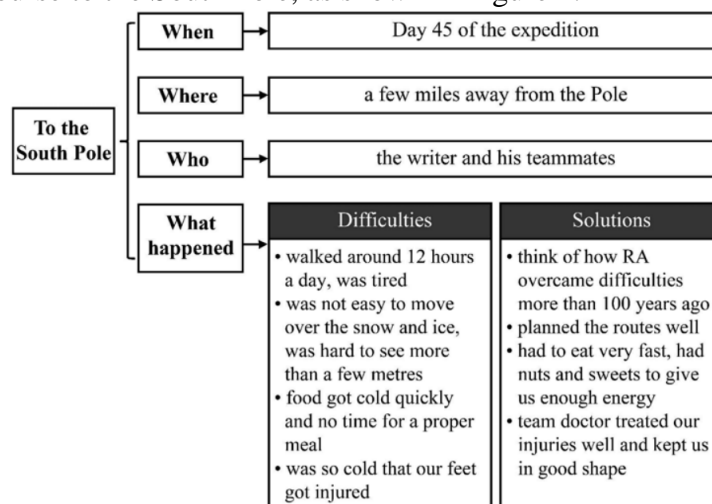

Figure 4: On the South Pole's knowledge structure chart

2.3 Skill-based Knowledge

Skill-based knowledge emphasizes students' ability to solve practical problems independently under the guidance of teachers and belongs to the category of inquiry learning. The learning of this

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kind of knowledge helps students form a deeper understanding of knowledge and is an important means to promote deeper absorption of knowledge. The visual representation of such knowledge needs to be designed in the direction of human-computer interaction, and interactive visualization teaching tools can meet this requirement [9]. These tools not only meet the requirements of student's independent inquiry learning, but are also process-oriented and hands-on. By replacing traditional teaching content with interactive visualization tools, learners can achieve a clearer and more accurate understanding, and in terms of learning motivation, these tools can increase students' interest in learning and their willingness to participate in the teaching process.
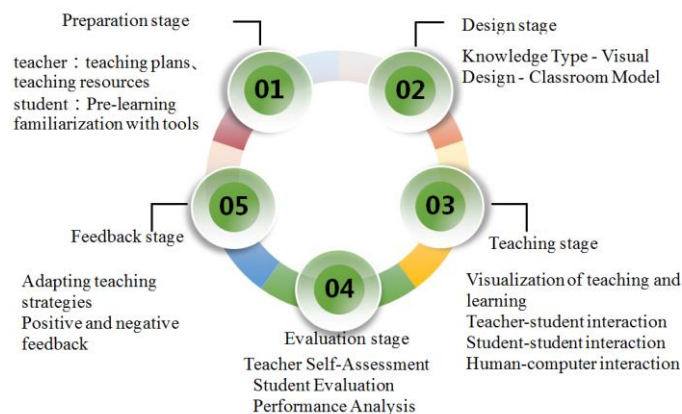
3. Visual Teaching Model

Figure 5: The five-stage model of visualization teaching

Different visual teaching models should be designed according to the characteristics of different majors and courses when using smart classrooms. For example, the course of the major of preschool education can be divided into five stages when using visual teaching, which are preparation stage, design stage teaching stage, evaluation stage, and feedback stage, as shown in Figure 5.

3.1 Preparation Stage

In the preparation stage, teachers must make effective and innovative teaching plans based on the requirements of the syllabus and according to the teaching objectives, teaching priorities, students' learning conditions, and the specific content of the teaching. While making the plan, you should prepare the corresponding teaching resources, such as relevant reference books, teaching videos, PPT, mooc resources, and so on[10]. For example, before teaching the new chapter on the developmental psychology of preschool children's perceptual development, the teacher will post prestudy tasks, students will prestudy and complete the appropriate tasks in advance, such as, investigating the auditory and visual characteristics of young children and making a video which will facilitate their discussion with teachers and classmates in class. As teacher and student, it is necessary to be familiar with the visualization tools that will be used in the teaching and learning process

3.2 Design stage

In this stage, what the teacher has to do is to determine the type of knowledge of the content to be taught, and then determine the corresponding visualization tools for visual representation. When the appropriate visualization tools are selected, then a reasonable classroom teaching model is

designed. In the process of visual teaching, the visual content needs to be illustrated with corresponding textual descriptions and displayed in the smart classroom in a graphical way. At this stage, teachers need to pay attention to clarify the type of knowledge of their lectures and then arrange effective interactive methods for visualization teaching.

3.3 Teaching stage

This stage is the implementation stage of visualization teaching, which should uphold the teacher-led, student-centered educational ideology. Three interactions will be reflected in the teaching stage, namely teacher-student interaction, student-student interaction, and human-computer interaction[11]. Teacher-student interaction emphasizes the interaction between teachers and students, as teachers should use various effective ways to guide students to participate in classroom teaching, actively participate in classroom discussions, and communicate with teachers about possible problems in teaching; student-student interaction is mostly used for after-class discussions, where teachers assign tasks for students to use their time to conduct relevant discussions, and form text, image or video materials. Human-computer interaction means that teachers should design human-computer interaction tasks in advance, actively organize students to participate in the operation of interactive visual teaching tools at the end, and fully mobilize students' learning enthusiasm and the teaching atmosphere of the classroom, such as using Learning Pass's roll call function, topic discussions, and so on. Throughout the whole teaching stage, teachers and students fully interact with each other, and students turn from passive learners to active participants and reap full rewards.

3.4 Evaluation stage

As an important step to evaluate the teaching effect, the evaluation stage is mainly divided into three aspects, including teachers' self-evaluation, i.e., teachers should analyze and summarize the problems in the whole teaching process after the class and propose a modification plan; students' evaluation can use questionnaires to assess four aspects, such as participation, attention, challenge and enjoyment, etc.; Performance analysis is a statistical analysis of students' midterm or final grades throughout the semester of determine whether the overall average grade is on an upward or downward trend. From these three aspects, the evaluation results of teaching and learning are obtained and finally summarized and analyzed to provide a reference for teachers and students to change the teaching contents and methods.

3.5 Feedback stage

The feedback stage is for teachers and students to adjust their teaching strategies according to the results of the evaluation stage, including two types of positive and negative feedback. Positive feedback means that the current teaching effect is well evaluated, the teacher's current teaching content and classroom mode are correctly chosen, students not only perform actively in class but also give positive feedback after class, and the performance of the whole class is also on an upward trend. Negative feedback means that the current teaching effect is poor, students' classroom performance is not good, and the postclass feedback is poor, and the learning performance does not change or is on a downward trend, in which case teachers need to change the teaching strategy quickly.

4. Visualization of Teaching Design Based on Classroom Model

The current teaching modes are mainly divided into three types: Didactic classroom, inquiry-based classroom, and collaborative classroom. According to the teaching characteristics of different classroom modes and combined with the visual teaching design concept in the smart classroom, the visual teaching design of different classrooms is carried out from three perspectives: visual representation, interactive format and dual-track teaching, as shown in Table 1.

Table 1: Visual teaching design based on different classroom modes

Classroom mode	Teaching; characteristics	Visual representation	Interactive format	Dual-track teaching
Didactic classroom	Teacher teaching; Student acceptance	Concept map; Mind map	Teacher-student interaction-based	Mind map + Knowledge content
Inquiry-based classroom	Teacher-led; Student inquiry	Animation, simulation; Academic tools	Teacher-student and human-computer interaction	Animation, simulation +Tips on important and difficult points
Collaborative classroom	Teacher-assisted; Student collaboration	Interactive visualization; Academic tools	Student-student, human-computer interaction-based	Interactive visualization + Operation skills

4.1 Didactic Classroom

Didactic Classroom is a teaching mode in which teachers and students systematically transfer and learn knowledge. Its teaching is characterized by students learning previous knowledge and experience through the teacher's lectures and presentation of materials. For teaching knowledge in this type of classroom, teachers should make this receptive learning more meaningful by allowing learners to connect new knowledge to learn concepts. Visual teaching in this kind of classroom should use more visual tools such as concept maps and mind maps from the perspective of visual representation to help learners discover the interrelationships between knowledge systems. And for important and difficult knowledge, some marking methods can be used, such as changing font size and color, using arrow underlines, etc., so that students can selectively pay attention to these important information and help deepen their impressions. In the form of interaction, the teacher-student interaction is the main focus, and other interaction methods are supplemented. In the teaching process, students can ask questions, answers, vote, and other feedback operations through the personal terminal with the teaching system, and the feedback for the individual should be displayed on the teacher's terminal, while the feedback for the group can be displayed on the secondary screens on both sides of the classroom, which is conducive to promoting the expression of the individual. At the same time, the "mind map + knowledge content" format can be used for dual-track teaching, so that learners understand the structure of the content learned.

4.2 Inquiry-based Classroom

The inquiry-based classroom is a teaching model in which the teacher guides students to learn from activities on their own, encouraging learners to take the initiative in the learning process and explore on their own. Its teaching characteristics are that students, under the guidance of the teacher, through conscious and active learning and exploration, discover the laws of the connection and development of things, to form their own concepts and improve the methods and abilities of

students to analyze and solve problems independently. This type of classroom teaching mainly focuses on process-oriented knowledge, which reflects the dynamic change process of things and is difficult to be accurately expressed by words. The interaction form of the classroom is mainly teacher-student and student-computer interaction, with teachers, setting tasks through teachers' terminals and students using visualization tools in their personal terminals to investigate and synchronize their operation screens to the secondary screens on both sides of the classroom in real time for teachers to grasp the learning progress and provide guidance. The main screen of the classroom gives students the necessary hints in the form of "animation, simulation + tips for important and difficult points", so that students can accurately grasp the focus of the investigation.

4.3 Collaborative Classroom

A collaborative classroom is a way of learning in which students collaborate with each other and promote each other. It is a teaching mode in which students learn in groups, and the teacher's main role is to assist the student team in sharing knowledge and creating a synergistic effect, which helps students deepen their knowledge and develop their creative abilities. This type of classroom is designed for experimental or creative courses that require hands-on and collaborative skills, and therefore uses interactive visualization tools. The interaction in the classroom is student-led and student-computer-based, with students communicating and interacting in small groups through individual learning terminals, and presenting their group results to the instructor and the class through secondary screens on both sides of the classroom. The main screen in the classroom displays interactive visualization tools and operating principles or techniques that are used to help students better complete their tasks.

5. Conclusions

In order to better innovate teaching methods, the use of smart classrooms is becoming increasingly common in university teaching. How to use smart classrooms efficiently and achieve high-quality visual teaching is a topic we keep exploring. Through this discussion, we have learned about the visual teaching model and the visual teaching design based on the classroom model, and hope that the relevant contents of this article will be helpful for us to continue to deepen the smart classroom teaching.

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