Research on Innovation and Application of Multi-dimensional Interactive Teaching Mode in Smart Classroom: Taking Junior Physics Applied Research as an Example

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Abstract. There are many phenomena such as the interaction between teachers and students is not smooth and rich in the current physics teaching of junior high school. With the help of "Guangdong Education Cloud" platform and the Digital Textbook, this paper mainly discussed multi-dimensional interactive and collaborative learning strategies, and built a multi-dimensional interactive cloud classroom model and application model. The implementation process of cloud interactive classroom teaching of junior middle school in physics was introduced as an example, and the validity of the model was verified according to the contrastive analysis of the data before and after the implementation of the multi-dimensional interactive cloud classroom.

1. Introduction
Physics is an important branch of natural science, and cultivating students' physical core literacy is one of the important goals of junior high school. The teaching method is mostly adopted in traditional teaching system. In this case the teaching and learning methods are relatively single, and the interaction between teachers and students is limited and not deep. The new curriculum standard promotes a variety of teaching methods, as well as cooperative and inquiring learning methods. At present, information technology is developing rapidly and it is deeply integrated with education, this better provides technical support for enriched and effective interaction in the classroom. It has been an important opportunity for exploring the reform of junior high school physics teaching.

2. Background of the Construction of Multi-Dimensional Interactive Smart Classroom
2.1. Integration of Information Technology and Physics Teaching
In the process of education informatization, technology and teaching are constantly converging, which is changing the form and process of traditional teaching, and physics teaching cannot be kept aside. Information technology is gradually penetrating into physics teaching. Teachers use the Internet to search or make videos and animations to stimulate students' interest in learning; through virtual simulation experiments, students are allowed to experience the process of scientific inquiry. However, there are some difficulties in this process, that is, interactions of teacher-student and student-student were not smooth and rich. This unbalanced interaction easily leads to the inactivate thinking of most students, which makes it difficult to achieve the goal of improving the thinking ability of all students.
2.2. "Guangdong Education Cloud" Project
"Guangdong Education Cloud" is one of the major plans of education informatization in Guangdong Province. It is committed to providing education informatization solutions integrating content, platform, terminal and service through education cloud technology. Based on the "Guangdong Education Cloud" public service platform, the project has built three types of "cloud based" classroom forms including cloud service, cloud interaction and cloud collaboration[1]. The cloud interactive classroom is a new teaching environment constructed by integrating cloud services, Digital Textbooks, and subject teaching tools, under the environment of one learning terminal per person. It consists of three main parts: wireless router, classroom teaching support system, learning terminal and application software.(see Figure 1). Cloud interactive classrooms provide a large number of high-quality educational resources (such as digital textbook) and personalized learning resources (such as micro-videos, assessments, question banks, subject teaching tools, etc.) through cloud services. The resources themselves are interactive.

Figure 1. Multi-dimensional interactive smart classroom of "Guangdong Education cloud".

3. Dimensional Interactive Smart Classroom and its Application Model

3.1. Multi-Dimensional Interaction Smart Classroom
Intelligent information technology is constantly integrated into education and teaching, bringing new ideas and practices to education[2]. The new technology environment can promote the innovation of subject teaching mode, and promote the development of learners' knowledge and wisdom [3]. The multi-dimensional interactive Smart Classroom refers to the learning process of using multimedia, network, cloud computing and other technologies to establish the classroom network learning environment in the traditional classroom, providing discussion, mutual exchange and information sharing channels for learners, students cooperate in the form of groups under the evaluation and incentive mechanism to effectively complete the common learning tasks and cooperate with each other. The application process is shown in Figure 2.
3.2. The Construction of Multi-Dimensional Interactive Smart Classroom Application Model

Under the guidance of teachers, students can internalize into their own knowledge system through the knowledge content of autonomous practice, thinking, and communication. And interaction and communication is an important part of it. The interactive teaching mode supported by the intelligent technology environment is conducive to the exchange and learning of students and the generation of wisdom [4]. Relying on the information technology environment, it can improve the physics classroom teaching mode, and then guide students to explore and improve their literacy [5]. Based on the multi-dimensional interactive cloud classroom, combining the characteristics of junior high school physics teaching, highlighting the characteristics of group collaborative learning, this paper constructs the "multi-dimensional interactive cloud classroom application model of junior high school physics" (as shown in Figure 3).
4. Practice of Multi-Dimensional Interactive Cloud Classroom in Junior High School Physics

4.1. The Teaching Case of Multi-Dimensional Interactive Cloud Classroom in Junior High School Physics

Next, this paper takes the teaching design of junior middle school physics "work" in people's edition as an example to illustrate the application and effect of multi-dimensional interactive cloud classroom in practice teaching.

4.1.1. Case overview

"Work" is the content of section 1 of Chapter 11 "work and mechanical energy" in the PEP Physics Volume II of Grade 8. Based on the students' preliminary knowledge of force, helping students to understand that the work formula is \( W = FS \). It is difficult for students to have a deep understanding in a short time, so we should gradually expand and deepen it. This class used the "PEP Digital Textbook", made full use of the statistical feedback, personalized evaluation functions of the "Guangdong education cloud" classroom, and carried out the "learning before teaching, mutual group help" collaborative learning with tablet computers.

4.1.2. Analysis of learning situation

Students already have a certain basic knowledge of mechanics, but their abstract thinking is not yet mature, they still need some perceptual knowledge to support. In teaching, we should use multimedia and case analysis to strengthen intuitiveness and image, and guide students to make full use of the existing knowledge to build the concept of "work".

4.1.3. Design of teaching activities

According to the multi-dimensional interactive cloud classroom teaching mode, we provide teachers and students with full interaction in various forms and links in teaching activities based on the "Guangdong Education cloud". Before teaching, let students group freely according to their own interests, use the tablet to preview the content of the "PEP Digital Textbook" course. In classroom teaching, the classroom teaching is divided into five links. Relying on the "Guangdong Education cloud" classroom and "PEP Digital Textbook", we created learning activities that help knowledge discovery and understanding based on interactions. The specific content of the activities, resources of the activities.

4.1.4. Teaching reflection

In this lesson, students' self-study experience, lectures, group discussions and other teaching methods are applied comprehensively, and the interaction between teachers and students is efficient. Digital Textbooks are rich in electronic textbook resources. Students use the communication and interactive platform provided by digital textbooks to engage in activities such as communication and collaboration, knowledge exploration, collaborative learning, problem formation and other activities with their peers. During the learning process, learning archive records was formed.

4.2. Analysis on the Application Effect of Multi-Dimensional Interactive Cloud Classroom in Junior Middle School Physics

4.2.1. Experiment design

In order to better evaluate the effect of the multi-dimensional interactive cloud classroom, a total of 94 students from two classes in the second grade of junior middle school (that is, junior two in class 1 and in class 2) were randomly selected as experimental subjects. In this study, the results of physics mid-term examination in the first semester of the second grade of junior middle school are selected as the pretest scores of the two classes before the experimental control. The results of pretest scores analysis show that there is no significant difference in the physical level of the two classes (\( t = -0.031, P = 0.975 > 0.05 \)), as shown in Table 3.
4.2.2. Data analysis

(1) Analysis of pretest results
According to the analysis of the results of physics mid-term examination in class 1 and class 2 of grade 2, there is no significant difference between the two classes in pretest scores, that is, the physical level of the students in class 1 (experimental class) and class 2 (control class) before the experimental control is the same.

Table 1. Pretest-Descriptive Analysis

| Class                | N  | Mean | Standard deviation | Standard error of mean value |
|----------------------|----|------|--------------------|-----------------------------|
| Pretest results      |    |      |                    |                             |
| Class 1 grade two    | 47 | 73.02| 20.889             | 3.047                       |
| Class 2 grade two    | 47 | 73.15| 18.448             | 2.691                       |

Table 2. Pretest-independent sample T test

| Levene test of variance equation | test of the mean equation | 95% confidence interval of difference |
|----------------------------------|---------------------------|--------------------------------------|
| F      | Sig. | t    | df   | Sig. (bilateral) | Mean difference | Standard error | Lower limit | Upper limit |
| Pretest results                  |                            |                                     |
| Assuming equal variance          | .369 .545                 | -.031                               | 92             | .975           | -.128        | 4.065       | -8.202      | 7.946       |
| Assuming variance is not equal   |                           |                                     |
|                                  |                           |                                     | 90.615         | .975           | -.128        | 4.065       | -8.203      | 7.948       |

(2) Analysis of post test results
After the experiment, the students in the experimental class and the control class were tested at the end of the semester. After the experimental control, the performance of the experimental class is significantly higher than that of the control class. The experimental results show that providing multi-dimensional interactive cloud classrooms can improve students' academic performance.

4.3. Teachers' Overall Evaluation of the Research Effect
For the research results, the teachers who participated in the research all agreed that: The physics teachers in charge are all the first-line teachers with rich teaching experience. Before the experiment, the teacher in the experimental class had two months' training on the application ability of "Guangdong education cloud" classroom teaching during the summer vacation. The advantages of the multi-dimensional interactive cloud classroom application model are summarized as follows:

(1) Create a teaching platform that facilitates deep collaboration.
Based on the teaching platform constructed by "Guangdong education cloud", the network teaching and classroom teaching are organically integrated, so that the teaching activities are extended in time and space, which makes up for the lack of a single classroom teaching method.

(2) Expand the way of communication.
The multi-dimensional interactive cloud classroom provides an instant and effective communication tool, which enables real-time and asynchronous communication and sharing between teachers and students, and enriches the communication means and ways. In the learning process with members of the group process, in order to achieve the group learning goals, students can use dialogues,
discussions, disputes and other forms[6] to fully demonstrate the problem, and then obtain the best way to achieve the learning goals.

(3) Expand the personalized learning space.
In the multi-dimensional interactive cloud classroom, learners use the "Guangdong education cloud" environment to set up a personal learning environment according to different topics, plan and manage personal learning, and freely choose the required learning resources and services. The "Guangdong education cloud" auxiliary teaching platform fully highlights the learners’ identity and provides a space for extension and expansion for their learning.

(4) Increased interest in collaboration.
The visual resources and tools provide a function for “Guangdong education Cloud”platform that supports multiple people to collaborate and modify files at the same time. Online collaboration is convenient and fast, just like face-to-face communication. The human-oriented design removes all obstacles for collaborative learning, increases the interest in collaboration, and ensures the effectiveness of collaborative learning.

5. Conclusion
The multi-dimensional interactive cloud classroom in junior middle school physics is an innovative teaching scheme that is being explored and tried. With the continuous advancement of the "multi-dimensional interactive cloud classroom" model in schools, students' learning methods has changed from passive acceptance to autonomous choice now, including knowledge points of interest, learning time, and information selection and integration. The deep participation in learning process has greatly improved the students' ability. For teachers, with the help of "Guangdong education cloud" project and "teachers' information technology application ability improvement project" in Zhuhai, the information technology ability of teachers participating in the "interactive cloud classroom" Application in teaching exploration has been improved rapidly.

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7. References
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