Research on teaching reform of 3D digital modeling (Pro/E) course for flipped classroom based on micro-lesson

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Abstract. Micro-lesson has the characteristics of "small, micro and fine", which is suitable for mobile learning, ubiquitous learning and autonomous learning in the internet era. Flipped classroom, also known as inverted classroom, is a teaching model that reverses the traditional classroom. In this paper, the characteristics and teaching current situation of the 3D digital modeling (Pro/E) course are analyzed, the reform of traditional teaching modle is put forward, the application study of flipped classroom teaching model based on micro-lesson on this course is carried out, the practice effect of the teaching model is analyzed and the problem of the teaching model is explored. The research results are expected to point out the direction for the promotion and application of the flipped classroom teaching model.

Keywords: Micro-lesson; Flipped classroom; Pro/E; Teaching reform.

1. Introduction

Micro-lesson is taking video as the main carrier to record brief and complete teaching activities of teacher around a certain knowledge point or teaching link [1]. The prototype of the micro-lesson originated from 60 second course, which was presented by Professor Le Roy's. The concept of the micro-lesson was firstly presented by instructional designer David penrose from American in 2008, and successfully applied to flipped classroom teaching activities. In China, the concept of micro-lesson was put forward by Mr. Hu Tiesheng in 2010, and caused a huge response in the following years. Micro-lesson has become the trend of the development of education informatization. The micro-lesson is usually about 10 minutes long, and has the characteristics of “small, micro, fine”, which is suitable for mobile learning, ubiquitous learning and autonomous learning in the internet era, and more suitable for on-demand selective learning, personalized learning and micro-mobile learning for knowledge points of different disciplines [2,3]. Flipped classroom is originated from the chemistry course of Woodland Park High School in the United States. Flipped classroom is based on the internet, mobile platforms, etc. information technology means, takes teaching videos (micro-lessons) as the main learning resources, builds an information teaching environment, replans the pre-class, class and after-class links, and realizes the reversal of the roles of teachers and students in traditional teaching through the inverted arrangement of knowledge transfer, knowledge internalization and knowledge consolidation, which has completely changed the traditional classroom teaching model [1,4]. The teaching model is beneficial to improve students' autonomous learning ability, enhance learning interactivity, improve practical ability, as well as carry out personalized teaching for teacher, which has become a hot issue in research and practice of educator at home and abroad. The positive impact of flipped classroom teaching model on teaching effect has been unanimously recognized by the industry.

2. 3D Digital Modeling (Pro/E) Course Characteristics and Teaching Status

3D digital modeling (Pro/E) course is the main course, required course of mechanical and electrical major in our school, which includes theory teaching and computer practice teaching. The theory

teaching is 17 class hours, while 34 class hours for computer practice teaching. This course mainly explains the methods and skills of two-dimensional sketch drawing, three-dimensional solid modeling, assembly of components and two-dimensional engineering drawing with the help of Pro/E software of PTC Company in the United States, cultivates students' three-dimensional modeling design skills and innovative thinking ability, enhance students' spatial imagination, and lays a good practical foundation for students to engage in the design, research and manufacturing of machinery and electrical machinery in the future. Pro/E software is a large three-dimensional modeling software, which has the characteristics of full parameterization and single database. Pro/E software has many operation commands, relatively complex modeling process, as well as more "drop-down menu" type interface, which makes it difficult to learn [5]. For traditional teaching model, according to teaching programme, teachers first explain knowledge points through multimedia courseware, then open Pro/E software for various command operation demonstration, and finally explain a few simple examples to carry on the software specific operation application in theory class.

After theory class, students will practice in computer classroom. The students follow the teacher's instructions to complete the class exercises. After course, according to attendance, computer exercises and final examination, the course score is assessed by teacher. Under this teaching model, the teacher seems to have completed the teaching task in the surface, but in this kind of "cramming education" teaching model, students are more passively accept knowledge. This teaching model is unable to achieve hierarchical teaching. With the development of internet technology, students' learning methods and thinking patterns are constantly changing. The traditional 3D digital modeling (Pro/E) course teaching model is no longer suitable for today's teaching environment. Therefore, it is necessary to rethink the existing teaching model of this course and reform it.

3. Implementation of Flipped Classroom Teaching Model Based on Micro-lesson

3.1. Teaching Preparation before Class

First, according to the overall teaching objective, the 3D digital modeling (Pro/E) course is decomposed for the first time, namely, it can be divided into Pro/E software basic knowledge, two-dimensional sketch drawing, three-dimensional solid modeling, component assembly and engineering drawing. Then, according to the characteristics of ease of operation, execution and evaluation, the each unit is decomposed into corresponding smaller microunits in the second time. For example, the unit of the 3D solid modeling can be divided into tensile feature, rotation feature, scanning feature, mixing feature, reference plane feature, reference axis feature, reference point feature, reference curve feature, reference coordinate system feature, hole feature, reinforcement feature, pull-out model feature, fillet feature and chamfering feature, and so on. Finally, according to micro-unit, the learning task list is designed, the micro-lesson is recorded and the micro-exercise is compiled. The learning task list is the learning task, which the students should be finished before class. The learning task list includes study guides, study content, study assignments, study questions and study summaries. The content of micro-lesson is to analyze and refine the teaching objectives, teaching objects and teaching content, which should be controlled within 10 minutes. Micro-lesson should be based on teacher's explanation, demonstration video, and the other learning resources are for references. According to the characteristics of the 3D digital modeling (Pro/E) course, the micro-lesson is recorded in the form of recording screen and simultaneous sound, and the operation process of mouse and keyboard is restored as far as possible. Moreover, on the basis of actual needs, combined with the teaching objectives, key and difficult points of micro-units, the feedback on learning including micro-exercise and on-line answering is assigned, and the learning status and problems of the students are grasped timely. So, the teacher can be able to provide targeted guidance.

3.2. Self-learning Micro-lessons before Class

According to the learning task list provided by the teacher and their own situation, students should reasonably arrange learning time and place to watch micro-lesson videos within the given time. The duration of students watching micro-lesson videos can be determined according to their own learning state. For the indigestible knowledge, the students can repeatably watch. For the easy knowledge, the students can leapingly watch. For the confusing knowledge points encountered in the learning process, they can record in the learning problem list of learning task, communicate and discuss with classmates and teachers. After learning micro-lessons independently, students need to complete micro-exercises to consolidate the learned knowledge and achieve knowledge to be transferred. In addition, the teacher corrects the students' micro-exercises, analyzes the online question answering situation, obtains the learning effect of micro-lessons, and finds the problems of students' self-learning micro-lessons.

3.3. Implementation of Classroom Teaching

According to the characteristics of 3D digital modeling (Pro/E) course, all classroom teaching are arranged in the computer room, so that students can listen and practice, keep up with the pace of the teacher, and enhance the hands-on ability. The first step in the whole implementation process of classroom teaching is that teachers should answer questions and solve doubts collected by students learning micro-lessons and doing micro-exercises before class. For more difficult operation feature, the teachers should carry out on-site demonstration, and the students are asked to complete the operation. Secondly, based on the knowledge objectives of micro-units, the teacher sets corresponding tasks. According to the difficulty of the tasks, the students can explore independently or learn cooperatively. The teacher observes the operation of the students or discusses and communicates with the students, and provides appropriate individual guidance or collective explanation. Finally, students complete the tasks assigned by teachers, which turn into works, and the knowledge is achieved the construction and internalization [6,7].

3.4. Consolidation and Improvement after Class

After reviewing the works of students, the excellent works will be posted on the QQ group of the course for display by the teacher, so that other students can learn from that, and all students achieve the purpose of common improvement. In addition, teachers also need to collect the expansion of resources, which are related to the teaching contents, and arrange the expansion of learning tasks. Students can conduct the challenge of learning if they have more energy. The flipped classroom teaching model can achieve the purpose of hierarchical teaching, and achieve the consolidation and expansion of knowledge.

3.5. Teaching Reflection and Practice Effect

Teaching reflection is an important link in the continuous improvement of flipped classroom teaching model [5]. On the one hand, teachers need to make objective, reasonable and comprehensive evaluation on learning micro-lessons independently, doing micro-exercises, computer operations in classroom, collaborative learning and so on. On the other hand, teachers also need to know the learning situation of each student in time. For students with learning difficulties, teachers will conduct on one-to-one tutoring. For students with more energy to learn, teachers will carry out on expanding and improving learning. Furthermore, teachers can continuously improve teaching resources such as micro-lesson videos, and improve, modify optimize flipped classroom teaching model to improve teaching effect by teaching reflection.

The flipped classroom teaching model based on micro-lesson is adopted in the teaching of 3D digital modeling (Pro/E) course. Through the practice of one semester, compared with the ordinary class, the experimental class has better achieved the teaching objectives of the course, and students have more strong practical operation ability. Most of the students actively participate the discipline competition, and get excellent scores. Through the questionnaire survey of students in the

experimental class, students give positive evaluation to the flipped classroom teaching model. They are willing to actively learn and operate on the computer, rather than passive knowledge infusion and mechanical imitation. For software application courses such as 3D digital modeling (Pro/E), flipped classroom teaching model enables students to have more hands-on time, which is conducive to improving students' hands-on ability.

However, flipped classroom teaching model puts forward higher requirements for teachers' professional competence. The teachers need to cost a lot of time and energy to prepare teaching resources before class and design teaching activities in class. This means that flipped classroom teaching model can only be applied selectively. At the same time, higher and stricter requirements are also put forward for students' learning, which will make it difficult for students with poor foundation to adapt to the high-intensity flipped classroom teaching model, and a few students even give up on themselves, give up their learning of this course. Therefore, how to take into account their learning emotions, help them to learn well, and improve their learning enthusiasm and initiative, which are needed to continue to improve and optimize the problem for the flipped classroom teaching model.

4. Summary

The flipped classroom teaching model based on micro lesson is applied to the teaching of 3D digital modeling (Pro/E) course, which has proved to be effective and feasible for the software application courses. This model fully embodies the principal position of students and the leading role of teachers. However, the promotion and implementation the teaching model for other courses need to be carried out flexibly in combination with the characteristics of various disciplines, majors and courses. It is necessary to constantly summarize and accumulate experience in practice, improve and optimize the flipped classroom teaching model, and dig out a suitable flipped classroom teaching model.

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