

Application of Innovative Flipped Classroom Teaching Model in Solid Waste Treatment and Disposal Course

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Abstract. Flipped classroom reformed the traditional teaching model, which realized the reverse innovation of the teaching process and showed the incomparable advantages of traditional teaching. Flipped classroom model emphasizes students' active involvement in learning process. Based on the analysis of the existing problems in traditional teaching pattern, the design and construction of flipped classroom-teaching model for solid waste treatment and disposal course were preliminarily discussed. Some measures such as adjustment of teaching concepts, enhancement of micro-class production, development of students' active learning platforms, and emphasis on interactive classroom communication were put forward. The implementation of flipped classroom will play an important role in improving teaching quality and cultivating high-quality talents, through encouraging students' participation and cultivating students' self-learning ability, thinking ability, exploring ability, cooperative ability and practical ability.

Keywords: Flipped classroom; Teaching; Active learning; Solid waste treatment and disposal course.

1. Introduction

The flipped classroom is a new, popular and interactive teaching pattern, in which students' knowledge learning will be conducted prior to class by using audiovisual lectures, podcast, and web-based resources, while students' active thinking, discussion, problem exploration, task solving and other hands-on activities will be conducted in a face-to-face classroom setting with the guidance and help of teachers. The flipped classroom was firstly introduced by Jon Bergmann and Aaron Sams from one high school in Colorado, US in 2007 [1]. In order to make up lessons for the students who are delayed in class, the videos of lectures are recorded and transmitted to the network platform. The students watched the videos outside classroom, and completed their homework and solved problems with the teacher's guidance in classroom. After the introduction of flipped classroom model, it has been widely recognized and applied in primary schools, middle schools and universities in many countries. In the flipped classroom, the teacher interactively communicates with the students instead of merely delivering knowledge, while the students become more active and responsible for the learning process.

Flipped classroom is an inversion and reform of traditional teaching model, which changes the teaching process from "teaching before learning" to "learning before teaching", and realizes the reverse innovation of traditional teaching process. Unlike traditional teacher-dominant teaching, in which students passively receive knowledge and information, flipped classroom model are centered around the students not the teacher, and the teacher-centered teaching mode for traditional teaching model is replaced by the student-centered teaching [2-4]. In flipped classroom model, teachers are not only knowledge transmitter, but also the organizers and guides in classroom. The role of students are converted from passive listeners into active learners, and students conduct active learning and have opportunities to perform deep-thinking activities [5]. Moreover, cooperative learning is also an important component of flipped classroom model, in which students will work together in group with interactive feedback and discussion. Cooperative learning can bring many benefits to students and teachers. For example, it can promote students in deep-learning and critical thinking. They also develop social and communication skills likely to be of use to them after graduation [6]. Flipped classroom can enhance students' interest in learning, enhance the interaction between teachers and students, help teachers to understand students better, and cultivate students' learning ability, thinking ability and innovative ability. Flipped classroom for tertiary teaching have typically been

implemented in order to increase student engagement, enhance the student learning experience and enthusiasm, and improve student outcomes [7-9]. Based on the current background of training practical talents, taking solid waste treatment and disposal course as an example, the application of flip classroom is discussed.

2. Flipped Classroom Teaching Model on Solid Waste Treatment and Disposal Course

The objective of solid waste treatment and disposal course is to enable students to master the methods, principles and resource-based technologies of solid waste treatment and disposal, and lay a foundation for future engineering and research and development in solid waste treatment and disposal. At present, in the traditional teaching process, it is found that students are in the position of passive acceptance of knowledge, insufficient interaction in the classroom teaching process and dull classroom atmosphere, which are not conducive to the cultivation of innovative thinking and innovative ability for students. These advantages of flipped classroom can well solve the problems existing in the current classroom teaching. Therefore, it is worth trying to introduce the flipped classroom into the teaching of solid waste treatment and disposal course and discuss the teaching mode of the flipped classroom.

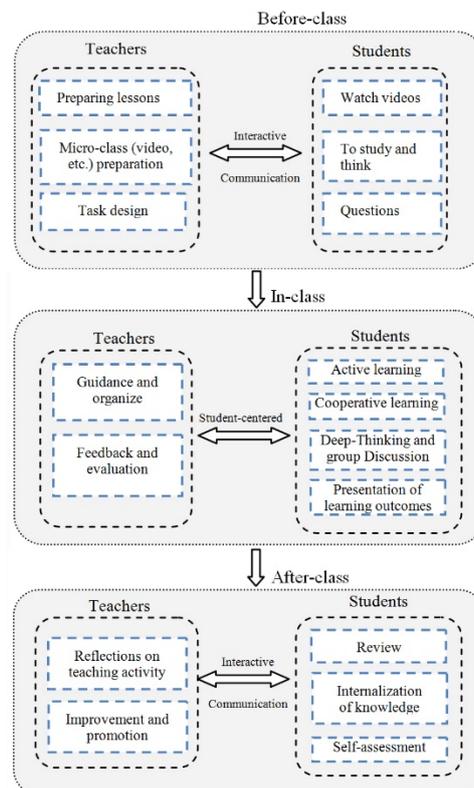


Fig. 1 The composition of flipped classroom teaching model

2.1 Adjustments of Traditional Teaching Concepts

Flipped classroom model is an inversion of traditional teaching model and realizes the reverse innovation (from "teaching before learning" to "learning before teaching"). Flipped classroom model are centered around the students not the teacher, and teachers are not only knowledge transmitter, but also the organizers and guides in classroom. The role of students is converted from passive listeners into active learners, and students conduct active learning and have opportunities to perform deep-thinking activities. Therefore, teachers need to adjust their teaching concepts, and study how to realize the role's transition during the teaching process. It requires in-depth study of the basic theoretical knowledge and practical ways of flipped classroom teaching model.

2.2 Course Resource Construction (Micro Class)

It is necessary to provide appropriate learning materials for students study prior to class. Micro-video (~15 minutes) production is the core content of resource preparation (e.g. domestic garbage landfill method and treatment of landfill leachate, air flotation pretreatment for solid waste screening, sewage sludge composting process, crushing technology of mineral resources) for students according to the needs of curriculum teaching requirements. Every micro-video should focus on one keypoint with clear teaching objective. Camtasia Studio 9.0 software is usually used to record micro-videos with clear pictures and simple operation. After the video production, they can be uploaded to website for students to download and watch. Teachers should clearly inform learners of pre-class learning tasks. At the same time, to establish network teaching platform and community (WeChat, QQ group) for students and teacher communication (Online discussion) before class.

2.3 Students Active Learning before Class

Teachers arrange learning tasks (e.g. learning objectives, content, assignments, and studying key points) for students before class according to teaching plan and objectives [10]. Students will finish learning activity by watching micro-videos and conducting pre-class exercises. When students encounter difficulties in learning process, they can communicate with their classmates or teachers through the network platform (e.g. WeChat, QQ group), and record the difficult problems that cannot be solved. For example, how to identify hazardous waste accurately, and master their classification and hazard characteristics, students can know the knowledge through micro-video, and fully understand the basic theory and environmental toxic effects of hazardous waste, and consult the latest list of hazardous waste, hazardous waste identification standards and methods.

2.4 Teaching Activities in Classroom

The most critical point to consider with in class teaching is to engage students and promote active learning [11]. Classroom activities mainly include identification the problems to be solved, independent exploration, collaborative learning, interactive communication, and feedback evaluation. Problems to be solved includes the difficulties students encounter before class learning, the difficult contents of the course, and the extension of the problem. Independent exploration can further improve students' ability to solve problems independently. For example, how to prevent and control the pollution of waste batteries used in daily life, the necessity of municipal domestic garbage incineration and its pollution control, teacher can let students actively explore independently, teacher timely provide face-to-face counseling and communication. Under the guidance of teacher, it can not only improve students' self-confidence and enthusiasm, but also exercise students' ability to think. Collaborative learning is an important part of flipping classroom activities, which is conducive to students' understanding, and cultivating the ability to solve practical problems. Hot topics is usually selected as studying materials for collaborative learning. For example, the discussion on advantages, disadvantages and application prospects of municipal solid waste incineration and landfill. Students develop their thinking ability through collaborative learning, and enhance their communication ability and tolerance. The solutions of the problems are shared with others, to achieve the goal of common improvement. Feedback and evaluation is a very important portion in classroom teaching activities, in which students send their learning experience and problems to teachers, and make self-evaluation on their own and group learning effectiveness. The assessment of task accomplishment is mainly carried out by means of self-assessment within group, mutual evaluation between groups and comprehensive evaluation by teachers. The evaluation includes process performance evaluation and result evaluation.

2.5 Evaluation and Summary

Evaluation and summary after class is very important portion for the flipped classroom teaching process. After class, students need to summarize and consolidate what they have learnt. Based on the feedback from students, the teachers need to analyze the existing problems in whole teaching activity, conduct reflection of teaching activity, and improve teaching performance.

3. Summary

Flipped classroom changes the teaching process from "teaching before learning" to "teaching after learning", and realizes the reverse innovation of teaching process. It is of great importance to apply the flipped classroom in college teaching, which will play an important role in improving teaching quality and training high-quality talents. The design and construction of flipped classroom-teaching model for solid waste treatment and disposal course were preliminarily discussed, and some measures such as adjustment of educational concepts, enhancement of micro-class production, development of students' active learning platforms, and emphasis on interactive classroom communication were put forward.

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References

- [1]. Gökçe Akçaylır, Murat Akçaylır. The flipped classroom: A review of its advantages and challenges. *Computers & Education*. Vol. 126 (2018), p. 231-236.
- [2]. Chiu-Lin Lai, Gwo-Jen Hwang. A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers & Education*, Vol. 100 (2016), p.126-140.
- [3]. Tosti Hsu-Cheng Chiang. Analysis of learning behavior in a flipped programming classroom adopting problem-solving strategies. *Interactive Learning Environments*, (2017), p. 1-14.
- [4]. Gillian Foster, Sigrid Stagl. Design, implementation, and evaluation of an inverted (flipped) classroom model economics for sustainable education course. *Journal of Cleaner Production*. Vol. 183 (2018), p. 1323-1336.
- [5]. Caviglia-Harris Jill. Flipping the undergraduate economics classroom: Using online videos to enhance teaching and learning. *Southern Economic Journal*. Vol. 83 (2016), p. 321-331.
- [6]. M.T. Munir, Saeid Baroutian, Brent R. Young, Susan Carter. Flipped classroom with cooperative learning as a cornerstone. *Education for Chemical Engineers*. Vol. 23 (2018) , p. 25-33.
- [7]. Choon Fu Goh, Eng Tek Ong. Flipped classroom as an effective approach in enhancing student learning of a pharmacy course with a historically low student pass rate. *Currents in Pharmacy Teaching and Learning*. Vol. 11 (2019), p. 621-629.
- [8]. Isaiah T. Awidi, Mark Paynter. The impact of a flipped classroom approach on student learning experience. *Computers & Education*. Vol. 128 (2019), p. 269-283.
- [9]. Hafidi Mohamed, Mahnane Lamia. Implementing flipped classroom that used an intelligent tutoring system into learning process. *Computers & Education*. Vol. 124 (2018), p. 62-76.
- [10]. Mario M. Valero, Maria Martinez, Francesc Pozo, et al. A successful experience with the flipped classroom in the TransportPhenomena course. *Education for Chemical Engineers*. Vol. 26 (2019), p. 67-79.
- [11]. Connie Barbour, Jenny B. Schuessler. A preliminary framework to guide implementation of The Flipped Classroom Method in nursing education. *Nurse Education in Practice*. Vol. 34 (2019), p. 36-42.