International Journal of Education and Humanities
ISSN: 2770-6702 | Vol. 5, No. 3, 2022

Exploration and Practice of Flipped Classroom Teaching Mode Based on Outcome-based Education

-- Taking the Energy Storage Technology course as an Example

Wanchun Jin*, Jiao Tian

College of Engineering, Southwest Petroleum University, Nanchong, Sichuan, China

Abstract: Combined with the teaching objectives and specific requirements of the "Energy Storage Technology " course, this paper explore the practical application of the flipped classroom teaching model based on the Outcome-based Education (OBE). An output-oriented and student-oriented teaching mode is constructed, and an evaluation system and teaching reform feedback mechanism with the process assessment link as the core are established based on this teaching model, which provides a reference for the teaching reform of other courses.

Keywords: Outcome-based education, Flipped classrooms, Teaching mode, Energy Storage Technology.

1. Introduction

Engineering education accreditation puts forward higher requirements for the teaching process and talent training quality of higher education[1]. With the rapid development of information technology, the limitations and drawbacks of traditional education methods with teachers teaching as the core have been further highlighted, and the traditional education and teaching mode can no longer meet the educational needs of the new era, and it is particularly important to explore a new and effective teaching mode and method. As the mainstream concept of internationally recognized engineering education, the Outcome-based Education(OBE) concept is highly compatible with the current educational needs of its core ideas of "outcome-oriented, student-centered, and continuous improvement"[2]. Because of its unique advantages, the "flipped classroom" teaching mode based on the OBE concept is increasingly adopted by various education and teaching institution [3].

Energy storage and utilization technology plays a vital role in modern energy production and allocation and is also a key technical link in the process of renewable energy utilization. The "Energy Storage Technology" course is essential for students majoring in energy and environmental systems engineering to build a sound body of knowledge. The course has the characteristics of involving many disciplines and wide knowledge coverage, relying only on the traditional teaching mode can not ensure the depth and breadth of teaching content at the same time, and the traditional "teacher-centered" teaching mode is difficult to achieve the ideal teaching effect in the "Energy Storage Technology " course. In contrast, as a new teaching model, the "flipped classroom" based on the OBE concept changes the learning process taught by teachers and passively accepted by students, so that students occupy the main position in the teaching process and allow students to actively interact with other learners and teachers. This model has the characteristics of high student participation and a flexible teaching process [5]. In addition to the learning of various knowledge points, this model pays more attention to the cultivation of students' comprehensive qualities, such as learning ability, teamwork ability, and the ability to find and solve problems, etc. Therefore, the application of flipped classroom teaching mode can well meet the teaching needs of the "Energy Storage Technology" course.

2. Overview of the OBE Concept and Flipped Classroom Teaching Modet

2.1. Outcome-based Education

Outcome-based Education originated from the reform of teaching abroad in the1980s. This concept focuses on teaching outcomes and takes students' learning outcomes as the guide to , determine teaching contents, and design teaching processes and teaching schemes based on students' learning results [6]. Experts at home and abroad have their own opinions on the OBE concept, but the analysis is fundamental, and the connotation of various explanations is the same. The implementation idea of the OBE concept teaching is shown in Figure 1. It is not difficult to find out that the OBE concept has abandoned the previous teaching logic of "teaching-learning-examination", and avoided the problem of measuring everything with test scores and guaranteeing the teaching effect. In addition to the examination of curriculum knowledge points, this concept pays more attention to the cultivation of students' comprehensive quality, reversely designs the teaching process with students' learning benefits as the goal, improves the teaching effect, and ensures the teaching quality.

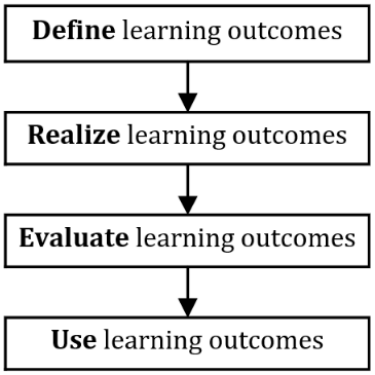

Figure 1. OBE teaching implementation ideas

2.2. Flipping classroom teaching mode

Flipped classroom teaching mode refers to redefining the teaching subject, giving students the time and core role, so that students can give full play to their learning initiative in the "teaching and learning" relationship. This mode is to transform the traditional classroom teaching mode of "acquiring knowledge in the classroom and internalizing knowledge outside the classroom" into "acquiring knowledge outside the classroom and internalizing knowledge in the classroom"[8]. In the flipped classroom teaching mode, students independently arrange learning plans outside the classroom through courseware, textbooks, network resources, and other ways to complete the established learning tasks. In class, students strengthen their understanding and grasp the relevant content of the course by answering questions, discussing, communicating, sharing, and other processes. This teaching mode originated at the end of the last century. After years of practice and exploration, scholars at home and abroad have made certain achievements, proving the superiority of this teaching mode.

At present, COVID-19 has not ended, and the epidemic prevention and control form is severe. Most courses are still taught by online teaching methods. Using the traditional teaching mode to conduct online teaching will cause problems such as students' difficulty in concentrating and teachers' difficulty in supervision, and the teaching effect will be greatly reduced. The flipped classroom teaching mode can solve this problem very well. The application of this mode in the online teaching process not only improves the students' learning initiative, avoids taking up more time and energy because of the need to strengthen management, but also pays more attention to the student's abilities in self-study, innovation, expression, and other aspects, and improves their comprehensive quality.

3. Construction of Flipped Classroom Teaching Mode Based on OBE Concept

3.1. Teaching Objectives of the Course "Energy Storage Technology"

The course "Energy Storage Technology " is an important professional course for the major of Energy and Environmental Systems Engineering. Due to the peak shaving demand of the power grid, the development of distributed energy systems, the space-time mismatch of industrial waste heat, and the instability of new energy utilization, energy storage technology have become an important link in today's energy system. The "Energy Storage Technology" course mainly introduces the basic concepts and technical means of the energy storage technology of energetic energy and process energy, such as thermal energy storage, mechanical energy storage, battery energy storage, hydrogen storage, and fuel cell, as well as new energy storage technologies, and covers the research progress and application case analysis of various energy storage technologies. The "Energy Storage Technology" course mainly introduces the basic concepts and technical means of the energy storage technology of energetic energy and process energy, such as thermal energy storage, mechanical energy storage, battery energy storage, hydrogen storage, and fuel cell, as well as new energy storage technologies, and covers the research progress and application case analysis of various energy storage technologies [9].

Through the study of this course, students are required to master the basic concepts and theories of energy storage technology and master the basic principles and technical characteristics of various energy storage technologies. At the same time, students are required to understand the research and application status of energy storage technology in different forms and scales and master the basic principles of engineering design and application of energy storage technology. Finally, students will have the ability to design and develop energy storage equipment and manage and operate energy storage projects. It will lay a good foundation for future work in the energy industry, and also provide a knowledge reserve for further exploration of energy storage technology in the postgraduate stage.

The course "Energy Storage Technology" is generally offered in the third academic year of the undergraduate course, which has the characteristics of wide coverage of basic knowledge and multiple research directions. There are some problems in teaching, such as students' passive learning, incomplete understanding of knowledge points, and incomplete coverage. Based on the teaching objectives and teaching practice of "Energy Storage Technology", OBE concept, and learning output, this paper discusses the specific implementation of flipped classroom teaching mode in the actual teaching process and seeks new ideas for the development of the teaching process.

3.2. Construction and implementation of teaching mode

The application of the flipped classroom teaching mode based on the OBE concept in the course "Energy Storage Technology " mainly takes students as the main body, with teachers' guidance as the auxiliary. It emphasizes the effect of students' independent learning while taking into account the role of teachers' guidance to help students master and expand knowledge points. The application of the flipped classroom teaching mode based on the OBE concept in the course "Energy Storage Technology" mainly takes students as the main body, with teachers' guidance as the auxiliary. It emphasizes the effect of students' independent learning while taking into account the role of teachers' guidance to help students master and expand knowledge points.

The teaching mode is generally divided into three modules: self-study before class, internalization in class, and assessment and summary after class. The specific construction and implementation of the teaching mode are shown in Figure 2.

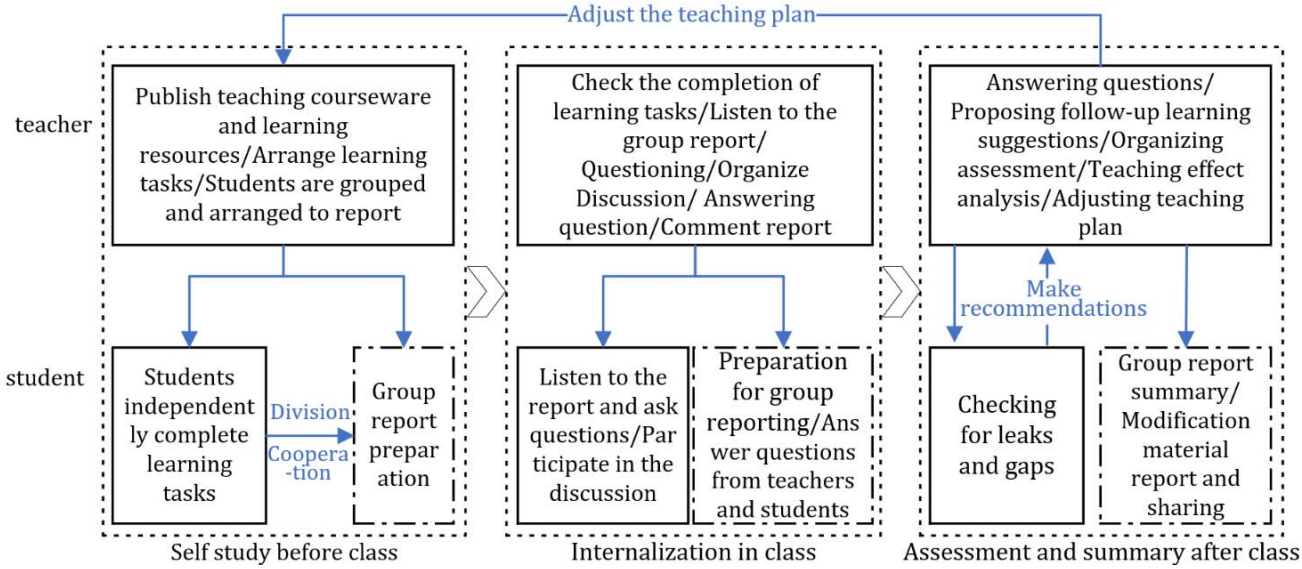

Figure 2. Schematic diagram of teaching mode construction

(1) Self-study before class

As for the flipped classroom teaching mode, pre-class autonomous learning is the most important link in the whole teaching process. The learning situation of students before class directly determines whether the following teaching arrangements can be carried out smoothly, and even affects the overall teaching effect.

As a teacher, first of all, we should make a teaching plan according to the curriculum requirements and training objectives before class, reasonably determine the teaching content and progress of each class, find information according to the teaching arrangement of each class, design courseware, and record the video frequency of self-study guidance micro class before class when necessary to help students complete self-study tasks. The video mainly includes the arrangement of learning content, analysis of key and difficult points, specific requirements, and guiding questions to help students understand relevant knowledge points. Secondly, the teacher determines the student groups in advance and arranges the reporting tasks of each group. During the implementation of this link, teachers and students maintain online and offline communication to help students solve their doubts in the learning process, help the group determine the theme of the report, adjust the content of the report, and even modify the report materials, such as presentations.

As the main body of pre-class learning, students refer to the learning materials shared by the teachers to complete the learning tasks arranged by the teachers. At the same time, according to the reporting theme undertaken by the group, they work together to prepare the group report. For problems encountered in the preparation of study and report, timely discussion with classmates or asking teachers for answers. During the period of epidemic prevention and control, when the school carries out online teaching, all team members cannot discuss face-to-face together. At this time, online meetings and online documents of multiple people can be used to maintain communication and cooperate to complete the report preparation.

(2) Internalization of knowledge in class

There are many tasks and few class hours in the course of "Energy Storage Technology", so the class time is relatively short for the teaching content, but it is crucial for students to internalize and master knowledge. Through classroom presentation, question answering, reporting, and discussion, students can effectively solve problems encountered in the learning process and help students further understand and master relevant knowledge.

As the guide and assistant in the flipped classroom teaching mode, teachers need to check and review students' pre-class learning in the classroom, systematically explain common problems, listen to group reports, and make comments, corrections, and supplements from three aspects: reporting materials, reporting content and on-site performance. To cultivate students' comprehensive ability, in addition to the content of the course covered by the report, students should be helped to put forward problems in such links as material preparation, on-site table, and reporting rhythm, and specific explanations should be given to individual problems. Finally, students should be organized to have class discussions to deepen the teaching content.

In the class, the study group that undertakes the reporting task will report in combination with the presentation prepared in advance. Other students will listen to the report to confirm what they have learned and ask the report group questions about the problems. The report group will answer the questions. At the same time, the report group should check and fill the gaps in combination with other students' questions and suggestions. Finally, all students actively participate in class discussions, share ideas, absorb new ideas and deepen their understanding of knowledge points.

(3) After-class summary and assessment

After-class review and teaching effect analysis can help teachers find problems in various teaching links and correct them, help teachers optimize teaching programs, and improve teaching quality. And for students, timely summaries after class and modularization and systematization of relevant knowledge points will help students consolidate what they have learned and improve themselves.

Teachers and students should maintain communication after class and put forward suggestions for students to follow up on their classroom performance. Arrange students to carry out course assessments, comprehensively evaluate students according to the assessment results and performance in the teaching process, comprehensively analyze the teaching

effect, find out deficiencies and continuously improve the teaching plan, improve the teaching design ability of the flipped classroom, and ensure the teaching quality.

After class, students should check and fill gaps, summarize what they have learned, and actively prepare for the course assessment. In particular, the group that undertakes the reporting task in each class should discuss in the group in combination with the problems and suggestions put forward by teachers and students, analyze problems in various links such as self-study, report preparation, on-site performance, and correct them promptly, improve their ability and knowledge level from various aspects, and finally revise the report materials of the group, and share it with other students.

As the main body of teaching and the actual beneficiary of teaching output, students can put forward their own opinions and suggestions to the teaching teachers in the teaching design and implementation process to help teachers optimize the teaching plan. Teachers should also fully consider the demands of students, deeply implement the OBE teaching concept in the teaching process, and put teaching objectives and teaching output as the top priority.

4. Teaching Evaluation System and Feedback Mechanism

4.1. Setting of the teaching evaluation system

The flipped classroom teaching mode based on the OBE concept emphasizes student-centered and output-oriented, so teaching evaluation should also focus on students' learning gains and growth. As shown in Table 1, to comprehensively evaluate students' learning, the evaluation system of the course "Energy Storage Technology" has introduced a process assessment link. The system is mainly composed of three parts: group report (30%), usual performance (30%), and final assessment (40%). The group report is evaluated from three aspects: report materials (including presentations), report content, and on-site performance. The biggest benefit of student group reports is realized in the process of report preparation. The quality of report materials can directly reflect students' learning attitude and self-study before class. Therefore, the score of this part is slightly higher, accounting for 40% of the report score. Classroom performance is composed of homework performance, classroom performance, and experiment performance, among which, classroom performance reflects participation in class discussion. The final examination is conducted in the form of a report or examination. This link directly reflects the student's mastery of the course content and whether the teaching objectives have been achieved. Therefore, this link accounts for 40% of the total score. The assessment system takes the process assessment link as the core. In addition to the assessment of student's mastery of knowledge points, it can comprehensively evaluate students' learning income and comprehensive ability. The implementation of the assessment system can guide students to develop in an all-around way.

Table 1. Course Evaluation System of "Energy Storage Technology"

Composition of achievements	Specific sub-items
Group report (30%)	Reporting materials (40%) Reporting content (30%) On-site performance (30%)
Daily performance (30%)	Operation completion (30%) Classroom performance (20%) Experimental results (50%)
Final examination (40%)	Reporting/Examination (100%)

4.2. Teaching feedback mechanism based on the evaluation system

The above evaluation system focuses on process assessment, which can better evaluate the teaching effect from all dimensions. By summarizing the scores of all students, analyzing the scoring rates of students in different links, and the scores of different knowledge modules, we can find out the students' insufficient knowledge of the course and help them find and fill the gaps in time. Moreover, teachers can also find out the weak points of flipped classroom teaching design through performance analysis, adjust the teaching plan, optimize the flipped classroom teaching design, and further improve the teaching quality in combination with student feedback.

5. Concluding Remarks

Output-oriented and student-centered is the core of the flipped classroom teaching mode based on the OBE concept, which provides an effective new idea for course teaching during the epidemic prevention and control period. The application of flipped classroom teaching mode also puts forward higher requirements for teachers and students, requiring students and teachers to invest more time and energy. Whether to implement flipped classrooms and how to implement it should be flexibly arranged according to the teaching content, and should not be generalized or formalistic. For example, for content that is too complex and theoretical, traditional teaching methods can be used. In addition, although the flipped classroom transfers the main body of learning from teachers to students, teachers' identities as "masters" cannot be ignored. Teachers' design of the teaching process and their grasp of each teaching link are the keys to achieving better benefits in the flipped classroom teaching mode, while students' initiative in learning and participation in each teaching link is the root of the success of the curriculum teaching.

Acknowledgment

This work is supported by Nanchong Social Science Research Project NC22C360 and NC2019B142.

References

[1] P.Q. Yang, Y. Zhang, W. Chen, K.S. Li, B. Bin: Teaching reform of electrical and electronic technology courses for nonelectrical majors under the concept of engineering

education certification, Electronics World, Vol. 26 (2020) No. 12, p. 61-62. (In Chinese)

[2] S.K. Srivastava, K. Agnihotri: A study on modern teaching pedagogy with special reference to outcome-based education system, International Journal of Business Excellence, Vol. 26 (2022) No. 1.

[3] Z.C. Ying, M. Kong, C.L. Min, X.J. Wang, L. Zhang: Exploration of Flipped Classroom Teaching Mode of Engineering Courses Based on OBE Concept, Journal of West Anhui University, Vol. 38 (2022) No.05, p. 54-58. (In Chinese)

[4] M.L. Lu, B.L. Xu, J. Shi, J.H. Zhu: Exploration of Online and Offline Hybrid Teaching Mode of Intelligent Control Course Based on OBE Concept, China Modern Educational Equipment, Vol. 22 (2022) No.19, p. 55-57+64. (In Chinese)

[5] D.Q. Wu, P.F. Guo, C.L. Zhang, C.J. Hou, Q. Wang, Z.W. Yang: Research and Practice of Data Structure Curriculum Reform Based on Outcome-Based Education and Chaoxing Platform, International Journal of Information and Education Technology, Vol. 11 (2022) No.8, p. 375-380.

[6] G. Li, H. Wang, X. Song: Current Situation and Development of Outcome-Based Education in Computer Teaching. International Conference on Educational and Information Technology (BeiJing, 2022 11th).

[7] S. Liu: Cultivating the Autonomous Learning Ability in College English based on Outcome-Based Education, Proceedings of 2020 3rd International Conference on Education Technology and Information System (Changsa, 2020). p.217.

[8] R.J. Liu, T. Zhang, M.J. Wu: Design and Practice of Flipped Classroom Based on the OBE Concep, Experiment Science and Technology, Vol. 19 (2021) No.04, p. 112-116. (In Chinese)

[9] Q.R. Wang: Development on Large-scale Energy Storage Technology. International Conference on Informatics, Control and Robotics (Shanghai, 2019). p.304.