Design and Construction of Information-based Teaching Cloud Space in Colleges and Universities under the Framework of TPACK

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Abstract. In order to improve the quality of information-based teaching in colleges and universities, promote the penetration of information technology into the classroom, and improve the teaching effect, based on the TPACK framework, this paper designs the information-based teaching cloud space in colleges and universities, and constructs the system framework by combining the learning theory and teaching needs with the characteristics of the cloud space. Teaching cloud space is to carry out research from four dimensions: technology dimension, teaching dimension, discipline dimension and deep learning dimension, to realize the integration of technology and education and teaching ideas, and to build a personalized teaching cloud space. The research results show that the information-based teaching cloud space based on TPACK theory can improve the teaching of practical courses and stimulate students' curiosity and enthusiasm for learning.

1. Introduction

With the continuous development of high and new technology, the traditional teaching methods have been unable to meet the actual needs of teaching in colleges and universities, and the combination of information technology and education and teaching is getting closer and closer. On the one hand, it helps colleges and universities to deepen teaching reform and promote the innovation of teaching methods. On the other hand, it is of great significance for teachers to improve their teaching ability, explore and stimulate students' in-depth learning. At present, the application depth of information technology in university teaching is still lacking, and there is a lack of shared personalized teaching cloud space for schools, teachers and students, which is used to solve practical problems in classroom teaching. Therefore, under the guidance of TPACK framework and from the perspective of resource integration, this paper designs and constructs a set of personalized teaching cloud space platform which can be used in information-based teaching in colleges and universities, so as to improve the shortcomings in classroom teaching and stimulate students' enthusiasm for learning.

Teaching cloud space takes cloud computing as the framework, teachers and students as the main body of co-construction and sharing, brings together teaching and learning-related information, resources and services, and provides users with a one-stop interactive learning cyberspace to meet the online communication between students and teachers. A shared platform to help students achieve autonomous learning, inquiry learning and collaborative learning.
2. TPACK theory and its constituent elements

In 2015, Mishra and Koehler put forward the subject teaching method of integrating technology, which is called TPACK theoretical framework (Technological Pedagogical and Content Knowledge) [1]. TPACK framework mainly includes subject knowledge (CK), teaching method knowledge (PK), technical knowledge (TK) three kinds of core knowledge and four kinds of compound elements [2]. The four kinds of composite element division are formed by the integration of three kinds of core knowledge, which emphasizes the integration and practice of technology, subject knowledge and teaching methods, as shown in figure 1.

![Figure 1. Theoretical framework of TPACK.](image)

Fig.1 merges pedagogy knowledge (competition) and discipline knowledge (CK), produces discipline pedagogy knowledge (PCK), merges technical knowledge (TK) and discipline knowledge (CK), information discipline knowledge (TCK), integrates technical knowledge (TK) and pedagogy knowledge (competition), produces information-based teaching knowledge (TPK), and produces information-based subject teaching knowledge (TPACK).

3. The design and construction of information-based teaching cloud space in colleges and universities

3.1. The construction dimension of information-based teaching cloud space based on TPACK framework

TPACK framework is an ideological framework that integrates technology, discipline and teaching. It meets the principles of teaching cloud space and the teaching needs of teachers and students [3]. Therefore, based on the TPACK framework, this paper constructs and designs the teaching cloud space with the integration of technology, teaching method and subject knowledge, so as to make the teaching cloud space more in line with the actual needs of discipline teaching in colleges and universities. The dimension of information-based teaching cloud space based on TPACK framework can be divided into three aspects: technology dimension, subject content dimension and teaching method dimension. Technology dimension, also known as teaching cloud space technology dimension, mainly refers to cloud computing, data visualization, educational data mining and analysis and other related technologies used to build cloud space. Technology dimension is not only the basis of
supporting and constructing teaching cloud space, but also the key link to realize the design and application of cloud space. The discipline content dimension refers to the specific subject tasks and teaching contents of the university discipline, such as the course knowledge points and skill points of learning, and so on. The dimension of teaching method refers to the teaching methods, teaching methods and teaching strategies used by teachers.

The integration of teaching cloud space dimension, subject content dimension and teaching method dimension produces four new dimensions. They are the integration of discipline resources dimension, the integration of discipline knowledge demand dimension, the integration of technology teaching demand dimension, the integration of technology discipline teaching demand dimension. The teaching cloud space technology dimension and the discipline content dimension are integrated to produce resources such as discipline shared resource database, discipline tools and so on. The subject content and the teaching dimension are integrated to produce specific curriculum knowledge content to meet the needs of training students. Learning cloud space technology dimensions and teaching methods will be integrated to produce personalized learning teaching methods and methods, such as deep learning, autonomous learning, collaborative learning and so on. The integration of the three dimensions can produce personalized dynamic learning space, visualize the learning process, guide and help students to set up learning paths independently, in order to meet the teaching needs of the subject. As shown in figure 2.

![Spatial dimension of information-based teaching cloud based on TPACK framework](image)

**Figure 2.** Spatial dimension of information-based teaching cloud based on TPACK framework.

### 3.2. Cloud Space system Architecture of Information-based Teaching based on Cloud Computing Technology

The cloud space system architecture of information-based teaching based on cloud computing technology is based on technology dimension, subject content dimension and teaching method dimension, and takes the key technologies of cloud technology as the core to build the system framework. The architecture of teaching cloud space system is composed of cloud platform infrastructure layer, data storage layer, model layer, core service layer and interactive application layer. As shown in figure 3.

The infrastructure layer takes virtualization as the core, including server virtualization, storage virtualization, network virtualization and so on. Based on cloud platform network resources, management nodes, computing nodes and storage nodes, the infrastructure layer improves the reliability and scalability of cloud space and realizes personalized customization of cloud space. The
principle of the infrastructure layer is to use the cloud computing management software to manage and call the underlying resources, and then support and share the data through the distributed storage system, in which the management node adopts Nova, Neutron and Cinder in the OpenStack component[4], the computing node uses the Linux system and the KVM virtual host, and the storage node uses the Ceph component to provide shared storage services for the teaching cloud space. As shown in figure 4.

Figure 3. Cloud space system architecture of information-based teaching based on cloud computing technology.

Figure 4. Key technologies of the infrastructure layer of the platform.
The model layer is based on the data of the data storage layer to build the student model and teaching model [5], and then use the similarity calculation method to match, so as to provide the basis for the personalized service of the core service layer. The core service layer mainly shows the process of course teaching [6], including the autonomy of learning methods, the visualization and interaction of learning process, the recommendation and mining of learning paths, the fragmentation of learning resources, and so on. The interactive application layer mainly supports students and teachers to communicate with each other using cloud space. Students can achieve topic-based inquiry collaborative learning in the space, and can also share and recommend knowledge and experience in the space. Teachers can manage and supervise the students’ learning process, set up the students’ learning environment, evaluate the learning effect and so on.

4. Cloud space teaching mode of information-based teaching in colleges and universities under the framework of TPACK

The cloud space teaching model of information-based teaching studied in this paper is mainly an inquiry teaching model with students as the main body and learning content as the theme. In this model, teacher activities and student activities are related to each other, which is divided into four links: clear theme, division of labor among members, collaborative inquiry and achievement presentation. First of all, teachers guide and suggest students to set up cooperative groups according to their interests and directions, analyze the objectives of exploration, make use of the theme recommendation of teaching cloud space, create situations, and determine the subject content of the final exploration [7]. Then, the groups discuss and communicate in the teaching cloud space, and teachers provide resources and interactive support for the group through the teaching cloud space to clarify the specific tasks of the group members and ensure that students can make preliminary research plans. Then, students use the learning resources and collaborative environment in the teaching cloud space to determine the final implementation plan through many discussions and communication. Finally, the team members use the learning points and visualization tools in the teaching cloud space to monitor and improve the learning effect, and show the final product, and the teachers evaluate and summarize according to the learning process data of the teaching cloud space. to help students sort out the details and problems ignored in the process of self-inquiry learning. As shown in figure 5.

5. Conclusion

In order to better improve the quality of information-based teaching in university classroom, based on the theoretical framework of TPACK, this paper analyses the elements of constructing university information-based classroom from the dimensions of technology, subject content and teaching method, and designs an information-based teaching cloud space system based on cloud computing technology, which effectively integrates educational ideas with information technology, improves teaching ideas and teaching methods, and finally draws a conclusion that students are the main body. The inquiry teaching mode with learning content as the main body provides a good reference for students’ in-depth
learning. In the future, we will further refine the teaching model, and verify and analyse the effectiveness in the teaching process, in order to better improve the construction of teaching cloud space and promote the reform and practice of information-based teaching in colleges and universities.

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