



An empirical study of blended teaching model based on SPOC—— Take the course "Modern Educational Technology" as an example

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Abstract

Background: In order to fight the epidemic, the Ministry of Education, PRC has put forward a work plan of "no suspension of classes", which promotes the sharing of high-quality online teaching resources through online education, promotes the "classroom revolution" by changing teaching and learning methods, and provides a learning platform with network technology, thus promoting the development of mixed teaching.

Statistical analysis: In order to adapt to the development trend of contemporary educational information and fully consider the principal position of students. **Finding:** a blended teaching mode based on SPOC which is suitable for the courses combining theory and practice is formulated. Taking the course of "Modern Educational Technology" as an example, the blended teaching is studied in detail. **Applications:** in order to provide reference for future blended teaching research.

Index Terms

SPOC Blended teaching model Online teaching E-learning Instructional design model

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- Manuscript received January 21, 2022.
- Revised February 24, 2022 ; Accepted March 21, 2022.
- Date of publication March 31, 2022.

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I. INTRODUCTION

With the rapid development of information technology, today's society has entered the era of "Internet plus". In 2015, The State Council issued the Guiding Opinions of The State Council on Actively Promoting the "Internet plus" Action ^[1], which clearly pointed out that "the integrated development of the Internet and education has broad prospects and unlimited potential, and has gradually become an irresistible trend of The Times.

From the Education Informatization 2.0 Action Plan ^[2] issued by the Ministry of Education in April 2018 to China's Education Modernization 2035 ^[3] issued in February 2019, it can be seen that online teaching as an important form of "Internet + education" is receiving increasing attention. The current strategic task is to speed up the educational reform in the information age, improve students' information technology literacy, and then promote the development of education information. ^[4]

Affected by the epidemic, on February 4, 2020, the Ministry of Education issued the Guidance on The Organization and Management of Online Teaching in Colleges and Universities during the Epidemic Prevention and Control Period ^[5], which proposed the postponement of the opening and required all colleges and universities to actively carry out online teaching. Since then, colleges and universities across the country have issued online teaching programs and encouraged teachers and students to actively carry out online teaching activities. ^[6]

II. REVIEW OF RELEVANT ACADEMIC RESEARCH

SPOC was first proposed and used by Professor Fox of University of California, Berkeley. In 2013, Harvard University conducted a SPOC experiment on three courses. Later, Duke university and Vanderbilt University also adopted different forms of blended learning. In April 2013, The NovoED platform launched by Stanford University also began to offer SPOCs such as Stanford executive education courses.

According to Deng Meizhen, SPOC hybrid teaching mode perfectly integrates traditional classroom teaching with information technology, and is a hybrid teaching mode combining online teaching (online teaching) and classroom teaching (offline teaching). ^[7] Zhang Yang believes that through SPOC and its platform, teachers and students can interact fully, timely and effectively anytime, anywhere, online and offline, and SPOC helps teachers know more about students and realize personalized teaching. ^[8] Zhong Lixia. constructed a

SPOC-oriented research and development method of "elastic presupposition - use excitation - generation creation - evaluation reflection" through research. The research strategies, such as creating interactive resources by using multimedia, real-time communication and feedback based on their own digital devices, task-driven problem exploration, three-dimensional development evaluation and reflection analysis and summary, have been formed. ^[9]

At present, the focus of research on online courses is gradually shifting from course construction to learners themselves. Therefore, open online courses pay more attention to the course satisfaction and participation of learners, as well as the cultivation of learners' abilities and learning effects. Teaching mode should also combine the concept of hybrid teaching to design teaching content, integrate learning resources and construct online and offline teaching environment.

III. THEORETICAL SUPPORT OF BLENDED TEACHING BASED ON SPOC

A. *Learner-centered constructivism learning theory*

Constructivists believe that learning is the process of establishing connections between old and new knowledge, the process of interaction between people, and the process of construction. Learners must construct their knowledge from the experience they have learned. ^[10] Constructivist learning theory emphasizes that learning is an active constructive practice with clear intention, including interactive intention, behavior, reflection and other behaviors. The blended teaching mode based on SPOC enables students to learn independently and construct knowledge system according to the task list before class, laying a good foundation for classroom learning.

B. *Deep learning theory*

Bloom divides the dimensions of cognitive processes into six levels: memory, understanding, application, analysis, evaluation, and creation. In the current classroom teaching, the vast majority of teachers' teaching work can only stay in how to guide students to actively carry out shallow learning activities, and the overall comprehensive use of knowledge and creative problem solving concerns have not been paid enough attention in teaching. The blended teaching mode based on SPOC realizes the reverse innovation of the teaching process. Students internalize knowledge in the form of discussion, practice, teacher guidance and help after pre-class learning, thus improving students' learning ability.

IV. BASIC CONNOTATION OF SPOC AND BLENDED TEACHING

A. SPOC

SPOC (short for Small Private Online Course) is "small-scale restricted Online courses". SPOC is a deep integration of MOOC and classroom teaching. Compared with MOOC, SPOC is suitable for small-scale groups in schools, classrooms and other similar environments. The main feature is the combination of online teaching and offline face-to-face teaching. Online learners take SPOC courses with requirements such as study time, participation in discussions, completion of assignments and exams.

B. Blended Teaching

After years of development, the definition of blended teaching gradually changed from broad to refined, and it is generally accepted as "blended teaching = online learning + face-to-face teaching". Students can not only use the rich network for learning, but also with teachers and classmates at any time for online communication and discussion, teachers and students can also face to face communication. [11] Li Kedong believes that "the main idea of blended learning is the integration of face-to-face teaching and online learning". [12] Professor Heckang pointed out that "The so-called hybrid Learning is to combine the advantages of traditional Learning methods with the advantages of e-learning. [13] In other words, only when students learn independently, practice and create actively, teachers inspire and guide students to assist them in learning, and students and teachers cooperate to complete learning tasks, can good learning effects be achieved. The academic circles at home and abroad have also given several definitions of "blended teaching", such as that blended learning is a mixture of various teaching media; It is a mixture of "teaching-centered" and "learning-centered" teaching modes. [14][15] Some scholars believe that blended teaching is actually a flexible teaching method, which provides optimized learning solutions according to the needs of different learners. [16]

In this study, the blended teaching mode is the combination of face-to-face teaching and online learning. In the teaching technology to combine a variety of multimedia technology; The teacher-student relationship should be combined with teacher-student relationship. In teaching evaluation, the combination of process evaluation and result evaluation is called "blended teaching based on SPOC".

V. THE CONSTRUCTION OF BLENDED TEACHING MODE BASED ON SPOC

A. Introduction to learning

Through the previous study, students have mastered the information technology related content, and have a preliminary understanding of modern teaching environment and courseware making, which lays a foundation for the learning of this course content. Stage of the students have good learning ability, the ability to autonomous learning, the content of each class and the knowledge to preview and comb, to watch the class video understanding teachers teaching content, in addition, students also have a certain analysis and problem solving ability and logical thinking ability, can according to what they have learned content to question and thinking to solve, and at the same time, Students also have some hands-on ability, can collect learning materials and design courseware.

B. Introduction to learning

At present, this course has the following problems: there are few class hours in one class, but there are many software to learn in the class. The modern educational technology course only takes 32 class hours. The theory and practical knowledge of INFORMATION technology such as PS, Goldwave, Multi-color Animation Master, PPT and Focusky are all taught to students. Each software can allocate less learning time, so students have less time for practical operation, and students cannot fully master the application of the software. Second, teachers often only pay attention to whether students can master knowledge, but do not pay attention to whether students cultivate their ability, let alone their interest in learning, so students' learning ability, cooperation and communication ability and thinking ability cannot be well improved. Third, classroom teaching has always been "teachers speak and students listen", that is, teachers impart knowledge to students in a one-way manner. The lack of necessary interaction between teachers and students also results in inflexible teaching content and poor teaching effect. Fourth, students' learning effect is evaluated in a single way, most of which is written and written. Students' learning ability and thinking ability can not be well evaluated, nor can they test the improvement of ability.

C. Course structure

As a comprehensive course, "modern educational technology" is an elective course combining theory and practice for teachers' major. The modern educational technology course of Yanbian University is 32 class hours, which includes theoretical content and skill practice content. Among them, there are more skills content and less class hours, so students

cannot fully master the course content through the existing class hours and apply the knowledge to specific operations. Therefore, this course adopts the blended teaching mode based on SPOC. The course is jointly taught by several teachers majoring in educational technology, each teacher is responsible for one software teaching, and the teaching object is the normal university students from all majors who take this course.

Teachers should first formulate teaching tasks according to the teaching syllabus and teaching objectives. In the hybrid teaching mode based on SPOC, theoretical and practical knowledge must be interspersed with teaching, so that students can master the theoretical basis flexibly and then apply it to practice, so as to achieve better learning effects. According to the knowledge structure system, the whole course is divided into three parts: theory, practice and integration, and there are six modules, each of which contains specific knowledge points. The course structure system is shown in Fig. 1.

	Teaching module	Teaching hour	Teaching content
Theory	Overview of modern educational technology	4	Basic concept, theoretical basis, function and development trend of modern educational technology
	Modern teaching environment multimedia classroom	7	Multimedia network classroom. Microteaching system digital campus network. Intelligent classroom. Virtual simulation learning environment
Practice	Acquisition and processing of teaching media	5	Overview of mathematical media. Multimedia material collection. Image, sound animation material processing
	Multimedia courseware making	6	Multimedia courseware design: PPT and Focusky courseware making. Design and application of Network courseware integration
Integration	Digital learning resources on the Web	3	Overview, retrieval, communication and resource sharing of digital learning resources
	Information technology and curriculum integration	7	Overview and implementation of information technology and curriculum integration: Inquiry-based learning; Informationization, flipped classroom teaching design; Microclass make

Fig. 1. Course structure system

D. Pattern structure process construction

Under the guidance of the above theories, on the basis of integrating the characteristics of SPOC courses and the advantages of the blended teaching mode, this study proposes a 3*3 stage structure process of the blended teaching mode based on SPOC that combines pre-class, in-class and after-class with online, offline and evaluation, and its framework is shown in Fig. 2.

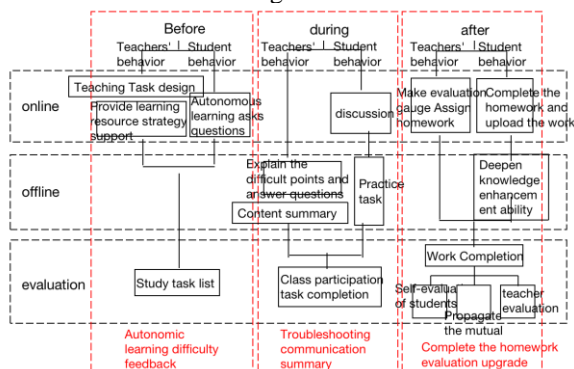


Fig. 2. Structure flow of blended teaching mode based on SPOC

a. Pre-class preparation

The pre-class preparation stage mainly focuses on autonomous learning and difficult feedback. The main task of teachers is to complete the design of teaching tasks for each class, and provide online learning resource strategy support for students with the goal of supporting the completion of teaching tasks. Learning resources need to be designed and integrated by teachers according to the teaching content, including micro-lesson videos recorded by teachers according to the content of each course, PPT of teaching courseware and materials required by the course. The materials include learning software installation files, work cases, images and audio materials required for the production of works, and evaluation measures. Policy support is issued by the teacher before every class of learning tasks, students according to the task list indicating this preview class learning content and comb, micro course video to watch and download learning materials, micro tutorial in the form of a radio or a multiple-choice review set knowledge, further deepen impression, learning to ask questions after the students' autonomous learning. Students will summarize the difficult problems and give feedback through the platform. Teachers will evaluate the students' learning situation based on the completion of the learning task list, and prepare for teaching in class according to the difficult questions raised by students, and make precise teaching. The pre-class preparation stage can effectively cultivate students' ability to study independently and raise questions, so that students become active seekers of knowledge.

b. In-class teaching

During the teaching stage, the students are divided into several groups to discuss and exchange what they have learned and difficult problems before class and try to solve them together. Discussion and communication are carried out through online platforms, QQ, wechat groups and other forms. Offline activities mainly teachers explain difficult point, solve students' problems, as well as content summary is given priority to, the teacher teaching according to the course characteristics and students' learning situation, understand the learning content is due to the students before class, class again after the teacher to explain and solve, students learn more quickly and efficiently to content, it also saving time for classroom practice, After the teacher's explanation, the students will release the exercise task, and the students will complete the task independently or cooperatively according to their own situation. After the task is completed, the teacher guides the students to summarize the key and difficult points, sort out the content learned in this section, and further realize the construction of

knowledge system. In terms of evaluation, teachers evaluate students' participation in class and knowledge mastery according to their participation in discussion and completion of tasks. Teachers can understand students' problems in the comprehensive application of knowledge and give specific guidance while accepting the results of learning tasks.

c. After-school promotion stage

The after-school promotion stage mainly focuses on homework completion and evaluation. Teachers assign homework online and formulate evaluation criteria, students complete homework and upload works according to evaluation criteria, and offline students further deepen their knowledge and improve their ability of information technology application by completing works. In terms of evaluation, there are three aspects of evaluation based on the completion of students' works, including students' self-evaluation, students' mutual evaluation and teachers' evaluation. Students will self-evaluate the completed works according to the learning task list, and then evaluate the works of other members in the group. Finally, teachers will evaluate the works. Through the content of the works, teachers can also understand the degree of knowledge mastered by students, and further accurate teaching.

d. Evaluate feedback

SPOC based hybrid teaching mode, evaluation feedback system throughout the teaching process of this research adopts the evaluation with summative evaluation, evaluation before class, class and class three stages in the process of teaching and learning completion of teaching, students learning situation and existing problems of teachers according to the results of the evaluation feedback precise teaching, Students can also integrate problems in their studies. The evaluation system based on network platform has more accurate data and more fair evaluation.

VI. IMPLEMENTATION EFFECT

In order to ensure the reliability and authenticity of the experimental results, the selection of elective course "modern education technology" for that in comparative classes class A of grade 2017 and grade 2018 B class successively investigated, that in comparative classes use the traditional teaching mode, experimental classes hybrid teaching mode based on SPOC respondents are to be engaged in education related professional college students in the future. To better understand the students through the teaching model based on hybrid SPOC learning of information technology application ability and level of cognitive development and the changes of situation to acceptance of the new teaching model, this study in experiments before and after the

experiment carries on the questionnaire survey to the student, the former measuring reference questionnaire developed by famous experts of teachers "self-assessment tool of students' information technology application ability" [17]. The questionnaire is divided into three dimensions of basic technical literacy, technology-supported learning and technology-supported teaching to evaluate the it application ability of normal university students. Post-test questionnaire added satisfaction survey on the basis of pre-test questionnaire. After the course, data were collected for statistical analysis through SPSS.

The α coefficient test method was used to test the reliability of the pre - and post-test questionnaires. The kronbach coefficient value of 0.968 was an ideal state, and the questionnaire had a high reliability. KMO and Bartlett were used to test the questionnaire validity. The KMO values of the questionnaire before and after test were 0.934 and 0.953 respectively, indicating that the questionnaire validity was high.

A. Dimension data

a. Samples before the experiment

In order to study the overall impact of curriculum design on students' cognitive level, the cognitive level of 2017 Class A students and 2018 class B students before the experiment were compared, and the P value was greater than 0.05. It was concluded that there was no significant difference in the cognitive level of the two classes in the three dimensions of basic technical literacy, technology-supported learning and technology-supported teaching.

b. Comparison of control class before and after the experiment

It can be seen from the analysis that the students in Class A of 2017 have p values less than 0.05 in all dimensions except information responsibility. It can be seen that there are significant differences in dimension measurement data before and after the experiment except information responsibility. In the dimensions of the attitude dimension of consciousness, research innovation, the resources to reserves dimension, process design, dimension and practice dimensions, the information technology application ability of students have obvious increase, but in a technical environment dimension, autonomous learning dimension, communication coordination dimensions, although the information technology application ability of students has little rise but not obvious.

c. Comparison of experimental class before and after the experiment

As shown in Table 1, students in Class B of grade 2018 had P values less than 0.05 in all dimensions except information responsibility. It can be seen that there were significant differences in dimension measurement data before and after the experiment except information responsibility. Experimental class information responsibility dimension p value is 0.594, is greater than 0.05, the specification information responsible for dimension data, there was no significant difference before and after the experiment analysis, the scores of dimensions students options experimental classes in the pretest information responsibility dimensions mean value of 4.35 (5 is highest), thus it can be seen in the experimental class students have generally have information before responsibility.

Table 1. COMPARISON OF TEST BEFORE AND AFTER IN CLASS B OF 2018

	average	standard deviation	Standard error of the mean	t	df	Sig (both sides)
consciousness and attitude	-.36117	.88829	.08753	-4.126	102	.000
Technical environment	-.64401	.89383	.08807	-7.312	102	.000
information responsibility	-.04854	.92226	.09087	-.534	102	.594
autonomous learning	-.47896	.99582	.09812	-4.881	102	.000
Communication and cooperation	-.43932	.89625	.08831	-4.975	102	.000
Research innovation	-.59917	1.01274	.09979	-6.004	102	.000
Resource readiness	-.61165	1.01171	.09969	-6.136	102	.000
Process design	-.77913	1.10065	.10065	-7.741	102	.000
Practice reserve	-.79450	.09529	.09529	-8.338	102	.000

Through a comparative study on the data of "modern Educational Technology" teaching before and after class by applying the hybrid teaching mode based on SPOC for class B students of grade 2018, the analysis of experimental results shows that in the technological environment, the number of students unable to skillfully operate the multimedia teaching equipment in the classroom has decreased from 21.55% to 4.85%. In autonomous learning, the number of students who can use information technology tools to assist learning has increased by 29.28%, and there is an obvious increase, which has achieved a certain effect. In research and innovation, the number of students who can process and analyze data by using data processing software rationally for specific problems increased by 29.4%. In resource preparation, most students can reasonably choose technical tools to manage digital educational resources according to the needs of backup, sharing and collaboration. In addition, in the dimension of process design and practice reserve, students' information technology application ability also improved significantly, but in the dimension of consciousness and attitude and communication and cooperation, students' information technology

application ability improved slightly but not significantly.

d. Post-experiment comparison of control class and experimental class

As shown in Table 2 below, after comparing the cognitive level of class A 2017 students and Class B 2018 students after the experiment, it can be seen that Sig values of the nine dimensions of the two classes are all greater than 0.05, with homogeneity of variance and P values less than 0.05, indicating that there are significant differences in the ability level of the two classes in these nine dimensions.

Table 2. COMPARISON OF POST-TEST BETWEEN CLASS A OF 2017 AND CLASS B OF 2018

	F	Sig	t	df	Sig (both sides)	Mean difference
consciousness and attitude	.001	.976	-3.748	224	.000	-.35351
Technical environment	.431	.512	-4.688	224	.000	-.39208
information responsibility	.022	.881	-2.869	224	.005	-.26187
autonomous learning	1.254	.264	-3.544	224	.000	-.34190
Communication and cooperation	.019	.890	-3.823	224	.000	-.36879
Research innovation	2.685	.103	-4.333	224	.000	-.40425
Resource readiness	2.104	.148	-4.002	224	.000	-.37930
Process design	1.676	.197	-4.922	224	.000	-.44776
Practice reserve	.001	.977	-4.730	224	.000	-.44346

The mean values of class A of 2017 and Class B of 2018 were measured before and after the experiment, and A broken line chart was made according to the data. Fig.3 compares the mean values of class A of 2017 and Class B of 2018 after the experiment, except that there is no significant difference between the two classes in the dimensions of consciousness and attitude, information responsibility and communication cooperation. The increase of information technology application ability of Class B of grade 2018 was significantly greater than that of Class A of Grade 2017. It can be seen that the information technology application ability of class B of Grade 2018 improved more after the experiment. Therefore, the information technology application ability of the class taught by hybrid teaching mode based on SPOC was significantly higher than that of the class taught by ordinary teaching mode.



Fig. 3. Comparison of post-test mean increase between Class A of 2017 and Class B of 2018

Taking the dimension of technological environment as an example, comparing the improvement degree of the dimension of technological environment in Class A of 2017 and Class B of 2018, students' grasp of basic skills of information technology has been improved significantly after training, but for the same type of skills, the degree of improvement is also significantly different. According to the data, Compared with class A of 2017, class B of 2018 has an average increase of 10%-25% in each item. It can be seen that in terms of technological environment, the information technology application ability of the class that adopts the hybrid teaching mode based on SPOC is significantly higher than that of the class that adopts the ordinary teaching mode.

B. Satisfaction data

According to the statistical analysis of the data, the satisfaction survey of the learning effect is conducted. After students use the resources of the course platform for independent learning, more than 95% of the students think that the offline tutoring effect of teachers after independent learning is better. In the satisfaction survey of the learning mode of "online independent learning + offline teacher guidance", 96.4% of students are satisfied with the mode of online and offline hybrid learning. They believe that online independent learning and offline teacher guidance can effectively improve the learning effect and improve their own abilities. In the course content satisfaction survey, students' satisfaction with the course video content of the course center platform was investigated, among which 89.6% students were satisfied with the course video content of the course center platform.

A satisfaction survey was conducted on learning resources in the course center platform. In terms of resource difficulty, more than 80% of the students thought that the task points in the video were moderately difficult, while 17.2% thought that the task points in the video were relatively difficult and acceptable. According to the survey of resource richness, 94.8% of the students think that the learning resources in the curriculum center platform are rich and can meet their learning needs. In terms of application, 94.8% of students believe that they can complete corresponding training tasks by using the resources of the course center platform for independent learning.

VII. REFLECTIONS AND SUGGESTIONS

A. Allocate class hours and increase practice

The government or schools should appropriately increase the number of class hours for some practical courses. Sufficient class hours are conducive to

teachers' full explanation of knowledge points, and students can effectively practice and combine theory with practice on the basis of learning theories well. Teachers give proper answers or guide students how to solve problems in the process of practice, which can not only strengthen the supervision of teachers, but also cultivate students' ability to analyze and solve problems, and then improve students' thinking ability.

B. Cultivate ability and increase interaction

In traditional teaching, teachers often only pay attention to whether students can master knowledge, but do not pay attention to whether students can cultivate their ability, let alone to cultivate their interest in learning, so students' learning ability, cooperative communication ability and thinking ability cannot be well improved. Teachers should not only impart knowledge to students, but also let students improve their thinking ability and cooperative communication ability through thinking, discussion and interaction. Teachers should do a good job in guiding and helping students, leading students to think about problems, promoting student interaction, so that students in thinking and communication at the same time master knowledge, improve thinking ability.

C. Comprehensive evaluation and multi-party evaluation

At present, there is a single way to evaluate students' learning effect, which is mostly written and written. Students' learning ability and thinking ability can not be well evaluated, nor can they test the improvement of ability. Teachers should adopt process evaluation and combination of summative evaluation, respectively to the stage of preparation before class, class teaching and after-class phase of ascension in the process of teaching and learning situation about teachers teaching and students learning task is complete to do evaluation and summary, in addition, teachers can also according to the network platform to corresponding evaluation feedback data, In this way, teachers can precisely locate the problems existing in the teaching process and reflect and optimize the teaching design in time, and students can constantly integrate their learning achievements.

D. Adopt the blended teaching mode based on SPOC

Due to the limitation of class hours, a single offline classroom teaching content is not enough. Teachers should use all kinds of teaching platforms and learning software to assist teaching. Based on SPOC hybrid teaching mode of teaching, teachers or cocoa part will be made into micro class is online courses and upload resources, so that the students

free before and after class, the teaching mode has greatly increased the students' interest in learning, the students completed the course is increased sharply, the proportion of students and teachers can use online communication and interaction, Grasp the student's study situation in time, better train the student's study thinking ability.

VIII. CONCLUSION

The practice results show that the hybrid teaching mode based on SPOC combined online and offline can realize the complementary advantages of online courses and classroom teaching. Compared with online education, teachers' supervisory role has been strengthened, and the proportion of students completing courses has been greatly increased; Compared with classroom teaching, teachers can select appropriate content as online teaching courses to reduce the cost of teaching process. Teachers can also improve classroom teaching according to the feedback information of online learning. In classroom teaching, teachers can introduce practice to strengthen students' learning experience and improve the teaching effect. The blended teaching mode based on SPOC can effectively stimulate students' interest in learning, give full play to the characteristics of teachers' dominance and students' subjectivity and creativity, and make teachers become guides of interactive teaching activities and students become active seekers of knowledge.

In order to improve students' ability of information technology application, the teaching completion and students' learning status in the three stages of teaching and learning are integrated. Adopt a new teaching mode can promote teachers change the traditional teaching ideas and practices, has practical significance to the improvement of teaching ability, will also be able to train students in information technology application ability and innovation ability, for the society to cultivate a batch of excellent information technology ability of teachers, to promote the modernization of education development play a good role.

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