OBE Schema Design of Software Engineering Professional Practice Under Background of Engineering Education Professional Certification

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ABSTRACT

As a new course, Software Engineering Professional Practice has no experience to learn from; Taking the software engineering professional certification of Chengdu University of Information Technology as an opportunity, with the idea of result-oriented education, a course teaching plan was designed based on OBE. Thoughts of 'project-driven' and 'Outcome-Based Education' into the course teaching were introduced in. The course objectives were decomposed into seven, and determined their correspondence with the graduation requirement points carried by the course. The course teaching content, assessment link and assessment requirements were designed. It has conducted beneficial exploration for the professional competence training of software engineers, which can help students better master the knowledge necessary for engaging in related occupations and lay a solid foundation for their social work positions.

Keywords: Engineering education professional certification, software engineering professional practice, outcome-based education, course targets, graduation standards

1. INTRODUCTION

Engineering education takes the whole process of CDIO as a carrier to train students' engineering ability [1]. By advocating new teaching models of 'outcome-based education' and 'project-driven', it focuses on cultivating students' engineering basic knowledge, personal ability, teamwork ability and engineering system ability, cultivating engineers with engineering expertise, social awareness , entrepreneurship and innovation that meet the needs of talents in modern society[2]. Engineering Education Professional Certification refers to the special certification implemented by professional certification institutions for engineering professional education offered by higher education institutions [3]. The goal of the professional certification is to determine whether the teaching quality of the engineering education major meets standards and whether it can provide a reference for the teaching evaluation system. The certification also monitors the entire quality of education, carrys out graduation tracking feedback and the social evaluation survey on engineering education students to comment whether the current education mechanism and teaching mode meets the development needs of students[4].

Engineering Education Professional Certification follows principles of Outcome-Based, student-centered and continuous improvement[5]. It is consistent with the educational concept of 'oriented by student learning achievements' advocated by Outcome-Based Education (OBE). Therefore, the OBE concept is widely used in global engineering education certification standards. OBE focuses on five issues [6]: What kind of learning results do students get? Why should students get such learning results? How to effectively help students achieve these learning results? How to know that students have achieved these learning results? How to ensure that students can achieve these learning results? The OBE program answers to these five questions at the curriculum level, and fully reflects OBE's educational philosophy. Many domestic colleges and universities have implemented the OBE concept in their courses, made useful attempts, and achieved good results[7-9].

The purpose of engineering education is to train excellent engineers with learning ability, problem analysis and solving ability, development their design ability, innovation ability and engineering practice ability. In order to achieve these goals, it is necessary to rationally design in terms of training objectives, curriculum system, syllabus, teaching process, quality evaluation, etc. The Software Engineering Professional Practice course is a practical course set up by the School of Software Engineering of Chengdu University of Information Technology to adapt to the training of software engineers. At present, we have combined the OBE concept and designed the Software Engineering Professional Practice course from aspects of course objectives, graduation requirement points, teaching links and the teaching link assessment, and strived to cultivate software engineers with problem analysis and solving ability through 'project-driven' and 'outcome-based education'.

2. COURSE OBJECTIVES AND GRADUATION REQUIREMENTS

2.1. Course Objectives

Software Engineering Professional Practice is established in the first half of the senior year. It mainly emphasizes the abilities that software engineering professionals should possess in relevant occupations, and focuses on the career development, comprehensive development and lifelong development of students in complex software engineering environment. Carriers of the software engineering projects train students' professional abilities in aspects of environmental protection, sustainable development, professional norms, communication, project management, lifelong learning, etc. The procedures also stimulate students' independent awareness of career development, establish a correct career outlook, and promote students' own future development. Through the course, students should achieve the following goals at three levels of attitude, knowledge and skills:

Objective 1: Be able to choose appropriate development technology and development environment according to business needs, and correctly understand and analyze the possible impact on environmental protection and sustainable development in software engineering practice.

Objective 2: Understand the professional ethics and practical requirements of software engineers, and be able to abide by relevant specifications and requirements during project implementation.

Objective 3: Be able to collect relevant literature and understand the research hotspots and trends in the field.

Objective 4: Be able to make reasonable estimates of software engineering project budgets and carry out project practice in accordance with the principles of software engineering.

Objective 5: Be able to effectively summarize the project and find relevant technical issues.

Objectives 6: Be able to find deficiencies and make up for them through autonomous learning.

2.2. Points for Graduation Requirements Carried by the Course

According to the requirements of Engineering Education Professional Certification, combined with the training goals and actual situation of the software engineering major, the 12 graduation requirements of the software engineering major are sorted out, and considering the characteristics and purposes of Software Engineering Professional Practice, five graduation requirement points carried by the course and their corresponding relationship with course goals are shown in Table 1.

Table 1 Points for graduation requirements carried by Software Engineering Professional Practice

Level 1 indicators	Level 2 indicators	Course objectives
7-Environment and sustainable development: in the field of software engineering with complex engineering problems, correctly understand and evaluate the impact of engineering practices on the environmental and social sustainable development.	7.2 Understand the relationship between the software engineering practice and the environmental protection and sustainable development.	Objective 1
8-Professional norms: Have humanities and social sciences literacy, social responsibility and engineering professional ethics. Understand the corporate culture and professional standards of the IT industry, and be able to abide by the engineering professional ethics and perform responsibilities in engineering practice.	8.3 Understand the basic engineering ethics, such as the safety, health and well-being of engineers to the public and the social responsibility of environment protection. Be able to consciously perform these duties in software engineering practice.	Objective 2
10-Communication: For complex software engineering issues, students can effectively communicate with industry peers and the public, including writing reports and design manuscripts, presenting statements, clearly expressing or responding to instructions, and have a certain international perspective, and also be able to communicate and exchange across cultures.	10.2Understand the international development trends and research hotspots in the field of software engineering and industry, understand and respect differences and diversity of cultures in the world.	Objective 3

Level 1 indicators	Level 2 indicators	Course objectives
11-Project management: understand and master the management principles and economic decision-making methods in the engineering field. Be able to apply the principles and methods in a multi-disciplinary environment.	11.3 Can use engineering management and economic decision-making methods in the process of designing and developing schemes in a multidisciplinary environment or a simulated environment.	Objective 4
12-LifeLong learning: develop self-directed learning habit, have a lifelong learning consciousness and a strong learning ability, and be able to adapt to social development through learning.	12.3 Be able to summarize technical issues.	Objective 5
	12.4 Be able to evaluate themselves, find and make up for deficiencies, adapt to the rapid development of the software engineering technology and information industry.	Objective 6

3. COURSE TEACHING DESIGN AND ASSESSMENT

Software Engineering Professional Practice uses software engineering projects as carriers. It helps students master the knowledge necessary for engaging in related occupations and lay a solid foundation for future social positions through projects and full life cycle activities of software engineering. According to the course objectives, the entire course content includes five parts: overview, social and environmental factors for software engineering project implementation, software engineering professional ethics and practical requirements, project management and project summary. The main contents of each part are as follows:

Overview: This part includes the course introduction, course requirements and team management. It mainly introduces the course, so that students can understand the purpose, content and requirements of the course and form suitable groups.

Social and environmental factors for software engineering project implementation: This part includes the policy feasibility analysis, technical feasibility analysis, economic feasibility analysis, environmental impact analysis and social impact of the project. This part mainly guides students review and study related content, and form feasibility analysis report of project according to project needs and pre-professional courses.

Software engineering professional ethics and practical requirements: This part mainly requires students to study Software Engineering Professional Ethics and Practice Requirements jointly recommended by the IEEE CS and ACM Software Engineering Professional Ethics and Professional Practice Working Group, and guides students to apply consciously in project implementation.

Project management: This part includes data collection, technical learning, software project schedule management, software project risk management and project practice. This process mainly guides students to complete project design and development according to relevant knowledge in software engineering, and effectively manage projects. In this process, students should pay attention to project management, team communication and self-learning of knowledge to form software project management reports.

Project summary: This part requires students to complete project summary, presentation of results and experience. Students should also write summary reports (Contains a brief english introduction).

According to the objectives, contents, graduation standards and teaching links carried by the course, the teaching contents and assessment links corresponding to the course objectives are shown in Table 2.

The course adopts the process assessment with results produced in different linkes. The results mainly include the feasibility analysis report, the literature review, the software project management report, the results presentation and defense effect and the project summary report. The assessment requirements and score ratio of each elements are shown in Table 3. The assessment results of the course can be used to measure the achievements of the course goals, and the achievement degree of the professional graduation requirements can be calculated through achievements of the course goal. This fully reflects the idea of measuring the student learning with final achievements. The supporting table of the assessments for achieving the course objectives of Software Engineering Professional Practice is shown in Table 4.

Table 2 Course objectives and assessment links

Assessments / Course objectives	Corresponding content	Assessment link 1 Feasibility report analysis	Assessment link 2 Literature review	Assessment link 3 Software project management report	Assessment link 4 Achievement presentation and defense	Assessment link 5 Project summary report
Objective 1	Technical feasibility analysis, Environment impact analysis, Impact on society	√				
Objective 2	Software Engineering Professional Ethics and Practice Requirements					√
Objective 3	Collect information, learn technology		√			
Objective 4	Economic feasibility analysis, Software project schedule management, Software project risk management	√		√		
Objective 5	Project practice, Project summary				√	√
Objective 6	Project practice				√	√

Table 3 The assessment requirements and score ratio of each link

Assessment link	Assessment requirements / Scoring rules	Assessment objects and score ratio(%)		
		Student	Team/Group	Subtotal
Feasibility analysis report	Submit a feasibility analysis report in groups. The analysis report must be in accordance with the template requirements and there must be no shortage of items. The results are given based on the quality of the report.		15%	15%

Assessment link	Assessment requirements / Scoring rules	Assessment objects and score ratio(%)		
Literature review	Submit a literature review in group. The literature review must be in accordance with the template requirements and no shortage of items, and the results should be based on quality.		10%	10%
Software project management report	Submit a software project management report in groups. The report must be in accordance with the template requirements and there must be no shortage of items. The results are given based on the quality of the report.		15%	15%
Achievement presentation and defense	Demonstrate the completed project in groups, and score should be given based on the completion of the project. Students explain the work done by the individual and answer teachers' question.Teachers give the score according to the actual situation. If the student does not participate in the specific work, his score would be directly judged as a failure.	10%	20%	30%
Summary report	Write a project summary report according to the prescribed format in groups. The report contains Chinese and English abstracts. The text includes the project analysis, project design, project realization, project management, problems and solutions, experience, etc. The results are given according to the quality of the report.		30%	30%
Total		10%	90%	100%

Table 4 The supporting table of assessment links for achieving the course objectives

points for graduation requirements	Course Objectives	Assessment links	Weight of the assessment link for the course objectives	Wright of course objectives
7.2	Course objective 1	Feasibility analysis report (1)	1	1
8.3	Course objective 2	Project summary report (1)	1	1
10.3	Course objective 3	Literature review	1	1
11.3	Course objective 4	Feasibility analysis report (2)	0.3	1
		Software project management report	0.7	

points for graduation requirements	Course Objectives	Assessment links	Weight of the assessment link for the course objectives	Wright of course objectives
12.3	Course objective 5	Achievement presentation and defense (1)	0.6	1
		Project summary report (2)	0.4	
12.4	Course objective 6	Achievement presentation and defense (2)	0.7	1
		Project summary report (3)	0.3	

4. CONCLUSION

Software Engineering Professional Practice is a course that the School of Software Engineering of Chengdu University of Information Technology tries to set up in engineering education practice, focusing on cultivating ability of software engineers to adapt to occupations. The thesis expounds the design of the curriculum plan based on OBE from three aspects: the course objective, the graduation requirement points carried by the course, and the course teaching link design and assessment. As a new course, there is no successful experience to learn from in many aspects of teaching. This needs to be continuously explored, summarized and improved in practice in conjunction with the idea of continuous improvement of OBE.

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