The CDIOTC Teaching Method based on Practical Courses

Xiangmei Li\textsuperscript{1,a,*}, Guohui Rao\textsuperscript{2,b}, Zhi Qin\textsuperscript{1,c}, Shibin Zhang\textsuperscript{1,d} and Bin Han\textsuperscript{1,e}

\textsuperscript{1}School of Cybersecurity, Chengdu University of Information Technology, Sichuan, China
\textsuperscript{2}School of Foreign Language, Chengdu University of Information Technology, Sichuan, China
\textsuperscript{a}lixiangmei@cuit.edu.cn, \textsuperscript{b}cdrghui@163.com \textsuperscript{*}mercyqz@cuit.edu.cn, \textsuperscript{d}cuitzsb@cuit.edu.cn, \textsuperscript{e}hanbin@cuit.edu.cn

Keywords: CDIO education concept; practical courses; flipped classroom; classroom teaching.

Abstract. In this paper, we first analyze the problems that are common in the teaching of traditional practical courses. For example, students' teamwork ability and responsibility cannot be improved, students are not interested in course learning, and they have no initiative of self-learning, the teaching effect is poor and so on. Secondly, the CDIOFC teaching method is proposed, which combines the educational concept of CDIO with the teaching mode of the flipped classroom, and redesigns the classroom teaching. Finally, the teaching method is applied to the network service configuration and management course. The implementation results show that the course teaching method effectively solves the problems existing in the teaching of the traditional practical courses. Herefore, the CDIOFC teaching method proposed in this paper is effective and worth promoting.

1 Introduction

At present, there is a very contradictory phenomenon: “Enterprises are in urgent need of talents, and they are hungry; college students often complain that it is difficult to find jobs, the enterprises have high requirements, low wages, overtime work, etc.” Why does this contradiction happen? The reason is that enterprises look for innovative, versatile and compound talents with team leadership, organizational, communicative and coordinating ability, while college one-sidedly emphasizes knowledge and focuses on students' professional skills. For practical courses, the following problems generally exist:

1) How can students' teamwork ability and responsibility be advanced? How can students' engineering awareness and literacy be cultivated?

The classroom teaching of practical courses is usually organized by teachers to explain the experimental principles and demonstrate the experimental process; students practice and complete designated experimental tasks. Through the whole process, the teacher is the leader, and the students don't need to think, just follow their teacher step by step. With such classroom teaching, has students' teamwork ability and responsibility been advanced? Has engineering awareness and engineering literacy been cultivated?

2) How can the individual needs of students be met? How can students' learning interest and their self-learning ability be increased?

What is taught by the teacher of practical courses largely depends on the teaching plan, so the difference in students’ reception can’t be made clearly. Therefore, students’ individual needs can't be met, nor their learning interest and their self-learning ability be increased.

3) How can the efficiency of classroom teaching be improved?

In the classroom of practical course teaching, students themselves are usually here, but they may be absent-minded or distracted, which leads to the Recessive Absence of learning subjects and thus cannot guarantee the effect of classroom teaching.
In summary, this paper proposes the CDIOFC teaching method, which combines the educational concept of CDIO with the teaching mode of the flipped classroom, aiming at cultivating students' engineering awareness and engineering literacy, advancing students' teamwork ability and responsibility; allowing students to make full use of the class time, improve the classroom effect; meet their individual needs, increase their interest in learning and self-learning.

2 The CDIOFC teaching method

CDIO, namely Conceive-Design-Implement-Operate (CDIO) framework, in the form of life cycle from product development to product, let students in an active, practical, organic connection between courses way learn engineering [1-4]. Flipping the classroom means re-adjusting the time inside and outside the classroom and transferring the decision-making power from the teacher to the student [5-6]. The CDIOFC teaching method combines the educational concept of CDIO with the teaching mode of the flipped classroom. The following is an example of the "Network Service Configuration and Management" course, which briefly describes the teaching design of CDIOFC.

The teaching place of network service configuration and management is laboratory, which is a typical practical course. In the first lesson of the course, the teacher explains the course requirements, content overview and classroom teaching design, and divides the students into groups, and assigns teaching tasks of each group in the course. The teaching design for each subsequent lesson is shown in Table 1.

Table 1. Teaching Design.

| Before class | Teaching group | Other groups | Teacher |
|--------------|----------------|--------------|---------|
| Watch teaching videos, experiment and make teaching courseware | Watch teaching video and preview | Prepare teaching videos and references |
| In class | 1. Share teaching topic; 2. Discuss around this teaching topic; 3. Experiment; 4. Let the teacher examine the experiment; 5. Tutor and examine the experiments of other groups; 6. Summarize and share the gains. | 1. Listen and learn 2. Participate in the discussion 3. Experiment 4. Evaluate the teaching group | 1. Review the previous teaching topics 2. Assist the teaching group 3. Solve difficult problems 4. Examine the experiment of the teaching group 5. Evaluate the teaching group and summarize. |

As can be seen from Table 1, the entire classroom is organized by the students of the teaching group. For the students in the teaching group, a classroom teaching is a project. The whole process from preparation, design to implementation is done by the students themselves. They need to keep communicating and finding a solution to the problem in various ways. In the whole classroom teaching, the teacher is just a supporting role. Only when the students encounter a problem, the teacher is introduced.

As can be seen from the entire teaching design, first of all, the CDIOFC teaching method uses the CDIO engineering education concept. Students take a classroom teaching as a project. Pre-class preparation can be regarded as a project conception and design; the implementation of teaching is the realization and operation of the project. Secondly, the CDIOFC teaching method incorporates the teaching mode of the flipped classroom. Throughout the classroom, students can watch teaching videos before, during, and after class, and actively participate in discussions during class.
The CDIOFC teaching method was implemented in the 2018 Network Services Configuration and Management course. After the course, each student participated in the questionnaire anonymously. The results are shown in Table 2.

Table 2. Questionnaire Results.

| Do you prepare carefully before class? | Have you achieved the desired results? | Do the students in the teaching group master the knowledge they have learned? | Do the students in other group master the knowledge they have learned? | Do you like this teaching method? |
|----------------------------------------|----------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------|
| Y                                      | Y                                      | Y                               | Y                               | Y                               | 97.06                           |
| N                                      | N                                      | 2.94                           | 79.41                           | 20.59                           | 2.94                       |

As can be seen from Table 2, 97% of the students carefully prepare the teaching tasks before class, 79.41% of the students are satisfied with their classroom performance. For the students in the teaching group, 94.12% of the students think that they have mastered the knowledge. For other groups of students, 79.41% of the students think that they have mastered the content; 88.24% of the students like this teaching method, only 11.76% of the students do not like it. The reason why they don't like it is that they spend too much time and bear too much pressure.

In the questionnaire survey, the students were asked which of their abilities were trained in this teaching method. The answer of most students is the teamwork ability, responsibility, self-learning ability, communication, organization and so on.

From the implementation results of the CDIOFC teaching method in the network service configuration and management course, it can be seen that the students' engineering awareness and engineering literacy have been cultivated, the teamwork ability and responsibility have been advanced; their individualized needs have been met, their learning interest and self-learning ability have been increased and the practical classroom teaching effect has been improved.

3 Conclusion

In this paper, we first analyze the problems that are common in the teaching of traditional practical courses. For example, students' teamwork ability and responsibility cannot be improved, students are not interested in course learning, and they have no initiative of self-learning, the teaching effect is poor and so on. Secondly, the CDIOFC teaching method is proposed, which combines the educational concept of CDIO with the teaching mode of the flipped classroom, and redesigns the classroom teaching. Finally, the teaching method is applied to the network service configuration and management course. The implementation results show that the course teaching method effectively solves the problems existing in the teaching of the traditional practical courses. Herefore, the CDIOFC teaching method proposed in this paper is effective and worth promoting.

Acknowledgement

In this paper, the research was sponsored by Undergraduate Teaching Engineering of Chengdu University of Information Technology (Project No. BKJX2019067) and Enterprise Industry-university Cooperation and Education Project of Department of higher Education, Ministry of Education (Project No. 201802095016).
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