Program Design Courses Reform and Exploration Based on Engineering Education Accreditation Standard

Di LV\textsuperscript{1,a}, Qing-Xia YAN\textsuperscript{1,b} and Lu XIE\textsuperscript{2,c}

\textsuperscript{1}School of Tourism and Culture, Yunnan University, LiJiang 674100, China
\textsuperscript{2}Yunnan Water Conservancy & Hypower Investment Co., Ltd., Yunnan Province, China
\textsuperscript{a}47038756@qq.com, \textsuperscript{b}85772097@qq.com, \textsuperscript{c}15713410@qq.com

Keywords: Engineering education accreditation; Integration of teaching methods; Teaching reform.

Abstract. According to the engineering education accreditation standard, taking Tourism and Culture School of Yunnan University as the example, we analyzed the relationship between program design courses and accreditation standard. With engineering education accreditation standard at its core idea, integrating massive open online course and project driving teaching methods, we tried to make reform in program design courses from study needs, teaching goals, teaching designs, study results evaluation and courses continuous improvement. We will make the professional teaching level achieve the standard of engineering education accreditation standard through teaching reform and teaching quality improvement.

Preface

At present, related majors in China’s universities and colleges have passed the China Engineering Education Accreditation in succession. In June of 2019, China Engineering Education Accreditation Association published that by the end of 2018, 1,170 majors in 227 universities and colleges have passed engineering education accreditation with 21 engineering majors such as machinery, chemicals, and pharmaceuticals. There will be more universities and colleges join the team of engineering accreditation. Engineering education accreditation system is a globally accepted system that ensures engineering education quality, a key base to realize mutual recognition between engineering education and engineer qualify, and an opportunity for universities and colleges to accelerate major construction, and improve talent cultivation quality [1]. Program design courses are the core in the major of computer science and technology, these curriculum groups are the link course for this major, and play a connecting role curriculum structure system. The thesis takes the program design curriculum in computer science and technology major in Tourism and Culture School of Yunnan University as example, based on the 12 specifications [2] for qualified graduates in China Engineering Education Accreditation System to achieve the goal of engineering education standard as well as carry out program design courses teaching reform practice. We offered new curriculum system with students’ multiple ability cultivation at its core, teaching team cooperation as base, and logical contact between courses as link, deepen teaching reform as motivation, and improve teaching quality as origin of force [3].

Analysis of the Current Situation of Program Design Curriculum under the Background of Engineering Education Accreditation

Before we carried the engineering education accreditation, professional teachers have actively adopted a battery of teaching modes such as CDIO [4] teaching modes, program motivation style, interactive style teaching to drive and promote teaching quality. When it entered the period of new engineering construction, we tried transformation based on former teaching reform, and explored new teaching mode by integrating standard of China Engineering Education Accreditation. Engineering Education Certification advocates "Student-centered, output-oriented (Outcome Education, OBE), Continuous Improvement (Continuing Quality Improvement, CQI)" [5] as a guide. With the goal of cultivating the ability to solve complex engineering problems, our school
carries out curriculum reform and practice on this basis. Compared with the standard, please see our problems below:

**Still have not Realized Teaching Activities with Students at its Core**

There is less time for students to practice because the curriculum required a number of basic knowledge, and the professional teacher are striving to teach the knowledge point and details to students. Most courses become single teaching output of teachers, and the teaching design focus more on teaching instead of practice. Teachers paid more attention to knowledge point namely knowledge pint oriented teaching mode, rather than the practice of students. Seen from the teaching evaluation way, examinations (in written or computer) are offered to evaluate the teaching, which is the most popular assessment methods in a majority universities and colleges. Both written test and computer test are slightly single, and the evaluation is from a single side of teachers. Compared with the 12 standard in Engineering Education Accreditation for graduates (hereafter referred as accreditation standard), we discovered that accreditation standard paid more attention on the evaluation on students in their study process and result, therefore, the inspection way should show the whole study process of students. We will try to put the 12 indicators into quantify the assessment methods to show the conception of Students at Its Core in teaching process. It means that we should emphasize students’ dominant role in teaching, always put students at its core, and fully demonstrate the teaching conception of Put People First [6].

**Knowledge Examination at its Core, Neglecting Students’ Ability Output**

In most universities and colleges, with the inspection ways of program design courses are written test and computer test, e.g. in our school, the final grade composition are 20% of normal scores, add 20% of the mid-term scores, and plus 60% of the final scores. Teachers are more concerned about the score of the final exam in the course of teaching. According to the 12 requests of accreditation standard, the above scores composition is not up to standard. Accreditation Standard underlines on Result-Oriented, i.e. define the study result, realize study result, evaluate study result, and apply study result. We can regard it as students understand study target before class and realize study target, as well as teachers record the study process and finally make evaluation to get the curriculum scores. Therefore, we need to redesign the performance composition of the course assessment and try to map 12 of the certification criteria to the assessment criteria to meet the deep meaning of educational certification. Finally, we still need to gain experience in the teaching reform, and maintain the conception of continuous improvement to perfect teaching plan.

**Exploration of Course Reform Based on Engineering Accreditation**

According to the differences between courses developing situation of computer science & technology and accreditation standard, in order to conform to the guiding ideology of the accreditation standard, we adopted the Study Result-Oriented teaching conception to transform knowledge teaching orientation into result evaluation orientation. Before class, teachers should firstly set up goals for students, then make teaching contents and designs, and they should act as tutors instead of instructor, record each evaluation indicators to make curriculum comments based on the result finally. Teachers should make analysis and conclusion after class and continue to improve and perfect teaching designs. We can ensure teaching goal is both the start point and final point of study, and keep the consistency between teaching objective and study result. The role of teachers in the teaching process is the designer of teaching links and the supervisor of teaching process, and the teaching of knowledge points allows students to complete it through the learning of teaching video before class. Please see the teaching ideas reform in Fig. 1. We will give details in several aspects to introduce the teaching reform content through study demand, teaching objective, teaching design, study result evaluation, and courses continuous improvement.
Teaching Ideas Reform Guidelines

Firstly, learning needs should make students at its core, be in accordance with the professional talents cultivation program and formulate on the basis of students combined with their own learning needs. Our program design courses opened to majors such as computer science and technology, information engineering and information management, and electronic information engineering, etc. Different majors have different needs in program design courses, e.g. the major of computer science and technology need to totally master the basic knowledge of programming, and deeply study the knowledge points and flexibly use the knowledge points, while the major of electronic information only required to grasp the basic programming skills. Teacher should study and work out curriculum outlines, teaching designs, and modular practice programs from the perspective of students and their professionalism in the very beginning of courses design in order to meet different demand of students. We will give students target for study and grasping degree of knowledge, respect students’ learning needs, and open suitable compulsory course and elective courses. Based on accreditation standard, with the major of computer science and technology as example, we formulated the reference standard for teaching reform in all program design curriculum.

Formulation of Teaching Goals

It is compulsory for students majored in computer science and technology to study the two basic courses for programming i.e. C Language Programming and Java Programming. We will design the following courses for computer basis with these two courses as the start point. In the following courses, Data Structure and Algorithm Analysis are compulsory courses, while elective courses include Python Program Design, JSP System Design, Web System Development, Android System Development, and JavaEE Development Foundation etc. After finishing the basis courses, students can choose the following courses by their own under the guideline of teachers. For example, if students have excellent mathematics analysis ability and statistics ability, it is recommended to study Python Programming Design to develop towards data analysis; if students want to develop website and operation system, they can study JSP System Design or Android System Development. In conclusion, the teaching works revolve around “Students At its Core” to meet students’ needs in terms of learning vision, with students choosing a developing road suitable to themselves based on their own conditions and interests. The setting courses in teaching design should concern about the supporting relationship between courses and accreditation standard, and the courses should both comply with the standard and meet market demand.

The Teaching Design Ideas

Teaching design ideas combined with the reform of massive online open course and a project-driven approach, while meeting the certification standards. Concrete teaching reform ideas
is like figure 1, we will take JAVA Program Design as example to explain the reform ideas in teaching design.

**Teaching Design Based on the Idea of Accreditation Standards.** The teaching design process based on accreditation standard conception should properly organize teaching process, choose concrete teaching methods and materials, and formulate teaching activity process for students and teachers to obey [7]. Teacher’s role should be transformed from instructor to tutor, assisting students to reach targeted results through strategies such as diagnostic, evaluation, feedback, and constructive intervention etc. [7]. Result Orientation not only focus on whether students could finish teaching contents, but also the quality of learning result in addition, which required to foster students’ ability to solve complicated engineering problem during the teaching design process, to let students learn to make analysis at the very beginning when they received the program, derive the relationship between modules step by step, and finally solve the problem. Students should enforce cooperation during the program learning process, learned from each other and make discussion during program analysis process, and improve personal professionalism through independent learning and experiment to finish self-challenge.

**Curriculum Design Ideas.** Firstly, teachers should lay out program driven teaching examples in accordance with teaching reform standard, and make teaching videos according to chapter knowledge points before class.

The program content should be “small but good” to show the use of knowledge, properly control the depth and breadth of program knowledge points, and the difficulty should be moderate. It should combine all knowledge points through the combination between programs, and part of the programs should involve the application of data structure and algorithm analysis. Due to the reason that there are a number of basic knowledge in the course of Java Program Design, more time were used to teach the basic knowledge in former teachings. Creating teaching videos to students for self-study before class, on the one hand, it can save teaching hours, on the other hand, it can increase the practice hours. During the class, we require students to make records, which can not only foster students’ self-study ability, but it is also one of the contents in final examination. We use their ways to reversely force students to form a habit to solve problem through study, and it is also conform to the requirements of lifelong learning in accreditation standard. The teaching videos should be made reasonably according to the teaching hours, clearly and essentially express the knowledge points, and include after-class practices. The created videos can be either used in the next class, or timely adjust teaching contents and continue to update. In the course of classroom teaching, teachers can summarize and answer questions on pre-class video teaching content, explain the content of the exercise questions in the video, and start the teaching and experimental activities of the project content. Teachers should conduct assessments and make records on multiple aspects such as students’ class notes, performance, the application ability of development tools, and innovation etc. The Fig. 2 Take Two Teaching Contents of Java Program Design as examples to demonstrate the course design ideas.

![Figure 2. Two Classes Design Process of Java Curriculum.](image)
Assessment of Learning Achievement

According to the 12 understandings of accreditation standard for graduates, the accreditation standard emphasize on students’ abilities in study, analyzing and solving problems, practice, innovation, and team cooperation. The evaluation on students should not be limited to homework, class performance, and exam scores, it should be assessed from the beginning to the end of curriculum. The concrete assessment indicators should be established by combining with the standard, not apply mechanically. Taking the course of Java Program Design as an example, we should choose accreditation indicators that are in accordance with the course nature. The concrete assessment indicators are learning ability, class performance, tools using, innovation, engineering knowledge, and the ability of design and creation. Please see the concrete assessment approaches below:

The Entire Assessment. Firstly, learning ability (10%). This is evaluated based on the completion of the learning notes and the work of video learning;
Secondly, classroom and team performance (10%). This assessment is based on the results of the project experiment and the performance of the team;
Thirdly, tool use (5%). This assessment is made on whether students can use the development environment skillfully, whether the debugging tools are familiar practice;
Fourthly, innovation (5%). According to whether students can use unique ideas to design the program, using optimized algorithms or methods to complete the program design.

The Assessment of Mid-term and Final Examinations. The assessment of mid-term examination (30%) final examination (40%) is independent program design, and the design content combine knowledge point to design engineering projects with a certain degree of complexity. With the background of achieving project requirement, it will be carried out through the way of answering questions, and the questions will be spread from the basic knowledge of program design, engineering logic design, to key code understanding.

The Continuous Improvement of Teaching Design

After a round of teaching practice, we should see the deviations between teaching goals and accreditation standard, teaching goals and students’ real needs during teaching process, and correct the unreasonable content in curriculum design. We should timely adjust teaching reform program to continue perfecting the course. The continuous progress should focus on improvement in teaching designs, teaching videos, project designs, and learning methods of students. The Same course should achieve the goal of perfecting teaching design continuous improvement through several rounds of teaching practices. From the student’s point of view, let them know their learning situation, timely adjustment of the follow-up learning objectives, learning methods and learning skills [8].

Conclusion

It is of great significance for colleges and universities to join the system of engineering education certification to improve the professional level recognition and the quality of teaching of professional teachers. Ideas promoted by the accreditation standard such as make students at its core, result orientation, and continuous improvement provide firm support for the teaching design, teaching content updating, teaching method transformation, and reform of evaluation system in computer professional program design practice courses.

Part of courses have finished two rounds of practice in our university, and make a further step in perfecting teaching reform through teaching information feedback and teaching reflections. Through practice, new teaching mode has meet the basic demand of the accreditation standard, courses teaching quality made a further progress, and got good feedback from both students and schools. Of course, some problems still exists in the teaching reform, firstly, the creation and edit of teaching videos have taken a large number of teachers’ time and energy; Secondly, it needs further designs for practice project content design in teaching, and the examination content design; finally,
it still need more rounds of practice to prove how much percent the assessment indicators and its scores are proper in the assessment system. Although the teaching reform has cost a lot of time and energy with accreditation standard as its guideline, it is worthy for our efforts to improve teaching quality and cultivate high standard talents in accordance with the standard.

Acknowledgement

2018, College of Tourism and Culture, Yunnan University, Teaching Reform Project "Research on Teaching Model of Engineering Design Certification for Program Design Courses" (No. XYJG201812).

References


