Exploration and reformation of teaching methods for "Software Engineering" Course

Tang Xiao-jun[1] Lu Ying[1] Liu Na[1]

1 Dalian Polytechnic University, Information science and engineering school, Dalian, 116034

Abstract—**Traditional teaching method does not work well for teaching SE. Without hands-on experience, the methods and concepts are difficult for students to apply in industrial-scale software development. This paper proposes four approaches, i.e., case-based teaching, project-based training, integrated practice, research-based learning to upgrade our teaching methods at Dalian Polytechnic University (DLPU). Our experiences in a platform of training are also introduced. We believe that the traditional instructor-centered educational model can be reinforced well by combining our approaches.**

Keywords-case-based teaching;project-based training; integrated practice;research-based learning; platform of training; software engineering

I. INTRODUCTION

Software Engineering is a core curriculum for undergraduate students in computer science major. Software engineering is concerned with theories, methods and tools for professional software development. It makes the students master the basic theory and method of software engineering, and use them to the analysis, design, coding, and testing activities of the software development. And train students the awareness of creativity and team spirit [1].

Software engineering is a curriculum, which emphasizes both theory and practice. Without hands-on experience, the methods and concepts are difficult for students to apply in industrial-scale software development. Existing curriculum content of software engineering is complex and abstract, practice teaching is weak. It makes students feel boring and hard to understand. With the rapid development of software engineering, the traditional content and teaching methods can not meet requests for training modern software talents.

The authors have been engaged in teaching software engineering at DLPU for years. Now, we achieve good results about teaching content, teaching mode and practice system, as described next.

II. RESEARCH ON TEACHING OF SOFTWARE ENGINEERING CURRICULUM

A. Case-based teaching

The principles, methods and techniques of software engineering are all abstract. The authors found that the students understood and appreciated the genuine cases and they enjoyed brainstorming and reflecting about cases. The case studies will be used in examples throughout the course to illustrate software development techniques and receives good effect. One or more complex projects are designed for students, threading throughout the course, rather than simple, unconnected examples, and because the former illustrate better the difficulties and merits of the solutions. In the whole teaching, explain each knowledge point around the case. Both projects are open-ended and without a clear objective, so that we can consider different features and better understand the requirements derivation process.

By seeing software engineering applied on complex (and realistic) scenarios, the students will better grasp compromises that must be made both in terms of accuracy and richness of our abstractions. For example, OS (online store) system and OA (office automation) system are used in software engineering curriculum. This case-based teaching enables students to easier comprehend theoretical knowledge, and improve the ability to develop software [2].

B. project-based training

"Knowledge must come through action; you can have no test which is not fanciful, save by trial."(Sophocles).The purpose of the course project is to provide the students with the knowledge of software engineering methodology and the skills to apply it. The particular project is not the goal in itself; rather, it serves as a vehicle to apply your knowledge and to develop the skills.

Projects also introduce students to teamwork, which is unavoidable for large-scale software development. Teamwork has positive and negative aspects, and a familiarizing yourself with both helps you get ready for your future workplace. This is a challenge in the course, where each students needs to be assigned a grade, as well as in your future workplace where your raise and promotion will depend on your perceived contributions.

Establish engineering practice learning environment on campus , which have been proved effectively in engineering education . Learning Factory is the most important one. The goal of Learning Factory is to introduces the real world into classroom, and make students be able to complete hands-on practical significance of the company's current engineering practice projects by projects from industry [3].

Our school is partner with the China Software Industry Association (CSIA). CSIA provide platform of training and 10 enterprise projects by which students can do project-based training.

The process of software engineering experiment is managed by training platform of CSIA, including task distribution, role assignment, project management, progress monitoring, resulting evaluation, student information management, etc. Training platform assigns user account for each team member, and students can login in and receive all the sources and documentations of the project which they select. Such as document template, design criterion and detailed paradigm. The training platform also provides the interface for teachers and software companies. Teachers can manage students and communicate online with them by the training platform. The software companies can release projects and track project achievement. For good students, they even offer jobs.

All projects in the training platform is the enterprise projects from the software companies of Beijing's Zpark （Beijing's Zhong Guancun Science Park）. Considering the different ability between employees and students，China Software Industry Association makes some modest adjustments for the projects. Adjusted projects better suit the requirements of software engineering experiment. Students choose the project according to their interests，so ensure that the students have enough enthusiasm and confidence to finish it in the entire project cycle.

The genuine software development process is adopted during project-based training, just like the software company. Each project is designed to be done by a team of 3-6 students. A project leader is chosen by team members，and he is responsible for the team. Each person in the team is assigned a process role. All team members must take part in all project activities, although responsibilities may be divided so that different members take lead in different activities. An eight-hour working system is used, and allows working overtime.

Teachers arrange team number according to the project (project requirements complexity, difficulty of design, the amount of code, etc).The team leader who selects this project assigns role, such as software engineers, test engineers, configuration engineer, etc. Divisions of roles make students better experience different roles in the enterprise. Each student has clearly been defined roles, responsibilities and works as employees in the teams. They have to be on time for work and supposed to submit weekly working reports. Performance evaluation plays a significant role in evaluating students' course grades. Students will get to know what it is like to work in an enterprise through a series of enterprise-style management and function mode.

The teacher is more like a project manager in the process of experiment. He check project development schedule, and evaluate project quality. The students analyze, design, model and arrange development process. Finally, the students have the ability to analyze and solve problems independently.

Students have 4 weeks to complete their chosen project. All deliverables is submitted through training platform, including: report, project demos, products and so on. Each student should provide an itemized list of his or her own contributions to the components of the particular deliverable. If several students contributed to a particular component, quantify, as a percentage, each student's contribution to this component. Also provide a short description of your own contribution. Teachers login in training platform and evaluate all team deliverables in time. Students can modify their deliverables according to teachers' opinions until the deadline. That can improve the students' motivation to continue to improve the project, and monitor the progress of the teams effectively.

The teacher establishes comprehensive and effective the quality evaluation index. Not only considers the quality of the project, including rationality, accuracy of requirement model，design model and integrity of the software code, but also considers performance of each team member.

This evaluation mechanism can ensure the students' engineering ability assessment, at the same time, can exercise the student's cooperation ability and professional quality [4].

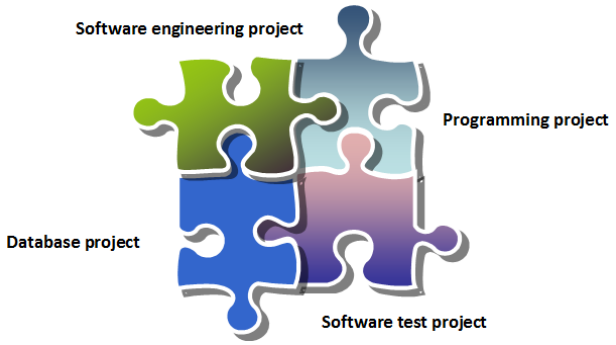

Figure 1 flexible combination of the integrated practice

C. Integrated practice

Software engineering curriculum should pay attention to building the integrated practice, which combine with the practice of related courses. With an example of Dalian Polytechnic University, according four curriculum groups of undergraduate program for computer science, set up four projects. The software engineering project corresponds to software engineering curriculum group. The programming project corresponds to programming curriculum group. The database project corresponds to database curriculum group. The software test project corresponds to software quality assurance and test curriculum group. Each project can last two weeks or more. Four projects can be flexibly combined and form different training cycle, as shown in Figure 1.

This is very convenience for school-enterprise cooperation. Computer science major of Dalian Polytechnic University put four projects together, and formed 8 weeks training cycle. According to cooperate with the famous IT companies, the students were guided by the engineers. The students completed analysis, design, implementation and testing of enterprise projects, and learnt related knowledge of four curriculum groups. It has been proved very effective, which promote the students' comprehensive practical ability [5].

D. Research-based learning

Computer Science students are encouraged to the teachers' lab when they are freshman at Dalian Polytechnic University. The students choose research subjects according to their interests and preferences, and start research-based learning and innovation activities.

The teachers of Computer Science Department have several labs, which mainly engage in the research for enterprises informatization, Geometric & Visual Computing, Web application technology, network application technology, database & information systems .There are about 200 students had studied in the lab in three years. The students' scientific research quality makes progress. Moreover, the students have received 6 invention patents and awarded about 60 prizes in various professional competitions. At the same time, students can finish some actual project development under the guidance of teachers, including Library Website of Dalian Polytechnic University, Examination System of Dalian Polytechnic University, and Educational Administration System of Dalian Polytechnic University and so on.

III. CONCLUSIONS

Educators and practitioners agree that the traditional teaching method does not work well for teaching software engineering. This paper discusses four approaches, case-based teaching, project-based training, integrated practice, research-based learning. We have proposed an experience based approach in this paper that can help teaching software engineering principles and practices. It is helpful to learn software engineering concepts and use them for developing more engineered software. Our students have expressed a high level of satisfaction, and in a survey, they indicated that what they learned in the course are highly applicable to their careers.

ACKNOWLEDGMENT

This work was supported by Boutique resource sharing lessons of LiaoNing Province (NO. [2013] 35).

REFERENCES

[1] Liu qiang. “Teaching Implementation Program of Software Engineering Course”. China University Teaching [J], 2011,9(2) :41-44

[2] Li yahong. “Exploration on Teaching Reform of Software Engineering Course”. Journal of Yangtze University(Nat Sci Edit)[J],Jan.2013,Vol.10No.1:96-98

[3] DONG Wei, NING Hong,QI Zhi-chang. “Study and Consideration of Software Engineering Practice Education”. Computer Enginerring& Science. [J], 2011, Vol. 33.No. A1:131-134

[4] Tang xiaojun, Li xiaohong .”Practice of the Course Design Teaching for Software Engineering based on Training”. Computer Education.[J],Nov.2011,No.22:92-95

[5] Tang xiaojun, Yao chunlong, Zhao xiuyan, Lu Ying,Li xiaohong. “Exploration of the Practice Teaching System of Computer Major through Amalgamation of Industry, Education, and Research. Research in teaching” [J], Mar.2013, Vol.36.No.2:36-38