Construction and practice of blended learning mode based on Understanding by Design (UbD)

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Abstract. The instructional design based on Understanding by Design(UbD) theory embodies the idea of pursuing understanding. It can deepen the understanding of knowledge and promote students' active construction of knowledge. Through the analysis of the current teaching situation of the Computer Network course, it is found that the existing teaching has the problems of redundant teaching links and weak students' migration ability. we constructed a hybrid reverse teaching mode, based on the UbD theory, and tried to carry out a hybrid reverse teaching design for the unit of "Planning and Assigning IP Addresses" in "Computer Networks" to enhance the students' understanding of the course content. At the same time, we have designed teaching evaluation program, covering the whole process of educating.

Keywords: UbD(Understanding by Design), Blended learning, Instructional design, Information-based education, Pursuit of understanding.

1 Introduction

Educational informatization has completed its "start" and "application", and is stepping into the 2.0 era of educational informatization of "integration" and "innovation"[1]. In this context, traditional education is facing serious challenges, and the teaching mode of colleges and universities is also seeking to change. In 2017, the Ministry of Education pointed out in the "Key Points of Educational Informatization" that it is necessary to "actively promote the popularization of the blended learning mode that combines online and off-line", and the blended mode of teaching will be one of the directions for the development of the teaching mode in the future. In recent years, in order to realize the core concept of the deep integration of information technology and education, online teaching platforms such as Rain Classroom, Wisdom Tree, and MOOC provide a wealth of teaching resources and teaching tools, which offer opportunities for the implementation of blended teaching in different ways. In the actual teaching process, teachers can carry out online check-in, random roll call, classroom tests, push courseware materials, assign homework, Q&A and discussion communities and other teaching activities at any time according to need through blended teaching. Teachers and students, students and students, can be fully interactive communication, to make

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up for the shortcomings of the traditional teaching poor communication[2].Therefore, based on the characteristics of the knowledge of the subject, selecting suitable teaching modes and information technology means to realize the in-depth integration of information technology and education and teaching is a direction that needs to be worked on urgently.

Computer Networks takes the TCP/IP architecture of the Internet as the main line, comprehensively teaches the basic principles and technical methods of data communication and computer networks, and equips students with a certain degree of network analysis and design, network planning and construction, network operation and maintenance, and other network technology application capabilities, so as to lay a solid foundation for learning other courses and engaging in the research, development, management and use of computer networks[3]. In the actual promotion process, due to the characteristics of the course such as wide knowledge, complicated concepts, rich terminology and strong practicality, both sides of the teaching profession face difficulties such as shifting teaching goals, redundant teaching sessions, and weak student transfer.

In the face of the many problems existing in the traditional teaching of Computer Networks, this paper intends to provide teaching scaffolding to stimulate students' interest through blended teaching; to reduce the redundancy of teaching links through reverse teaching design; and to construct a blended reverse teaching model by combining the two to improve students' academic level and enhance their learning effects.

2 Construction of a hybrid reverse teaching model

Relying on modern information technology, blended teaching mode breaks the traditional teaching concept, aiming to provide students with more flexible and diversified learning methods, and better meet the students' personalized learning needs. In this teaching mode, teachers can use multimedia equipment and network facilities to present the course content more vividly and intuitively, stimulate students' interest in learning, enable students to better master the learning content, achieve better learning results, and continuously improve their learning ability in practice.

The model of Understanding by Design (UbD) is a new instructional design model put forward by Grant Wiggins and Jay McTiger, American experts in the field of curriculum and teaching, on the basis of reflecting on the shortcomings of traditional instructional design. It is also called reverse instructional design model. That is, "starting from the ultimate goal or standard, forming teaching according to the learning evidence required by the standard and the teaching activities used to assist students in learning". The process mainly consists of three stages, namely, expected results, evaluation evidence and learning plan[4]. Under this design philosophy, the ultimate goal of all instructional activities is to achieve the goal, all instructional design processes are designed as a means to achieve the goal, and all instructional design is designed out of necessity[5].

More and more teachers are now realizing that understanding is a prerequisite for facilitating transfer to occur. In this context, a classroom in pursuit of understanding has emerged.

2.1 Teaching program design

In the design of teaching programs, the blended reverse teaching model takes the big goal as the core. First, identify the essential questions based on the big goal. And break down the big goals into implementable instructional objectives. Then, combining the teaching objectives and the basic problems, determine the assessment standards of the classroom, and make good preparations for the teaching design. Finally, the complete design of the teaching link is carried out in the light of the specific learning situation and course content. The overall process of "decomposition of the broad objectives - determine the teaching objectives - develop assessment criteria - teaching design" is followed, as shown in Figure 1.

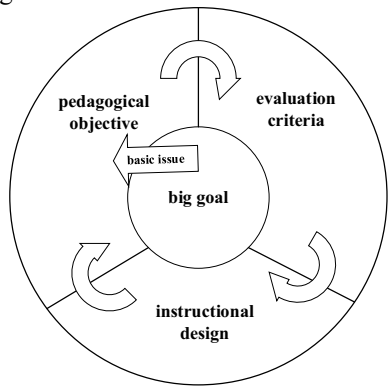

Fig. 1. Design of the hybrid reverse teaching model

The big goal is the core of the whole reverse instructional design, which is a tool for learning content construction. The first stage in the UbD instructional design framework is to put forward a long-term goal, called the big goal, as the core of the whole instructional design, with the end as the beginning. After that, based on the big goal, the basic problem is oriented to decompose and form the small goal of unit learning, the logic is clear and explicit[6].Therefore, in order to promote better student mastery of knowledge and to ensure the rationality of the teaching and learning process, when teachers use the UbD instructional design framework for instructional design, they will classify the knowledge into three levels: knowledge that only needs to be known, knowledge that needs to be mastered, and knowledge that serves to achieve the big goal[7]. The UbD instructional design framework aims to enable students to gain a deeper understanding of knowledge and practice problem-solving skills through the exploration of broad objectives. Relying on their original cognitive structure, the learning content was reconstructed to make it easier to understand.

Determining assessment criteria is an important part of the design. In the teaching and learning process, a scale with uniform and reasonable standards will allow students to feel the fairness of teaching and possess the motivation to obtain the assessment. In terms of assessment content design, Wiggins argues that assessment design needs to answer three foundational questions, "What types of evidence do we need to show that

students are meeting instructional goals that include comprehension? What specific features in students' responses, work, or behavior determine the extent to which they achieve the desired outcomes? Does the evidence we present allow us to make inferences about students' knowledge, skills, or understanding?" In the design of who is assessed, attention should be paid to the diversity of subjects. Whether the assessor is the teacher, another person or oneself, feedback should be provided immediately after the assessment, and feedback with reference standards is more likely to have an impact on students. In terms of assessment format design, consider using expressive tasks as a form of assessment. Students completing a task or solving a problem using a scoring scale as a criterion can make student thinking visible and student understanding assessable [8].

2.2 Design of the evaluation program

In the design of the evaluation program, it starts from the three links before, during and after the class, covering the whole process of educating people.

2.2.1.Pre-course Study.

The Rain Classroom platform is used as a tool to deliver lessons. Teachers provide students with learning resources and materials for independent study before class. Online tests are answered by students to test the level of independent learning, or students provide direct feedback on their personal problems. After students complete online learning and online tests on the Rain Classroom platform, teachers can conduct diagnostic evaluations of students to understand their knowledge mastery through data such as students' correct rate, number of engagements, number of lookbacks, and feedback on questions.

2.2.2.Learning in class.

Relying on the tasks, we take the knowledge from the job and take it out of the textbook by creating situations, microlesson demonstrations, simulation experiments, and practical exercises in the course to cultivate the problem-solving ability of the students. Focus on students' ability to work in groups and to communicate and coordinate. Reduce questioning of individuals and increase the presentation of group results to reach more students with group assessment and ensure more students feel engaged in the course. In caring for students should not uphold the principle of majority rule, should pay attention to and treat the emotional needs of each student equally, to provide targeted satisfaction[9].

2.2.3.Quizzes at the end of the class.

After class, teachers can rely on the Rain Classroom platform to assign homework and exercises for students to test the effect of learning in class. When relying on the online platform for summative evaluation, it is important to ensure anonymity among

students and protect their self-esteem. Feedback that has been collected is coached if there is a problem. All feedback needs to be responded to positively.

3 Analysis of teaching practices and effects

In this paper, we choose the module "Planning and Assigning IP Addresses" in Computer Networks to carry out a hybrid reverse instructional design. The whole instructional design is based on UbD theory, and the instructional design of this module consists of the following three phases: "Phase 1 - Determine the pedagogical objectives; Phase 2 - Determine reasonable evaluation criteria; Phase 3 -Designing teaching activities and links".

3.1 Determination of pedagogical objectives

There are three stages in the establishment of teaching objectives, namely, "determining the expected results, posing the basic questions, and breaking down the major objectives". First, determine the expected results, that is, what level we hope students can achieve after learning the course, what kind of knowledge and skills we hope students can master, and determine the major objectives based on the conception of the expected results. Second, the basic questions based on the big goals are asked to guide students to actively construct new knowledge. When teaching "Planning and Assigning IP Addresses", the teacher guides students to think about "In network communication, how does a computer that sends data find a computer that receives data?", "How do we make every computer in the same classroom a 'named', 'unique' computer?", "Can computers in different classrooms communicate with each other and why?" By setting up basic questions to guide the direction of students' thinking, the students' thoughts will be faster and more accurate in the classroom. Finally, to carry out the decomposition of the big goal, the big goal is a conceptual principle with vague meaning and unmeasurable, so it is necessary to decompose the big goal into specific teaching objectives that are operable and measurable. According to the determined expected results, teachers can categorize the specific teaching objectives into three aspects, namely cognitive objectives, skill objectives and affective objectives. This completes the design of all teaching objectives.

3.2 Identifying sound evaluation criteria

Based on the specific pedagogical objectives developed in the previous phase, reasonable evaluation criteria are defined. In the whole teaching process, there will be a variety of aspects that need to be evaluated, which can be mainly divided into knowledge-based results, task-based results and learning specific performance. Knowledge-based outcomes mainly refer to the new principles and methods taught by the teacher in the teaching process, usually using in-class quizzes to determine the degree of mastery. Task-based outcomes mainly refer to specific practical training tasks issued in the teaching process. After watching the teacher's case demonstration, students produce the

task outcomes through group cooperation and independent inquiry. Teachers use scales to analyze the results to determine the degree of students' mastery of the task-based outcomes, as shown in Table 1.

Table 1. Scale for evaluating the task-based outcome "Planning and assigning IP addresses".

Evaluation dimensions	**Specific Indicator**	**Evaluation criteria**		
		A	**B**	**C**
Task breakdown (10%)	Clear understanding of the requirements of the mandate, with no omissions			
Mandate implementation (60%)	Correct IPv4 address assignments for computer and router interfaces			
	Computers and routers in the same broadcast domain have the same network identification			
	Router with different interfaces connected to different broadcast domains			
	Routing table reads and writes correctly			
Mission accomplished (30%)	Reducing Waste of IPv4 Addresses			
	Whether the address allocation is reasonable			
A: completely correct, 10 points B: Partially correct, 5 points C: Completely incorrect, 0 points The final score will be converted into a percentage according to the weighting.				

Class-specific performance is usually observed and evaluated by the teacher using a classroom observation record sheet for class observation and evaluation, including whether students pay attention, group cooperation, teacher-student interaction, etc., as shown in Table 2.

Table 2. Class Observation Sheet "Planning and Assigning IP Addresses".

Class Observation Record Sheet		
Observation direction	Student performances	Record of observations
Self-directed learning	Ways for students to learn independently? (Ask, practice, rain classroom lesson) Do students have an initial understanding of the principle knowledge and complete the appropriate pre-reading exercises after independent study?	
Class performance	Do students listen attentively when their classmates are speaking? Are students playing games or engaging in other behaviors unrelated to the lesson?	

Teacher-student interaction	When the teacher asks a question, does the student actively answer the question? Do students answer questions clearly and with innovative ideas? Do students respond positively and add to their classmates' statements?	
Group cooperation	Are students active in the group activity? Are there different points of view in the group activity? Are students in the group able to help each other?	
Completion of objectives	Did the student complete the task in the time allotted? Was the student's task completion complete and how far from expectations was it?	

3.3 Designing teaching activities and links

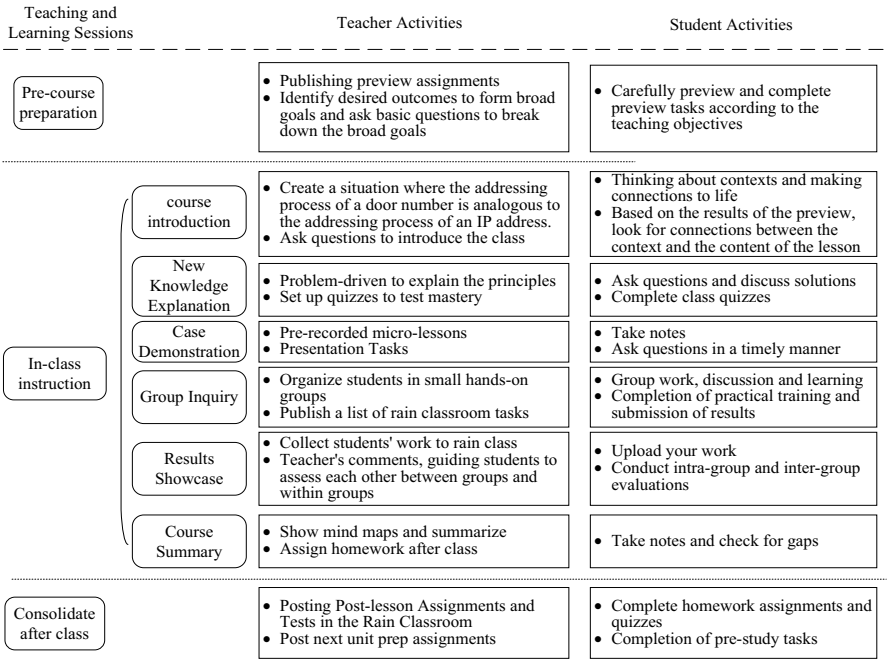

Fig. 2. Instructional design for phase 3, "Planning and assigning IP addresses"

UbD theory requires that instructional design should begin at the output end. The first thing we need to do is to clarify the expected outcomes, set up the underlying questions under the jurisdiction, and promote the decomposition of the big goals into specific and actionable instructional objectives. Second, reasonable evaluation criteria must be set to measure the degree of student mastery in the instructional process. Once the preliminaries are in place, the teacher can begin to design specific teaching and learning activities and sessions. The UbD theory suggests a clear element of reflection: the "WHERETO" element[10]. W—Ensure that students understand the objectives and rationale for the unit being studied; H—Engage students and keep their attention from

the start; E—Provide students with the necessary experiences, tools, knowledge, and skills to achieve performance-based goals; R—Provide plenty of opportunities for students to rethink big goals, reflect on progress, and revise their design work; E—Provide opportunities for students to assess progress and self-assessment; T—Reflects individual talents, interests, styles and needs; O—Reasonably organized so that students gain a deep understanding rather than a superficial one. Based on the consideration of the above elements, we have finalized the teaching design for phase 3 of "Planning and allocating IP addresses". The detailed design of teaching links and activities is shown in Figure 2.

This lesson involves three stages in the design process: pre-course guidance, in-course instruction and post-course consolidation, so that learning does not only happen in the classroom and promotes the development of good learning habits among students.

3.4 Impact analysis

The test scores of 2 parallel classes of students under the same instructor were selected to be analyzed with the students of computer science and technology in our university as the research object. The students of this major were randomly assigned to different classes after enrollment, and the students' knowledge bases were basically the same, and there was no significant difference in the initial conditions. A quasi-experimental research method was used, with 55 students in the experimental class, which was taught in a blended reverse teaching mode; the control class was 51 students, which was taught in a traditional way.

The same question bank was used at the end of teaching, and the test was completed by randomly selecting questions in the online platform of Rain Classroom, and the test scores were segmented according to excellent (100, 85), good (84, 70), passing (69, 60), and failing (59, 0), and students' scores were counted by using the platform of Rain Classroom and the specific scores were imported into the SPSS software for descriptive analysis of the students' scores. The study used independent samples t-test to determine the effect of whether or not to use the blended reverse teaching mode on students' performance, and the results showed that the performance of students using the blended reverse teaching mode differed from that of students using the traditional teaching mode at the 0.05 level of significance, as shown in Table 3, and further comparison of the means showed that the performance of students using the blended reverse teaching mode was higher than that of students using the traditional teaching mode, and the average score of students using the traditional teaching mode increased by more than 3 points compared with the control class. The mean score of the students' performance in the experimental class is improved by more than 3 points compared with the control class, the excellent rate is significantly increased, and the failure rate is substantially reduced, see Table 4.

Table 3. Independent samples t-test for student test scores.

groups	average score	T	Sig
experimental class	80.6	2.002	.048*
control class	77.4		

Note: * indicates a difference at the significance level of 0.05, ** indicates a difference at the significance level of 0.01.

Table 4. Distribution of students' test scores.

classes	Number of students	average score	Percentage（%）			
			excellent	good	pass	fail
experimental class	55	80.6	27.48	58.51	8.34	5.67
control class	51	77.4	25.88	55.92	10.67	7.53

The use of SPSS statistical analysis software to analyze student test scores, can be more intuitive, effective, simple and comprehensive to reflect the information reflected in the student's performance. Helps teachers to understand the students' knowledge, effectively grasp the teaching progress, and maximize the effectiveness of the teacher's teaching. It helps teachers to understand the knowledge level of students, take control of the teaching schedule effectively, and maximize the effectiveness of the teacher's teaching.

4 Conclusion

This study constructs a hybrid reverse teaching model on the basis of analyzing the reverse teaching design and hybrid teaching model in pursuit of understanding. In this paper, we take the unit content of "Planning and Assigning IP Addresses" in the course of "Computer Networks" as an example, sort out the hybrid reverse teaching design based on this model, and try to guide college teachers to carry out reverse teaching design from the level of teaching practice. There are still deficiencies in this study, such as the limited number of samples, how to enhance the expandability of the teaching model, and how to make full use of digital technology. In the subsequent research practice, the empirical study will be continued to expand the experimental scale and increase the number of samples to further validate the teaching model and further improve it according to the experimental results.

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