Journal of Contemporary Educational Research, 2023, Volume 7, Issue 11
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Remolding Software Engineering Course Based on Engineering Education Concepts

Jing Jiang[1]*, Xianyang Wang[1], Yangcheng Xia[1], Huoyuan Wang[1], Pingping Tong[1], Juanjuan Hong[2]

[1]School of Computer and Information, Anqing Normal University, Anqing 246133, Anhui Province, China
[2]College of Foreign Languages, Anqing Normal University, Anqing 246133, Anhui Province, China

Corresponding author: Jing Jiang, jiangjing@aqnu.edu.cn

Abstract: The core of the engineering education concepts is student-centered teaching, result-oriented teaching, and continuous improvement. It is necessary to carry out course remolding of software engineering course guided by engineering education concepts. This paper first analyzes the pain points of teaching the course of software engineering, and then introduces how to remold the course based on engineering education concepts, including reformulating the teaching objectives, teaching modes, and assessment methods. Through teaching practice, we find that the improved course has achieved a better teaching result, which reflects the advantages of the engineering education concepts.

Keywords: Engineering education; Course remolding; Software engineering

Online publication: November 23, 2023

1. Introduction

Engineering education concept is a form of education based on the concepts of "student-centered teaching, result-oriented teaching, and continuous improvement," the core of which is to combine the theoretical knowledge with practical skills. It allows the students to apply their knowledge and skills in solving the actual engineering projects, so as to improve their comprehensive quality and practical ability [1]. In 2020, the Chinese Academy of Engineering published the "Guiding Opinions on Promoting the Construction of First-Class Engineering Education," which puts forward a number of specific measures to promote the education reform and strengthen the construction of the discipline [2]. In this context, many colleges and universities have explored the reforms of majors and courses, and thus built a number of majors and courses that fit the concept of engineering education [3].

The software engineering course is a professional course for computer-related majors. It mainly introduces the basic concepts and principles of software engineering, the engineering methods and techniques for developing software projects, the processes and guidelines to be followed during the development process, as well as the advanced software development management methods. It focuses on cultivating the students' practical engineering skills and their capability to solve complex problems. At present, there are still a lot of

colleges and universities that teach software engineering with the traditional teacher-led teaching mode, and fail to keep pace with the times in terms of course objectives and course evaluation, which is not conducive to achieving the cultivation requirements, nor to the development of engineering education [4].

To this end, this paper introduces how to remold the course of software engineering based on its characteristics and guided by the engineering education concepts, including remolding the teaching objectives, teaching modes, and assessment methods. It aims at enabling students to understand and master the theories and methods of software engineering in a more in-depth manner, and cultivating their ability to apply the software engineering knowledge to solve complex engineering problems.

2. Pain points of teaching the course of software engineering

The course of software engineering occupies an important position in the talent training system of various majors. With the country vigorously advocating the new engineering discipline and engineering education, the teaching of the course currently faces the following problems.

2.1. Failure to reflect "results-oriented teaching" in the teaching objectives

The current teaching objectives are generally test-oriented, ignoring the bridge between course teaching and the demand of the software industry. They also ignore the connection between course teaching and the effectiveness of student training, and thus failing to reflect the concept of "results-oriented teaching" in engineering education [5]. In this case, it is difficult for the students to apply the knowledge in the process of solving the actual problems of software engineering, as well as to sharpen the solid professionalism of the software industry.

2.2. Failure to reflect "student-centered teaching" in the teaching modes

The current teaching modes are mainly teacher-led and offline teaching. They underestimate the value of hybrid teaching mode and intelligent teaching tools, which fails to reflect the concept of "student-centered teaching" in engineering education [6]. In the uninteresting offline teaching process, the teacher plays the role of knowledge transmitter and decision maker in the classroom, while the students only passively accept and learn the knowledge. Therefore, it is difficult for the students to produce perceptual understanding of the obscure knowledge.

2.3. Failure to reflect "continuous improvement" in the assessment methods

The current assessment methods rely on the summative evaluation to measure the students' learning outcomes, and ignore the role of formative evaluation in monitoring and guiding the students' learning process, which fails to reflect the concept of "continuous improvement" in engineering education [7]. On the one hand, this kind of assessment cannot truly reflect the students' knowledge mastery and engineering practical skill, and it is also difficult to provide an effective support for the analysis of the achievement of teaching objectives and the diagnosis of teaching problems.

3. Remolding the software engineering course

In order to solve the above pain points, the teaching team of software engineering course in Anqing Normal University has deeply explored the connotation of the engineering education and remolded the course with the guidance of the engineering education concepts. The teaching objectives, teaching modes, and assessment methods are introduced below.

3.1. Remolding the teaching objectives based on "results-oriented teaching"

According to the concept of "result-oriented teaching," the new teaching objectives no longer focus on the knowledge learning alone, but focus on a three-dimensional objective of "knowledge learning, skill training, and emotion shaping." They emphasize that the students should be able to apply the principles, methods, processes, and tools of software engineering to solve complex software engineering problems, and have the necessary professionalism to engage in the software industry. Compared with the engineering certification standards, the improved three-dimensional teaching objectives are described as follows.

For the objective of knowledge cultivation, we require the students to systematically master the knowledge of software engineering methodology, process, tools, and project management, and understand the latest theories and development dynamics of the software engineering research.

For the objective of skill cultivation, we require the students to have certain software engineering professional thinking, logical thinking, and innovative thinking, and be able to independently complete small software development tasks and participate in large-scale software project development as a team member.

For the objective of emotion cultivation, we will stimulate the students' respect for domestic outstanding software developers, cultivate their enthusiasm for overcoming software technology difficulties, and establish a correct outlook on life, world view, values, and application of science and technology.

3.2. Remolding the teaching modes based on "student-centered teaching"

The utilization of intelligent teaching tools, such as ChaoXing (a learning software) and Rain Classroom, not only enriches the offline teaching methods, but also serves as a "database" for storing online teaching resources. Therefore, the new teaching modes are characterized as a type of hybrid mode incorporating online and offline teaching, which is based on ChaoXing and the concept of "student-centered teaching."

Before the class, the teacher distributes online learning tasks through the massive open online course (MOOC) resources in ChaoXing to remind the students to do the pre-study work. It should be noted that the course of software engineering has a lot of content and vary greatly in difficulty. Therefore, the students can master the knowledge points that are easy to understand or strongly related to the content of the pre-study courses through the MOOC resources. The teachers can answer the questions in the classroom according to the students' pre-study situation in a targeted manner, and teach the key points and difficult points in detail.

In the class, the teacher firstly gives out the exercises through the learning activity of "practice with class" in ChaoXing to help students to review the content of the previous lesson. Then, the teacher mobilizes students' learning enthusiasm and passion through learning activities such as "selecting people," "quiz," and "group task." Lastly, the teacher gives out some discussion questions containing Civic and Political Education to inspire students to think. In particular, ChaoXing will record the students' participation in all kinds of learning activities, which will be counted in their regular grades. The record of participation can be used as process materials to provide the basis and support for the formative evaluation of the course and the analysis of the achievement of the course objectives.

After class, the students are required to carry out an independent study according to their own needs by relying on ChaoXing to consolidate the knowledge points and carry out practical projects. The course team has prepared more than 1,000 post-course exercises, more than 10 real-life project cases, and electronic versions of several classic books related to software engineering, thereby providing students with abundant post-course learning resources. At the same time, the teacher team carries out weekly question and answer (Q&A) activities, monitors the completion of post-course assignments, and helps students to check and fill in the gaps in their mastery of course knowledge.

3.3. Remolding the assessment methods based on "continuous improvement"

To implement the concept of "continuous improvement" in engineering education, the new assessment methods combine both quantitative evaluation (taking into account both formative and summative evaluations) and qualitative evaluation. They will help to refine the teaching by constantly measuring the students' learning results and the realization of teaching objectives.

Formative evaluation is a quantitative evaluation of students' learning process and milestones, and the data comes from the learning activities recorded in ChaoXing, including the completion of pre-study, class attendance, in-class exercises, question answering, group tasks, thematic discussions, and post-class tasks. Among them, the assessment on group tasks mainly evaluates the completion of students' project, including the project research, project development, project modeling, and project writing.

Summative evaluation is a quantitative evaluation of whether students have mastered the software engineering knowledge and skills required by the syllabus. The data comes from the scores of each question type in the final exam, which usually includes the noun explanation, short answer, material analysis, modeling, and comprehensive practice questions.

Qualitative evaluation is conducted by teachers through a survey questionnaire distributed through ChaoXing when the course teaching is completed. Students can conduct a self-assessment of their knowledge mastery according to the teaching objectives, and they can also evaluate the course teaching according to their own learning experience. Teachers collect students' opinions and suggestions by collating and analyzing the questionnaires, and formulate some course teaching improvement measures before the next teaching cycle, thereby forming a better closed-loop teaching model to ensure the continuous improvement of teaching quality.

4. Teaching effect

Based on the above measures, the teaching team of software engineering in Anqing Normal University has carried out a series of teaching practices since 2023. The following is an analysis of the teaching effect in the spring semester of 2022 (before course remolding) and the spring semester of 2023 (after course remolding) as an example. In this case, the instruction in the spring semester of 2022 was given to Class 2 of the major of Computer Science and Technology of Grade 2019, while another instruction in the spring semester of 2023 was given to Class 2 of the major of Computer Science and Technology of Grade 2020. The number of students, the usual grades, final grades, and scores of teaching quality (evaluated by the students) of the two classes are shown in **Table 1**. The data is obtained under the condition of ensuring that the difficulty level of the test exam remains the same.

As seen from **Table 1**, the students' usual grades and final grades have been improved to a certain extent, i.e., after the course has been improved, the students' participation in the course as well as their mastery of the knowledge of the course have also been improved to a certain extent. For the scores of teaching quality, although the improvement is not significant, they are generally at a high level, indicating that the students have always been satisfied with the teaching of the course of software engineering. The results also indicate that the improved course objectives, teaching modes, and assessment methods have achieved better teaching results.

Table 1. Comparison of the teaching effectiveness of software engineering course before and after remolding

	Class 2 of the major of Computer Science and Technology of Grade 2019	Class 2 of the major of Computer Science and Technology of Grade 2020	Increase (%)
Number of students	53	53	-
Average of usual grades	83.58	93.21	11.5
Average of final grades	71.09	87.42	22.97
Average of scores of teaching quality	94.77	96.67	2

5. Conclusion

This paper addresses the pain points of teaching the course of software engineering, combines the engineering education concepts and requirements, and reforms and improves the course objectives, teaching modes, and assessment methods of the course. The teaching effect shows that the remolding of the course has achieved a positive result, which is worthwhile for other related courses to learn from.

Funding

This work was supported by the Project of Teaching Research of Anqing Normal University (Project number: 2022aqnujyxm20), the Project of Innovation and Entrepreneurship Training for University Students of Anqing Normal University (Project numbers: X202310372033 and X202310372005) and the Project of Quality Engineering of Anhui Province (Project number: 2022xsxx119).

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhu Q, 2022, Exploration of Engineering Education Reform Path--Based on the Comparison of Accreditation Standards for Engineering Education in China, the United States, France and Germany. Modern Business Trade Industry, 43(21): 31–33.

[2] Sun X, Yang Q, Li S, 2022, Research on University Curriculum Reform Based on Engineering Education Accreditation--A Review of Outcome-Based Education and Engineering Education Accreditation. Chinese University Science & Technology, 2022(03): 106.

[3] Bai Y, Duan H, Zhang W, et al., 2022, Innovative Research and Practice of Teaching Database Principles and Applications Course Based on "SPOC+PTA." Computer Knowledge and Technology: Academic Edition, 18(1): 15–17.

[4] Zhao Z, Lin S, Wang J, 2021, Research on the Teaching Reform of Software Engineering Courses in the Context of New Engineering and Engineering Certification. Journal of Bohai University (Natural Science Edition), 42(02): 181–186.

[5] Liu Q, 2018, Remoulding the Course of Software Engineering Based on the OBE Concept. China University Teaching, 2018(10): 25–31.

[6] Shan D, Ma L, Li H, et al., 2019, Reform and Practice of the Course of Software Engineering Under Professional Certification of Engineering Education. Computer Knowledge and Technology, 15(34): 101–102 + 107.

[7] Liang B, Wang G, Tang Q, et al., 2022, Research and Practice of Blended Teaching Mode of Software Engineering Course in Local Applied Undergraduate Colleges. Journal of Sichuan College of Arts and Sciences, 32(5): 137–142.