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Research on the mixed teaching mode based on "SPOC + BOPPPS"—Taking "digital sub-technology"as an example

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Abstract: *With the rapid development of the information age, the informatization of teaching modes has become an inevitable trend. This article takes the "Golden Course" as the standard for gender equality (i.e., advanced, innovative, and challenging), and takes the Simulated Electronic Technology course of the School of Artificial Intelligence at Hezhou University as an example. Using Chaoxing Learning Pass to establish a SPOC teaching platform, a SPOC + BOPPPS hybrid teaching mode is constructed for application. From the effectiveness of teaching practice, it can be seen that this blended learning model can mobilize students enthusiasm, increase interaction between instructors and students, and achieve better teaching results.*

Keywords: *SPOC, BOPPPS, Blended learning*

1. Introduction

"The Notice on Implementing the Spirit of the National Conference on Undergraduate Education in the New Era"[1], "the Opinions on Implementing the Excellent Teacher Training Plan 2.0", and the "Double Ten Thousand Plan" for the Construction of First Class Undergraduate Majors require all universities across the country to eliminate meaningless and non compliant "water courses", create "gold courses", reasonably increase academic difficulty, increase a course difficulty, expand a course depth, and effectively improve the quality of course teaching[2]. Adopting new concepts, methods, content, and technologies, deeply practicing the path of "student-centered" teaching innovation, strengthening the cultivation of student abilities, and creating high-quality "golden courses" with innovation, high order, and challenge have become an important task of higher education reform.

2. Analysis of the Current Situation of " Digital Electronic Technology" Teaching

(1)Digital electronic technology is a professional basic course of Internet of things engineering. Its characteristics are that the knowledge points cover a wide range, the principle concepts are complex and abstract, and it is difficult for students to understand and master, which not only leads to the reduction of students interest in learning, but also increases the difficulty of teaching.

(2)The teaching method is single, and there are still many colleges and universities still using the traditional teaching mode centered on the teaching of teachers, which is mainly based on PPT explanation and supplemented by blackboard writing. This kind of teaching mode will make students in passive participation, just "mechanical" listening, it is easy to distract, lazy to think after class. Teachers will not be able to understand the learning level and ability of students more clearly, and cannot teach students in accordance with their aptitude. They can only "sing a monologue" and "ask and answer" teaching, which leads to inactive classroom atmosphere and low student participation. In the long run, the learning enthusiasm of students will be lower and the learning effect will be worse. Finally, students will not have the opportunity to transform classroom learning into their own comprehensive application ability, nor can they develop their own higher-order thinking ability.

(3)The teaching feedback is not timely and thorough. The traditional feedback can only find the the learning situation of students from the homework or even the final examination, so that the teaching means and methods can not be adjusted in time, which can effectively improve the learning efficiency of students and ensure the teaching quality.

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(4)The curriculum evaluation method is single. Usually, the evaluation of teaching performance includes usual performance and examination performance. The previous usual performance assessment methods are mainly composed of attendance, homework and other links. This assessment method is not only not comprehensive enough and lacks a supervision system, but also makes the distinction between students very small, and can not better mobilize the enthusiasm of students.

3. Introduction of "SPOC + BOPPPS " teaching model

3.1 SPOC

SPOC (Small Private Online Course) has two characteristics: First, it is small in scale. Different from MOOC, which can accommodate up to tens of thousands of students to participate in learning, SPOC can only accept dozens to hundreds of people. Second, there are restrictions. SPOC courses are mostly courses for professional teachers in colleges and universities to set up independently. They will limit the learning objects to students in their own classes, and will not open courses to students outside the class. Compared with MOOC, SPOC inherits the advantages of MOOC, makes up for the shortcomings of MOOC, and appropriately innovates some learning contents, teaching methods, practical ideas and technical realization, which can better adapt to different teaching requirements and objectives[3].

3.2 BOPPPS teaching mode

The BOPPPS teaching model originated from teaching skills workshop project of the teachers in Canadian. It emphasizes student-centered and aims to improve participation of students in the classroom more effectively. Abandoning the traditional teaching mode of "teaching" by teachers and "immersive self-questioning and self-answering" by teachers, under the requirement of meeting the development of educational connotation in the new era, strengthening "student participation" can enable students to transform classroom learning into their own comprehensive application ability and develop their own higher-order thinking ability. BOPPPS teaching mode is a teaching method based on modularization, which is divided into six stages: introduction, learning goal, pretest, participation in learning, post-test and summary[4].

3.3 Construct the "SPOC + BOPPPS" teaching mode.

According to the learning situation of students majoring in Internet of Things Engineering in the School of Artificial Intelligence and the characteristics of digital electronic technology courses, SPOC and BOPPPS are combined and applied to the teaching process. In terms of teaching scope, a small-scale class with limited access conditions is adopted. In terms of teaching methods, a three-stage hybrid teaching method of "pre-class-in-class-after-class" combining online and offline is adopted. In the teaching process, the teaching is divided into six parts, as shown in Figure 1.

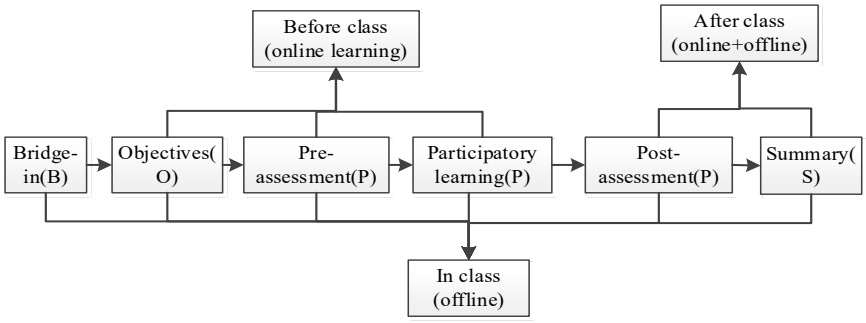

Figure 1: SPOC+BOPPPS teaching mode

(1) Bridge-in(B)

When teachers teach offline, they introduce topics by teaching practical engineering cases, guide students to think and stimulate +=the interest of students in learning, which can better lead to the teaching content of this course.

(2) Objectives(O)

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Before class, students combine the “learning task list” issued by the teacher to clarify the learning objectives to be mastered in each course. They can use the online resources and teaching materials in the SPOC course to conduct autonomous learning.

(3)Pre-assessment(P)

After the students complete the online learning independently through the Superstar platform before class, they need to complete the relevant tests for self-examination. In the classroom, the teacher understands the learning situation mastered by the students by asking questions. The pretest data can reflect the students ' early learning effect. Teachers can flexibly adjust the teaching plan and schedule according to the data, so as to improve the teaching quality with more scientific teaching methods.

(4)Participatory learning(P)

This link allows students to participate in learning through various teaching methods such as the online autonomous learning of students and the offline flipped classroom of teachers, the case analysis, problem discussion, and answering questions.

(5) Post-assessment(P)

Teachers test whether students successfully master the key and difficult points in digital electronic technology knowledge through in-class tests and online unit chapter tests, assignments, mid-term examinations and other forms.

(6) Summary(S)

By summarizing the knowledge points of this lesson, teachers can design relevant topics after class, initiate discussion activities online, so that students can communicate in depth and share their learning experience. In this way, students can improve the efficiency of “absorption and internalization” learning process, thus improving classroom effect and improving teaching quality.

3.4 Integrating ideological and political elements

Integrating ideological and political elements with course teaching content, teachers can cleverly design course teaching based on the course content before class. During class, teachers can use the knowledge characteristics of digital electronic technology courses, such as the background of the times, the development process of devices, the principles of circuits, or specific engineering examples, to deepen the understanding of knowledge of students while also providing ideological and political education to students, enabling them to establish correct worldviews, life views, and values.

3.5 Teaching evaluation methods

Formulate a diversified teaching evaluation system, diversified evaluation methods and comprehensive evaluation content that is compatible with the teaching model. This not only helps to guide, promote, diagnose and regulate the learning of students, but also can effectively improve and enhance the teaching of teachers[5].

4. Practice of blended teaching mode based on “SPOC+BOPPPS” in “Digital Electronic Technology”

Using Superstar Learning to build a SPOC teaching platform, a SPOC + BOPPPS hybrid teaching mode is constructed to carry out teaching practice on the digital electronic technology course.

4.1 The construction of online open course teaching platform

Firstly, utilizing the SPOC platform to draw on online resources, we independently create a digital electronic technology course. Based on the teaching outline, the digital electronic technology course is divided into 6 chapters on the platform, with the course chapters as the main thread. Each chapter is further subdivided into multiple independent knowledge points, each of which is accompanied by relevant learning videos, corresponding courseware, and related tests and discussions. At the same time, we also provide students with suggestions and task lists for self-directed learning.

Secondly, during the teaching process, various check-in methods are used for students through the platform to achieve daily attendance. In class, diverse activities such as voting, quizzes, grading, and

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discussions are conducted to encourage students to participate in the course, while also increasing the assessment mechanism for regular scores.Post class assignments and tests related to course content can be diversified, including multiple-choice questions, fill in the blank questions, true or false questions, simple calculation questions, and other forms. When assigning homework, corresponding deadlines and evaluation methods can be set, which can be teacher evaluation or student student peer evaluation. This can greatly reduce the workload of teachers and stimulate the learning enthusiasm of students.

Finally, after the course is over, use the platform to understand the basic datum, schools and learning situation of the class students in this course, making it convenient for student performance statistics. With the continuous improvement of platform functions, SPOC platform will become the main platform for college students to learn independently.

4.2 Implementation process of teaching mode

In the teaching process of digital electronic technology, the SPOC+BOPPPS teaching model is combined to strengthen the commonality of "student participation". In terms of teaching methods, a hybrid teaching method of "Before class - During class -After class" is adopted, which combines online and offline teaching methods. The specific teaching activity process is as follows.

(1)Before class Students use the SPOC courses, online resources, and textbooks built on the Chaoxing Fanya platform to learn in a targeted manner based on the "learning task list" published by the teacher, and complete relevant tests and learning.Utilize online discussion spaces to raise and answer relevant questions. Teachers use channels such as practice, testing, and discussion on the SPOC platform to understand the learning situation of students, and therefore develop or adjust teaching plans.

(2)In class Teachers use face-to-face communication or online tools and resources to organize students to combine relevant knowledge and skills, and conduct in-depth discussions around the unit theme.The teacher analyzed the learning requirements that need to be mastered in this class through the application of digital electronic technology in practical engineering cases. By asking questions and combining with the learning situations before class of students, clarify the connection and application of knowledge points, and focus on explaining the ideas and methods of analyzing problems.Through the presentation of PPT and handwritten blackboard notes on the content of PPT, as well as demonstration of problem-solving thinking, face-to-face communication and interaction between teachers and students are carried out in the classroom, timely feedback is given on the questions raised by students. Then, through various forms such as in class testing, problem discussion, and answering questions, students are led to understand, synthesize, evaluate, and apply together.Classroom management can effectively implement supervision mechanisms, which can enhance the mastery of knowledge of students, ability to apply knowledge, and expression ability.

(3)After class Students complete unit chapter tests, assignments, and mid-term exams assigned by teachers both online and offline, and receive feedback from the platform, teachers, and peers.Teachers design relevant themes and initiate online discussion activities for students to engage in in-depth communication and share their learning experiences. Through discussions, students can enhance the effectiveness of the "absorption internalization" learning process, thereby improving classroom effectiveness and teaching quality.

4.3 Incorporating ideological and political elements into the teaching process

Comprehensively and multi-dimensionally explore and extract moral education teaching resources for ideological and political courses, and establish a case library of ideological and political education.The elements of ideological and political education mainly include focusing on six aspects: innovative spirit, patriotism, team spirit, firm belief, diligent learning and training, and craftsmanship spirit. Core values, traditional culture, and other ideological and political elements are integrated into the course professional knowledge and teaching.The elements of ideological and political education mainly include focusing on six aspects: innovative spirit, patriotism, team spirit, firm belief, diligent learning and training, and craftsmanship spirit. Core values, traditional culture, and other ideological and political elements are integrated into the course professional knowledge and teaching.Students not only cultivate their professional abilities and cultural literacy, but also enhance their sense of professional identity and mission, achieving the coupling of ideological and political education with the teaching process of professional courses, promoting curriculum teaching and education to go hand in hand, and focusing on solving the "two skin" problem of professional education and ideological and

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political education.The overview of teaching content, ideological and political education goals, and teaching methods related to the course is shown in Table 1.

Table 1: Digital Electronic Technology Course Ideological and Political Table

Number	Overview of teaching content	The goal of ideological and political education in the curriculum		teaching method
1	1.Fundamentals of Logic Algebra The teaching content of this chapter is to explain the basic concepts of logical algebra, the representation methods of logical functions, and the methods of mutual transformation	creative spirit	From the five description methods of logical function to understand the diversity of things in dialectics. In this way, students can be guided to integrate the diversity of knowledge, ideas, methods and motivations obtained in the university into the cultivation of innovative ability, so as to stimulate and improve their innovative consciousness.	Lecture method and case teaching method
2	2.Gate circuit The second teaching content of this chapter is about the switching characteristics of transistors and the working principle of integrated gate circuits	Patriotic sentiment	By introducing the development history of chips, the national self-confidence of students and sense of mission is enhanced. Enhance the patriotic sentiment of students through Huawei and ZTE events	Teaching method
3	3.Combinational logic circuit The teaching content of this chapter is to explain the analysis and design methods of combinational logic circuits	team spirit	In a combinational circuit, each gate circuit implements a function. Only when all functions are added together can a complete set of logic be formed, guiding students to correctly view the dialectical relationship between individuals and the whole, fully leveraging the role of individuals in innovative teams, and achieving personal creativity and the core strength while improving team cohesion and comprehensive innovation ability	Lecture method and case teaching method
4	4.Trigger The teaching content of this chapter is to explain the circuit structure, working principle, and logical function of triggers	strengthen one's belief	The characteristic that triggers remain unchanged during high and low voltage periods encourages students to firmly establish their ideals and beliefs, lay a solid foundation, and contribute to the development of society in the future	Lecture method and case teaching method
5	5.Sequential logic circuit The teaching content of this chapter is to explain the analysis and design methods of sequential logic circuits	study and train hard	The state of a sequential logic circuit depends not only on the current input signal, but also on the previous circuit state, indicating that a person's development is closely related to history. The importance of learning during university is demonstrated through successful examples of outstanding alumni	Lecture method and case teaching method
6	6.555 Timer and Pulse Generation Shaping Circuit The teaching content of this chapter is to explain the structure, working principle, and application of the 555 timer circuit	The spirit of craftsmanship	Explain the internal manufacturing process of the 555 timer and inspire students to develop a rigorous, meticulous, and innovative craftsmanship spirit when dealing with things	Teaching method

4.4 Establishing evaluation methods

To evaluate the effectiveness of curriculum teaching reform, it is necessary to optimize the course assessment methods and strive to explore whether the professional knowledge of students and learning outcomes have added value, in order to meet the requirements of the new engineering talent training assessment. Reform the single assessment method, to strengthen the process assessment, and further highlight the importance of the learning process. Break the common assessment method of relying

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mainly on final exam scores and supplemented by "attendance+homework scores". Process assessment can use multiple indicators: (1) attendance; (2) Classroom performance; (3) Classroom activities; (4) Task point learning; (5) Homework; (6) Discussion, the specific assessment process is shown in Table 2. This diversified evaluation method can provide a more comprehensive and systematic evaluation of the abilities of students in various aspects, effectively evaluate their learning outcomes, and thus ensure the quality of teaching.

Table 2: Course Process Assessment Plan

Evaluation project	Proportion to total score	Specific assessment plan
check work attendance	10%	Teachers conduct random attendance to students in the classroom or use Superstar Learning to publish online check-in.
Classroom performance	10%	Online and offline questioning, interaction, and class status are tested to assess whether students are concise in answering questions, whether respondents are adequately prepared, and to assess group assistance and language expression abilities.
Classroom activities	20%	Classroom random selection, quizzes, voting, in class practice, etc.
Task Point Learning	10%	Before class, pre release the preview task points through the "Chaoxing Learning Platform", including knowledge point videos, self-test questions, and discussion questions for this section, clarifying the key and difficult points.
task	40%	By publishing assignments on the Learning Platform and setting deadlines, teachers can evaluate, students can self evaluate, or students can mutually evaluate, achieving diverse evaluations.
discuss	10%	Online and offline interaction between teachers and students, homework answer situation, the problem summary, or students share their learning experience, etc.

5. Research results

In order to compare the teaching effects of the "SPOC+BOPPPS" hybrid teaching mode and the traditional teaching mode applied to the simulation of electronic technology course, Class 1 and Class 2 of the Internet of Things Engineering major at the 22nd level of the School of Artificial Intelligence was used as experimental and control classes, respectively. The teaching content of the simulation of electronic technology course was divided into hybrid teaching and traditional teaching modes. After one semester of teaching, the final grades of the two classes were distributed as shown in Figure 2.

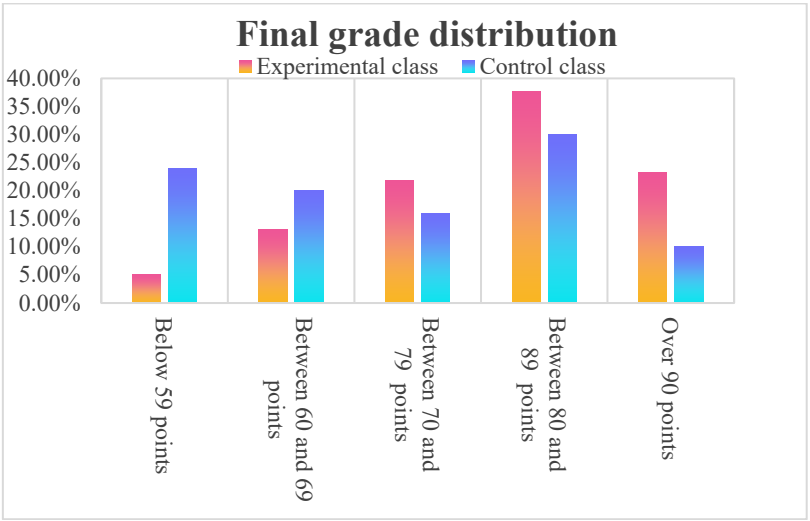

Figure 2: Distribution of final grades

From the graph, it can be seen that the pass rate of the experimental class has significantly improved compared to the control class, and the proportion of the experimental class is higher than that of the control class in the other four score ranges. This indicates that compared with traditional teaching methods, the learning effect of using blended learning is more significant. This reflects that using SPOC platform combined with BOPPPS mode teaching can better mobilize student participation and

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enthusiasm, and can also increase interaction between teachers and students, achieving better teaching results.

6. Conclusion

Based on the "SPOC+BOPPPS" hybrid teaching mode, with the help of new era information technology and the construction and development of SPOC platform, the teaching process can be informationized, effectively integrating online and offline teaching, significantly improving the learning efficiency and efficiency of students, and providing reference for the teaching mode of other related courses in the future.

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3) The Course Ideological and Political Project of Hezhou University: Communication Principle, project number: hzxykcsz202314.

4) The Course Ideological and Political Project of Hezhou University:Experiment on Microcomputer Principles and Interface Technology, project number: hzxykcszyb202418.

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