

Research on a New Blended Teaching Mode Based on "Flipped Classroom"—Taking Engineering Drawing” Course as an Example

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Abstract—B-Learning, as a teaching model that complements the disadvantages of Face-to-Face learning and E-Learning, is an important research direction in current university teaching reform. On the basis of the hybrid teaching theory and the flipping classroom teaching method, this paper constructs a new type of hybrid teaching model based on flipped classroom and applies it to teaching. With strong practicality and creativity, the "Engineering Drawing and CAD" course is consistent with the seminar-based and project-task-driven learning mode widely adopted in the flipping classroom. And the "mixed teaching mode based on flipped classroom" referred in this paper is also directed against classroom teaching, which has conducted effective exploration and practice and achieved good teaching effects.

Keywords—Mixed teaching; Flipping classroom; MOOC; Innovative talent; Teaching mode; Online autonomous learning

I. INTRODUCTION

With the rapid development of information technology, especially from the Internet to the mobile Internet, life, work, and learning methods have been created across time and space, which have fundamentally changed the way knowledge is acquired. Teaching and learning can be limited by time, space, and location conditions, and knowledge acquisition channels are flexible and diversified. With the popularization of terminal construction, the "Internet+education" hybrid teaching adopts online teaching and classroom teaching in a parallel manner and gradually gains favor and recognition from teachers. This model speeds up the flow of information, highlights the dominant role of teachers and the main role of students in learning [1-2], and is one of the trends in education reform and development.

Under the background of major development strategies such as innovation-driven development, "Made in China 2025," "Internet +," "Powerful Internet," and "One Belt and One Road", the country will be able to adapt to the country's strategic needs and support new technologies and services. New engineering and technological talents characterized by industries, new industries, and new models, strengthening the professional education engineering accreditation system and accelerating the construction and development of new engineering subjects are major issues facing higher education.

The deep integration of information technology and education teaching means that information technology is effectively integrated into the teaching of various disciplines, an information-based teaching environment is created, and a new type of teaching characterized by "mastery, inquiry, and cooperation" is exhibited. Ways to give full play to students' initiative, enthusiasm and creativity. The fusion of information technology and teaching of various disciplines is of great significance for the deepening of the teaching process. Under the guidance of advanced educational ideas, teaching theories, and learning theories, computer-based information technology is used as a cognitive tool and emotional incentive for students' independent learning. Tools, to create a new type of "dominant-subject" teaching structure between teachers and students, to achieve the overall reform of subject teaching content, means and methods, so as to achieve the goal of training applied talents.

II. "FLIPPING CLASS" TEACHING MODE

The flipping classroom is the focus of attention of the global education community in recent years. It originated from the teaching experiments of Jonathan Berman and Aaron Sams at the Rocky Mountain Woodland Park High School in Colorado, USA, around 2007. The two teachers began to provide online video lectures to help students who are absent from the classroom because other students also benefited from these videos. Therefore, the two teachers mainly let students watch videos at home, and the lessons are used to help students complete their homework. As a result, the traditional teaching model of "teaching in class and doing homework after class" has "turned over" and has become a model of "watching videos at home before class and doing homework in class".² It is also the meaning of "flipping classroom".

- "Turn the classroom" upside down the classroom subvert the traditional teaching process. In the past, students walked in class to learn new knowledge. Self-study after class, apply the knowledge and skills learned. Inverted classrooms are self-study before class. Teachers in the classroom teach students in accordance with their aptitude, or carry out activities to help students master and use new knowledge and skills learned before class.

- Inverting the classroom reverses the traditional teaching philosophy. At present, many classrooms are still "teacher-centered," and "student-centered" is difficult to implement. Inverted classrooms have truly become "student-centered" and "teaching students in accordance with their aptitudes."
- "Flipping classrooms" Inverting classrooms reverses the roles of teachers and students. In the traditional classroom, the teacher is the owner and communicator of knowledge, and the students are passively learning as a whole. However, in an upside-down classroom, students are actively learning on their own initiative, and teachers are individually targeted.
- "Turn the classroom" upside down the classroom reversed the traditional teaching mode. Traditional teaching is often self-study by students after class, and students have psychological dependence. In any case, the teacher will speak in class. Inverted classrooms, however, make good use of the blended learning model and subtly combine online learning with face-to-face teaching, the learning of new knowledge and skills, and their application and migration.

III. THE CONSTRUCTION OF MIXED TEACHING MODE

Members of the project team conducted systematic research on heuristic, project-based, discussion-based and inquiry-based hybrid teaching methods, and combined with the characteristics of the curriculum to continuously explore new teaching modes in the teaching process. For example, in order to make the teaching of "Engineering Mechanics" more diversified, classroom teaching, exercises under class, online learning, experimental operations, and practice training are closely combined to transform the learning ability of theoretical knowledge into practical applications for students. Ability to train students' logical thinking, and feedback to the classroom lectures through problems encountered by students in the actual hands-on operation, allowing students to more fully apply the theoretical knowledge learned to solve problems in the actual hands-on operation process and improve The students' theoretical ability to solve practical problems has also cultivated students' practical hands-on ability, better achieved the integration of "teaching, learning, and doing" integration, significantly improved teaching conditions, and improved teaching results while overcoming time. Space limitations. In the teaching practice of the "Project Evaluation" course, a case teaching method for project evaluation course based on group cooperative learning was proposed, and the case was introduced into the classroom teaching. However, due to the complex content system of the course, additional learning was added between the teacher and the student. The group's organizational form, a complete teaching process can be summarized as: the construction of knowledge framework → case selection or design → case discussion and summary → practical application and testing, these four links constitute a more complete process.

"Safety System Engineering" and "Safety Assessment" are the core courses of the undergraduate major in safety engineering. The teaching effects of these two courses will

directly affect the safety work that students will undertake in the future. During the course of the teaching of "Safety System Engineering" and "Safety Assessment", according to the training characteristics, training objectives, and employment conditions of the safety engineering professionals, the project team members optimize the curriculum content, design and expand the teaching process, etc. The teaching of safety system engineering has been explored for a long period of teaching practice:

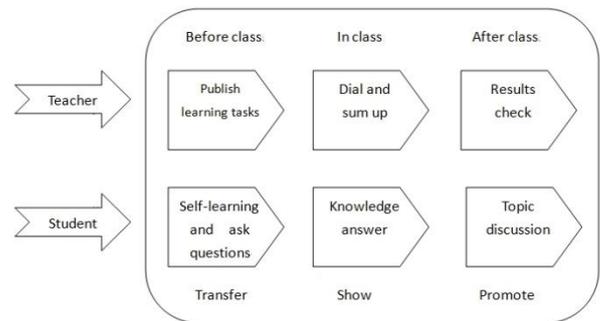


Fig. 1. Flow chart of a hybrid learning process based on flipped classroom

Rationally design the teaching process. Following the characteristics of science, innovation, and operability, the teaching process including self-study before class, deepening in class, and expanding after class is carried out so that the lesson is closely connected both inside and outside of the class to achieve the activities before the course, during the course, and after the course. Integration. Conduct bilateral activities on teaching and learning between teachers and students to meet the needs of students and promote their personalized learning. The learning process is as shown in the above diagram.

Conduct a "pre-class (on-line) preview, online (under-the-line) interaction, and after-school (on-line) review development" teaching model to develop students' habits of independent study. For students who do not study autonomously under the course, set up interactive sessions in the classroom. Students should use materials or network resources beforehand to conduct self-study before class. In the classroom, some simple knowledge points should be set as interactive teaching methods, such as questioning and teacher-student discussion, role change, etc., and give students who speak enthusiastically to give a reward during the time of peacetime, thereby mobilizing the enthusiasm of students for pre-class preview. After class, guide students to review by using homework assignments and study notes.

Strengthen "case teaching" and use time and resources to expand classroom knowledge and stimulate students' interest. Upload the relevant background knowledge, security situation and development frontier online before teaching the lesson content, help students to be familiar with the system that needs analysis, and explain the application of the analysis method in the system in the classroom. Choose similar cases as the assignments, and after the students are finished, select some

assignments to explain in class and discuss with everyone to form a full participation, to discuss and solve practical problems. Through this teaching method, it has played a role in deepening the link between theory and practice, inspiring students' interest in learning, and improving teaching effectiveness. The teaching link design is shown in Figure 1.

In the course of "Engineering Drawing and CAD", which is a basic course for engineering majors, a mixed teaching mode of "group exploration + flipping classroom" was adopted. The traditional classroom teaching activities are generally centered on teachers. In the class, they are introduced through new classes and then lectured in class. Then, after-school homework assignments are arranged and the exercises are consolidated after class. The mixed teaching emphasizes student-centered, before class Pre-learning (learning of network teaching resources and completing pre-class test), in the form of group discussion, conducting counseling for problem exploration and questioning of difficult points (pre-study student feedback through class), and then laying out homework assignments for students. In the process, when encountering suspicious points, the relevant teaching videos or other electronic resources may be recalled in a timely manner or communicated with classmates and teachers through an informatization platform to solve problems in a timely manner. Finally, a variety of evaluation methods were used for evaluation (teacher evaluation, student peer review, student self-assessment). Throughout the entire process, the role of the teacher has changed from the former "knowledge imparter and classroom manager" to the "leader and mentor of learning". The role of the student has also changed from "passive acceptor" to "active explorer". Compared with traditional teaching, the mixed teaching model has changed in terms of teaching objectives, design of teaching activities, teaching methods, means, teachers and student roles, and teaching evaluation.

In the past teaching, we generally adopted the traditional teaching model and used the "five-step" teaching method to carry out teaching activities. The teaching activities followed the five steps of "introducing new lessons, teaching new lessons, practicing new knowledge, summarizing and consolidating, and assigning homework" get on. This teaching model can fully reflect the dominant position of the teacher. All the activities of the students are conducted under the guidance of the teacher. The students do not have independent thinking time, but memorize and practice mechanically. The teaching content is a subject-based knowledge system and teaches theories. Knowledge-based, lack of practical activities, the disconnect between theory and practice, it is difficult to achieve the unity of knowledge and practice. Therefore, under this traditional teaching model, no matter how well the teachers design the teaching process, the actual practical ability of the students is not strong enough to meet the training objectives of the applied talents.

Secondly, the course is a highly demanding course for hands-on ability. The teaching often focuses only on the theory of the book and describes boring drawing commands step by step, but often does not provide corresponding task items, and gives students practical hands-on time. Rarely, in this way, students will learn to be at a loss. They only know

that the students of theoretical knowledge will be hard-coded, and they cannot be flexible in the actual operation, and the quality of teaching is greatly reduced.

Again, the traditional "AutoCAD" course is taught without majors, and the course content and curriculum implementation are much the same. Therefore, when students progress to the professional courses, the application of AutoCAD can not be handy. In other words, professional basic courses do not realize the task of serving professional courses. Therefore, the course should be designed for the corresponding professional requirements and professional positioning, and the corresponding curriculum content and curriculum implementation should be designed.

Traditional teaching methods, teaching content lags behind. Due to the influence of traditional thinking, most of the instructors use "swallow" teaching. Classroom teaching focuses on teacher explanation. The focus is on theoretical knowledge of the syllabus, lack of other teaching aids, neglect of students' subject status, and students' learning. The interest is not high and it is difficult to achieve the intended teaching effect. In addition, the teaching content is limited to teaching materials, ignoring the pursuit of CAD advanced content, especially the transformation of the CAD version, AutoCAD version from the initial 2000 version to the current version of 2013.

Teaching activities are rigidly adhered to classroom teaching. From the perspective of quality education, it is far from enough to master theoretical knowledge. It is necessary to grasp both theory and technology at the same time so as to achieve the goal of having a flexible grasp of theoretical knowledge and the ability to use certain techniques to solve practical problems. The "Engineering Drawing and CAD" course is a course that is very practically integrated with the mine. It is limited by the academic hours of the course. Teaching activities tend to take up a larger proportion of classroom teaching, ignoring the cultivation of students' hands-on operational skills, leading to students it is difficult to use the learned commands flexibly during the drawing process.

IV. TEACHING EFFECT

A. *The first is to build a mixed-mode teaching model that combines online self-learning + flipping classroom + group inquiry collaborative learning online and offline/under class and class.*

This project proposes the teaching mode of "Autonomous Learning on the Internet + Flipping Classroom + Group Inquiry and Collaborative Learning" to discuss the perfect combination of cooperative learning of students' group and the mixed teaching mode of "under class and online and offline", from knowledge dimensions and knowledge. Two aspects of the dimension are used to construct the teaching system, explore the applicable teaching methods and their reasonable cooperation. Study curriculum multi-dimensional assessment assessment problems, to achieve a combination of process assessment and final assessment, teacher evaluation, student evaluation, student self-evaluation and other multiple evaluation methods combined through scientific evaluation,

better mobilize the subjective initiative of students' learning, Promote learning and teaching quality.

B. Constructing Evaluation Index System of Mixed Teaching Effect in Colleges and Universities

Based on the scientific development concept of constructivism, behaviorism, cognitivism, and ubiquitous learning theory, according to the principles of system science, dynamics, and operability, we construct teaching resource factors, teaching environment factors, teaching design factors, and learning. The first-level index system of attitude factor, learning process factor, and learning outcome factor are analyzed. The second-level and third-level index layers under each level of the index are analyzed in turn to form a three-level index system for the evaluation of mixed teaching effectiveness in colleges and universities.

C. Evaluating the Present Situation of Constructing Mixed Teaching Effect in Colleges and Universities

According to the evaluation index system of the mixed teaching effect of colleges and universities, using the form of questionnaires, factor analysis and reliability analysis are carried out on each indicator layer, and each index value gauge is used to integrate the university with fuzzy comprehensive evaluation or gray system evaluation method. Each evaluation index of the teaching effect is converted from the grade evaluation of the gauge to the quantitative score evaluation, and the qualitative evaluation result is finally quantified. This can not only evaluate the effect of the mixed teaching of a certain course, but also can be used for some courses. Blended teaching effects are compared horizontally.

D. Constructing Evaluation System of Mixed Teaching Effect Development Trend in Colleges and Universities

The evaluation of mixed teaching development trends in universities includes two aspects: First, the volatility of the mixed teaching effect of universities over time; and second, the change direction and rate of each indicator, that is, the change of each indicator is a mixed model for colleges and universities. The effect of teaching effects.

Using the system dynamics (SD) method of structural prediction model, according to the interaction between subsystems such as teaching resources, teaching environment, instructional design, learning attitude, learning process, and learning outcomes, the construction of mixed teaching dynamics in colleges and universities The simulation model incorporates the indicators of the mixed teaching evaluation index system in universities into the SD model, and uses the data envelopment method (DEA) and entropy method to weight the relevant indicators as an auxiliary variable to predict the time profiles of the various influencing factors in the mixed teaching of colleges and universities. State value. At the same time referring to the state space method, the space vector is used to measure the value of each indicator of the mixed teaching in colleges and universities. Finally, the state space calculation process is nested in the system dynamics model, and the development trends of the evaluation indexes of various subsystems at different time intervals are derived,

as well as the development trends of mixed teaching development in various universities.

V. CONCLUSION

The value of the SPOC curriculum is maximized through the combination of the online and offline combined teaching of flipped classrooms. It embodies the "learning as the main" education and teaching concept, and cultivates students' independence, collaboration, inquiry learning ability and good learning. Habits also effectively reflect the significance of online open courses. It is an effective measure for education and teaching reform under the current background of diversified and multi-leveled higher education. The hybrid teaching model respects the potential of students and provides students with plenty of opportunities to explore, discuss, question, and criticize themselves, so that they can derive new ideas in teamwork discussions, test the authenticity of knowledge in practice, and learn to explore traditions. The dialectical relationship between innovation and innovation. The teacher's leading role in the face-to-face classroom instruction can both solve doubts and arouse students' creative thinking. Therefore, in addition to creating new ideas for academic research, the hybrid teaching model based on flipped classrooms is of great value for cultivating the future of cross-border talents and innovative talents with diverse talents.

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