
Innovation on “Software Engineering” Under Engineering Education Professional Certification

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Abstract: It's well-known that the purpose of engineering education professional certification is to provide preparatory education quality assurance for relevant engineering and technical personnel to enter the industry. Its main task is to achieve the goal of professional training, advocating the teaching mode and teaching scheme of reverse design course. Under the background of engineering education certification, the teaching team has carried out the reform from four aspects combining with the characteristics of software engineering course. First of all, focus on the teaching objectives of engineering education certification, strengthen the construction of course content and resources, strengthen the cooperation with industry and enterprises, and increase the teaching content of enterprises; the second is to improve the teaching design, design the teaching content of software engineering course as a teaching task that is suitable for the teaching objectives, and decompose the knowledge points of the course into the project tasks; the third is to adopt diversified teaching methods, introduce micro class and flipped classroom teaching, at the same time, strengthen the practical teaching, enhance the ability of document description and graphic design practice; The fourth is to improve the evaluation mechanism, and use the way of achieving the curriculum objectives to evaluate the course, so as to make teaching more effective, learning feedback is more intuitive and easy to make continuous improvement in the later stage. The results show that the content of class-teaching and engineering practice has been enriched and improved, simultaneously, diversified teaching methods with process teaching evaluation has greatly promoted students' ability of study independently and engineering practice, and effectively improved the achievement of graduation requirements of engineering education in software engineering specialty.

Keywords: Engineering Education Certification, Course Revolution, Software Engineering

1. Introduction

Engineering education certification is an internationally accepted quality assurance system for engineering education, and also a qualified evaluation for engineering majors in Higher Education [1]. Engineering education certification has been carried out in many colleges and universities in China for many years, Yiyang Fan, Jingyi Yi and Wu Qidi refer to the core of engineering education professional certification is to confirm that engineering graduates meet the established quality standard requirements accepted by the industry [2, 3]. It is a qualification evaluation oriented by training objectives and graduation export requirements. Engineering education is an important part of China's higher education, in the higher education system, "one of the three parts of the world". Alex

Kootsookos, Aden Darge and Li-min Tian point out that the core task of Engineering education certification is to achieve the degree of students' professional training objectives [4-6], advocate reverse design course teaching mode and teaching scheme, and Haiyan Wang, Yongsheng Hu emphasize the establishment of professional continuous improvement mechanism to ensure The quality and vitality of professional education [7].

Engineering education professional certification is an internationally accepted means of engineering education quality evaluation. The research shows that the professional certification of engineering education is student-centered, oriented by the development of students' ability, with continuous improvement as the main line [8]. It is to ensure that the educated have the necessary knowledge and ability to work in the field of engineering technology by controlling the key links of

engineering education. In March 2015, China Engineering Education Accreditation Association issued the 2015 edition of engineering education accreditation standards, which put forward new requirements for the curriculum system of undergraduate engineering education specialty in China's colleges and universities [9, 10]. The standard emphasizes that the school's educational goal is to cultivate and achieve the engineering practice ability, emphasizes that the learning results drive curriculum activities, and constructs the evaluation system according to the students' learning output [11]. Compared with the higher engineering education of the world's leading countries, China's engineering education accreditation is still in its infancy. As an application-oriented university, actively responding to the call of the Ministry of education, vigorously developing engineering education, and comprehensively improving the quality of application-oriented talents training are the important contents of the strategic planning for the transformation and development of our university and the construction of a high-level application-oriented university [12]. Therefore, it is necessary to conduct in-depth exploration and research in the software engineering personnel training reform.

Software engineering course is a professional basic course of computer science and related majors. It is mainly used to guide the development and maintenance of computer software, and it is a course with strong theoretical, practical and engineering characteristics [13]. Software engineering course is an important way to cultivate students' ability to solve complex engineering. Software engineering course mainly trains students to complete the analysis and design work of a medium-sized software engineering project, so that they have the post ability of software designers. In order to achieve this goal, this paper studies and reforms the teaching content, method and evaluation of software engineering course in our school of software.

2. Teaching Reform Ideas of "Software Engineering"

2.1. The Teaching Process Is Centered on Students' Development and Ability Improvement

The core concept of engineering education professional certification emphasizes that education and teaching is student-centered. Software engineering course is a professional basic course of computer science and related majors. This course is mainly used to guide the development and maintenance of computer software. It is a course with strong theory, practice and engineering. According to the students' cognitive law, discipline characteristics, teaching objectives of software engineering course, cooperate with enterprises, through the combination of professional standards and industry standards, the combination of teaching content and the actual information industry, the curriculum content is formulated according to the curriculum objectives, and the knowledge unit and disassembly are reasonably designed according to the framework of "module + teaching unit" Divide and allocate knowledge points and skills points. Each

module sets up the teaching situation, and each unit organizes the teaching content and resources through the "task decomposition + micro class" under the teaching situation, so as to realize the integration of theory and practice teaching.

The training goal of software engineering course is to enable students to have independent project analysis and design ability. In different stages of software project development, different tools are used for analysis (data flow diagram, data dictionary, use case diagram, state diagram, etc.) and design (structure diagram, class diagram, box diagram, etc.) In order to facilitate different levels of learning, especially in MOOC University platform of China, open online courses, recording teaching micro video for each knowledge point in the course, and attaching test questions after the micro video to test students' mastery. Each unit is equipped with a comprehensive unit test. Students pass the self-test, and they could not master the knowledge and technology in place Can carry on the enhancement study, fully manifests the student-centered teaching idea, conforms to "the authentication standard" to put the student's training goal in the first place request. The teaching mode adopts online and offline hybrid teaching. For the knowledge points that are easy to master, students use the online self-study method. For the difficult points and key points, they should explain and practice uniformly in the classroom, and focus on analyzing and solving complex engineering problems with strong comprehensiveness. In addition, online discussion is used to guide students to search for materials on the frontier hot issues of the course by using network and library resources, so as to cultivate students' ability of literature collection and reading. At the end of the semester, the students are divided into groups for project development to cultivate the ability of learning to solve practical problems and team cooperation. There is competition between teams, and the competitiveness of students in the process of training will be improved. In short, the arrangement of teaching content and the implementation of teaching process always put student development as the center in the first place.

2.2. Teaching Evaluation Based on Continuous Quality Improvement

"Certification standard" emphasizes that the improvement of education and teaching quality must have continuous improvement mechanism and implementable measures [14]. Teaching evaluation mechanism is the power to promote the continuous improvement of teaching. Through the performance of students, analyze the achievement degree of corresponding curriculum objectives, analyze the reasons (test statistics and interviews, etc.), find the method of continuous improvement for implementation, and then continue to track the performance of students to achieve continuous improvement, promote the improvement of education quality in the cycle process, and make the teaching objectives more in line with the direction of professional training, so as to achieve graduation for students It is required to lay a good foundation. In terms of specific implementation, corresponding to the four curriculum objectives, the paper examines the achievement degree of each course goal in terms of homework, experiment and final examination

3. Reform and Practice of “Software Engineering” Course

3.1. Curriculum Construction

Centered on the teaching objectives of engineering education certification, we should strengthen the construction of course content and resources construction, simplify the teaching content, eliminate the content that is not suitable for engineering education, strengthen the cooperation with industrial enterprises, and increase the relevant content of enterprise teaching cases.

3.1.1. Curriculum Content Construction

The teaching of software engineering course depends on the development cases of actual projects in the software industry, and its main teaching contents are structural analysis and design and object-oriented analysis and design. Through the mastery and practice of knowledge points of online open courses, teachers can directly enter the analysis and explanation of cases in classroom teaching, and make students consolidate the knowledge content through classroom practice feedback. The content is divided into three categories: overview, software development methods and software project management. The software engineering overview module mainly introduces the concepts of software crisis, software engineering and software process. The software development method module mainly teaches common structured methods and object-oriented methods. Software project management module mainly through a series of activities such as planning, organization and control to reasonably allocate and use various resources. The software

development method module is organized in the form of "software development process + practice project topic-case-task". Among them, software development methods are divided into structured method and object-oriented method. Each software development method organizes the knowledge unit according to the software development process, and sets up a practice project topic and knowledge unit link respectively. Each project topic decomposes the actual software project into several cases, and each case is decomposed into several tasks corresponding to knowledge units, which can help learners master the basic process and tasks of software development more systematically and completely in a short time. At the end of the semester, there will be a week of professional training, there will be a week of professional training, and students will complete a small group in the practical application project, the analysis, design and implementation of the system are carried out completely according to the software engineering methodology, and the project reports and documents are written. Using online discussion, we can guide students to make effective use of network and library resources, and cultivate their literature research ability.

3.1.2. Curriculum Resources Construction

According to the syllabus of software engineering, according to the software development process and the graduation ability requirements of the course, the course content is re integrated, and the granular and diversified online open course resources of software engineering based on OBE concept are constructed. Due to the space limitation, table 1 lists the knowledge points and its resources corresponding in chapter 1 and 10.

Table 1. Teaching contents and corresponding teaching resources.

Chapter	Knowledge Unit	Knowledge Points	Corresponding resource
Ch1 software engineering sketch	Software	Software and its characteristics Software classification	(1, 2, 6)
	Software Crisis	Forms of expression Elimination path	(1, 2, 3, 4, 5, 6, 7, 8, 9)
	software engineering	The concept and development of software engineering The content of software engineering research Objectives and principles of software engineering Software engineering knowledge system	
	Software process	Waterfall model Rapid prototyping model Incremental model Fountain model Agile development model	(1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
...
Ch10 Software project management	Software scale estimation	Software development cost estimation method Code line calculation method Function point check method	(2, 3, 4, 5, 6, 10)
	Software scale estimation	COCOMO2 model Workload Estimation	(1, 2, 3, 4, 5, 6, 10)
	Personnel organization And schedule	Personnel organization schedule	(1, 2, 5, 6, 10)
	Quality assurance and software configuration management	Quality assurance Capability Maturity Model	(1, 2, 3, 4, 5, 6)

Note: (1) Micro lecture video; (2) PPT (3) case teaching; (4) Quiz; (5) discussion; (6) reading materials; (7) Teaching guidance; (8) Online Q&A; (9) Online test; (10) Project tasks

3.2. Teaching Design

In view of the course content, according to the idea of engineering education certification, the teaching content of software engineering course is designed as a teaching task

corresponding to the teaching objectives. The knowledge points of the course are decomposed into the task of the project, and run through the whole software development process. See Table 2 for details.

Table 2. Teaching design.

Projects	Purpose and requirement	work breakdown
Project 1: Structured methodology Model 1: Analysis on the management system of College Students' attendance	Understand the process of feasibility analysis, tasks and analysis methods in the demand analysis stage, complete the feasibility study report and requirement specification of the target system with the learning group as the unit, determine the function and performance of the system, and lay the foundation for the design in the later stage.	task1: feasibility analysis task2: Select software process model task3: obtain user's requirements task4: System requirement analysis
Project 1: model 2: Design of attendance management system for College Students	To understand the content of overall design and detailed design of structured methodology. There are SD method, Jackson method, HIPO method and other design methods. Design principles and heuristic rules are applied in the project design process to optimize the design.	task1: data design task2: Module and interface design task3: Process design task4: Interface design task5: other design
Project 1: Model 3: Detailed design of attendance management system for College Students	To master the basic concept of programming, programming style and structured programming method.	task1: model design task2: Specific design of system platform task3: The concrete design of database structure task4: Process transformation
Project 1: model 4: system implementation	Combined with the training course, to discuss how to use programming language and object-oriented programming style to realize system functions flexibly.	task1: Establishment of database table structure task2: Application program design and interface design task1: test design
Project1: model 5 System testing	The purpose and principle of software testing, the characteristics and basic steps of software testing, the main methods and technologies of software testing.	task2: white box test task3: b lack box test task4: model test task5: overall test
Project1: Model 5: System running	Combined with the training course, the application of software development tools and computer aided software engineering is discussed.	task1: instruction for use task2: running results task3: system evaluation
Project 2: Object oriented methodology, experimental teaching management system is divided into analysis and design model	To master the requirements analysis, design and implementation of object-oriented methodology, and apply the object-oriented method to practical training courses	task1: object model task2: behaviour model task3: function model task4: class design task5: sub-system design task6: Association and optimization design

3.3. Teaching Method

The traditional teaching methods don't take into account the differences of students' learning. Most of them urge the backward students by asking questions, exercises or homework after class. The effect often leads to the students with poor learning initiative always in a backward situation. Therefore, the software engineering course logs into the online open course MOOC platform, records the course knowledge points into the micro class release network, which is convenient for students to carry out fragmented learning before class. By adopting the teaching method of "flipped classroom", the mode of "teaching in class and internalizing after class" is transformed into the mode of "imparting before class and internalizing in class". In the classroom, teachers connect the knowledge points through case teaching Solving practical problems, students have a sense of substitution, learning interest can be naturally mobilized. Encourage students to establish problem awareness in the learning process of online courses and actively participate in class discussion [15]. Classroom teaching discussion is a good opportunity to

strengthen students to solve complex engineering problems. Under the guidance of teachers, students complete problem analysis and modeling, code implementation and testing after class, and comprehensively practice course knowledge contents such as programming language, database, software testing, etc. Students in the network classroom to complete the corresponding test questions, teachers can timely grasp the students' knowledge points and knowledge application situation, and take corresponding countermeasures.

In addition, in the classroom teaching, the "seminar" teaching method is interspersed to carry out classroom discussion on open topics. Usually, teachers will select classic software designer test questions over the years, and students will analyze the problems by consulting materials, combing their own knowledge, and communicating with each other. The use of this teaching method can better train and evaluate students' mastery and comprehensive application of knowledge, and effectively improve the quality of teaching.

3.4. Practical Teaching

Engineering education accreditation emphasizes the

importance of highlighting professional characteristics and the core position of engineering application ability. For the software engineering course, highlighting the practicality not only needs to be continuously infiltrated in the classroom teaching process, but also needs to be gradually guided and strengthened in the experiment and training courses. The difference between software engineering course and general programming language course is that the experimental content is system analysis, graphical design results (such as structure diagram, data flow diagram, use case diagram, etc.) and written description (such as use case description, data dictionary, pseudo code, phased document, etc.), and various graphs in analysis and design stage are drawn by using Visio or rational rose. Based on this, practical teaching focuses on the examination of design ideas, so the description of documents and design drawings are the focus of practical ability. The practice part is also the training of students' ability to write reports and design manuscripts.

3.5. Teaching Evaluation

The assessment of software engineering course mostly adopts the way of "usual performance + experimental score + final score". Each assessment method has corresponding achievement

index of course objectives. The specific achievement degree of each assessment method in each objective is shown in table 3. The following takes goal 4 as an example to illustrate. As the goal achievement degree of assessment objective 4 focuses on communication, communication and document writing, it is difficult to reflect the assessment content in the paper volume of the final examination. Therefore, there are only two assessment methods: ordinary assessment and experimental assessment. In the two assessment methods, homework and discussion can partly reflect students' writing reports and design manuscripts, the ability of presentation and speech, effective communication and communication of complex problems in software engineering field, so it accounts for 40%. The experimental part, including the content of experiment and training, can fully test the students' ability goal, so it accounts for 60%. Similarly, for goal 3, the ability to design solutions to complex engineering problems in the field of software engineering can be tested. The comprehensive questions in the final examination paper can fully reflect the students' achievement in goal 3, so it accounts for 60%, while the remaining 40% can be reflected in the regular homework and experimental process, so each accounts for 20%. This is no longer the case.

Table 3. Proportion of assessment methods for achievement of curriculum objectives.

curriculum objectives	Proportion of assessment
Objective 1. Master the engineering foundation and software engineering knowledge related to natural science and engineering technology to solve complex engineering problems, and have the basic scientific literacy of system development engineer.	Test Homework Practice
Objective 2. Master the thinking methods needed to solve complex software engineering problems, have good problem analysis ability, being able to apply the basic principles of mathematics, natural science and engineering science to identify, express and analysing complex engineering problems in the field of software engineering through literature research.	Test Homework Practice
Objective 3. Be able to design solutions for complex engineering problems in the field of software engineering, develop software systems that meet specific requirements, and embody innovation consciousness in the design / development process.	Test Homework Practice
Objective 4. Have the ability, methods and skills of communication, be able to effectively communicate and communicate with peers in the industry and the public on complex issues in the field of software engineering, including writing reports and design manuscripts, making statements, clearly expressing or responding to instructions, and being able to communicate and communicate in a cross-cultural context.	Homework Practice

4. Conclusion

Under the background of engineering education certification, the teaching team of software engineering in Pingdingshan University has carried out a series of reforms on "software engineering" course for many years. Relying on the network course resources, in the selection and arrangement of teaching content, from the shallow to the deep, step by step, through the classroom explanation of comprehensive application cases, strengthen the application of students' knowledge and skills; in the teaching method, do not stick to one pattern, flip the classroom, case teaching, project training, research-based teaching, guide students to learn and communicate independently, and emphasize the analysis and return of knowledge In the teaching evaluation, according to the degree of achievement of the curriculum objectives, process assessment is adopted to emphasize the comprehensive application of knowledge and the ability to

solve complex engineering problems. Through the teaching reform, we can fully mobilize the students' learning enthusiasm, improve the teaching quality and lay a good foundation for the engineering education graduation requirements of cost major students.

Project Source

New engineering project of Pingdingshan University: research and practice of curriculum reform based on cdio-obe engineering education mode ---- Taking "software engineering" course as an example. (No.: 2018-xgk10).

References

- [1] Qinmin Ma, Xiaochun Wang (2018). Research on the accreditation system of Engineering Education. Education and Teaching Forum, 2018 (16): 251-253.

- [2] Yiyang Fan, Jingyi Yi (2014). Washington Protocols' Enlightenment of Chinese Higher Education of Engineering. *China Higher Education Research*, 2014 (08): 45-49.
- [3] Wu Qidi (2008). Improving the quality of engineering education and promoting the professional certification of Engineering Education——Speech at the plenary meeting of national engineering education professional certification Expert Committee. *Research in Higher Education of Engineering*, 2008 (02): 1-4.
- [4] Alex Kootsookos, Firoz Alam, Harun Chowdhury, Margaret Jollands (2017). Offshore Engineering Education: Assuring Quality Through Dual Accreditation [J]. *Energy Procedia*, 3 (110): 537-542.
- [5] Aden Darge, Dr Rajesh Sharma R, Desta Zerihum, et al (2019). Practice and Reform of Electronic Technology Practice Curriculum under Background of Professional Certification In Engineering Education, 1 (1): 263-269.
- [6] Li-min Tian (2019). Exploration of Internet of Things Professional English Teaching Reform Based on Engineering Education Professional Certification. *International Journal of Education and Management*, 4 (1).
- [7] Haiyan Wang, Yongsheng Hu (2018). Research on Computer Professional Training System Reform Based on Engineering Education Certification. *International Journal of Education and Management*, 3 (2).
- [8] Quan Bai, Kexiang Wei, Gaosheng Wang, Yueqi Guan (2017). Exploration and practice of teaching reform of mechanical manufacturing equipment design course based on engineering education professional certification -- Taking mechanical design and manufacturing and automation specialty of Hunan Institute of technology as an example. *Journal of Hunan Institute of Engineering (SOCIAL SCIENCE EDITION)*, 2017, 27 (03): 99-101 + 105.
- [9] Carlo Lipizzi, Shipra Manchanda, Monis Kamil, Art Pyster, Deva Henry, Nicole Hutchison, Nicole Hutchison, Christina Barboza, Courtney Wright. The Education Background of INCOSE Systems Engineering Professional Certification Program Applicants [J]. *INCOSE International Symposium*, 2015, 25 (s1): 139-151.
- [10] Luo Weimin, Wang Ling. Teaching reform of C language course conforming to engineering education certification standard [J]. *Computer age*, 2017 (2): 79-81.
- [11] Lan Huang, Chunli, LV, Yinxue Shi, et al (2018). Exploration on curriculum construction of computer composition principle for engineering certification. *Education and teaching forum*, 2018 (12): 260-262.
- [12] Miao Huang, KuiYi Wang (2017). Curriculum reform of Java curriculum group based on cdio-obe engineering education mode. *Computer knowledge and technology*, 13 (34): 169-170 + 175.
- [13] Li Ma, Zhen Li, Weina He, Donghong Shan (2018). Exploration on the construction of online open course of software engineering based on CDIO concept. *Software Guide (Educational Technology)*, 17 (10): 14-17.
- [14] Jing Zuo, Tanwei Zhou, Lijun Liu, Xuwei Kang, Hui Zhong. (2015) Leading the improvement of education and teaching evaluation technology with engineering education professional certification and evaluation. *Education and teaching forum*, 2015 (27): 174-175.
- [15] Hui, Wang Jun Zhang, Shengjiao Wang (2020). Exploration and Research on the teaching reform of College Mathematics Course under the background of engineering education professional certification -- Taking Henan Institute of technology as an example. *Science and Education Journal*, 2020 (01): 48-50.