Research on Case Learning System for Engineering Subject
----Software Engineering as an Example

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Abstract—The great appliance of engineering makes it different from other common subjects in teaching methods. This paper puts forward a concept of case learning that is constructed with projects and a corresponding case learning system based on project is designed and attained, which is believed to bring a new way for the future teaching of engineering.

Keywords: PBCLS; Learning by Doing; Case Teaching Method

I. INTRODUCTION

In recent years, thanks to the development of education theory and information science technology, the methods and effect of teaching have been enjoying great progress. However, for the teaching of engineering itself, because it needs much practice and operation, it is developing rather slowly. This paper takes the teaching of software engineering for example and brings forward a concept that engineering cases are projectized for teaching. Meantime we have built Project Based Case Learning System (PBCLS) to realize the goal that students can practice.

II. CURRENT STATE OF SOFTWARE ENGINEERING TEACHING

In the recently years, quite a few colleges and universities have gradually abandoned the phase that students take in knowledge only by instructions of teachers in classes during the practice of teaching by software engineering in recent years. They are trying a new teaching method that students learn on their own. For instance, problem-based learning [1] is a method that teachers divide a project into several modules and assigns the problems that need to be settled in each module to study groups, letting them discuss to decide how to solve problems. Finally teachers will gather all the study groups to have a discussion under the instruction of the teachers. Case study [2, 3] is a method that teachers let students analyze and deliberate existing cases and compare the students’ solutions to the standard one to have a better understanding of the problems. Project teaching [6] is a method that teachers arrange a small or medium project for students to deal with according to the basis for study of the whole class. The effect can be achieved when teachers comment on documents and programs made by students at the end of the semester.

However, there are a variety of defects in the methods mentioned above. In the method of problem-based learning, because problems are distributed to groups, the ones that each study group gets are merely partial in the development of software engineering, which leads to the fact that the problems which each study group ponders over and gets experience from are just one part of the whole process. As to case study method, cases are simply expounded orally or students do contemplate the problems without putting the circs in the case into practice, so they cannot really get the experience, like teamwork, the composition of documents, etc, in that circumstance. It seems that the project study method somehow makes up for the deficiency in the case study method, but oversize program can hardly be carried out and the methods used in the whole software engineering project become impractical due to time limitation. Students can master only one of the methods of software development when the class comes to an end.

III. PROPOSED PROJECT BASED CASE LEARNING SYSTEM

A. The main idea of “Learning by doing”

“Learning by doing” is a method that put forwards by Carnegie Mellon University USA [4, 5]; it allows students to attain accumulation of knowledge by finding out solutions during learning processes. Under the guidance of such teaching mode, teachers will infuse knowledge into projects and guide students in practice pertinently, rather than simply play roles in classroom instruction [7, 8]. Actually, the method of “Learning by doing” has been proved to be a great choice in engineering education. For instance, the survey made on software engineering graduates from Carnegie Mellon University indicates that [4] 92% believe that their Carnegie Mellon West education has given them a competitive advantage relative to their professional peers; 78% have seen salary increases greater than 5%, and 45% (of all students) have seen salary increases greater than 20%; 65% were promoted during the program or after graduating. This method also has been successfully used in China, like the exploration of the teaching practice of software engineering carried out by Sun Yat-Sen University [9]; the exploration of WINCE embedded system teaching conducted by Tongji University [10], etc. Nevertheless merely in terms of the reformation of learning courses these examples have not projectized case study and summarized the cases that was used, which we take into consideration. We put forward case learning system based on cases, aiming at providing convenience for the “Learning by doing” teaching method,
which helps avoid reduplicate work during the teaching process by accumulating former cases.

B. Organize cases in the form of project

PBCLS, takes the merits and demerits of traditional teaching styles into account, puts forward a method in the form of project [11] organization and for the drive of tasks to reconstruct engineering cases. This method extracted the common elements in the engineering cases to compose a task-node Project Evaluation and Review Technique (PERT) network diagram to form a Project Based Case Object (PBCO) that constitutes the constraints of PBCLS (Figure 1).

PBCO, the central data structure of PBCLS, is responsible for describing, recording, transferring and extending the information of project. It is described with XML schema, showing the essential attributes of project, which can be recognized and treated by the system easily. PERT network diagram (Figure 1) shows the projectized object represented by PBCO which could had been parsed by PBCLS.

Once a case which meets the constraints is loaded, it can be used in the teaching and practice of the system, which bring back the classic to students. The advantages of the method are quite obvious as follows:

Firstly, the project leads in the manner of small questions and subtasks, which shows the advantages of the problem-based learning method. Meanwhile, because the system is organized in a complete project, students can completely practice and experience from the beginning of the project to the end, which is the solution to the shortage of the problem-based learning method that students can only learn part of the whole development cycle.

Secondly, the case that is organized in the form of project for students to practice makes them really learn by experiencing the development process before teachers explain, rather than the traditional situation where optimal solutions are delivered in a short time in classes. Thus the learning effect that students received is totally different.

Finally, the projects, consisting of real cases, which are quite distinct from traditional project teaching methods confined to a few simple and minor-cycle ones, are all authentic from enterprises and laboratories in colleges and universities, which settle the problem of the project teaching method that students can master only one of the methods of developing software in a semester. Because certain methods of developing software are adopted according to certain cases, students can seek for cases which are designed by other software development methods to learn autonomically out of interest after they have learnt one method, which in turn helps improve their capability of self-directed learning.

C. Characteristics of the system

In terms of teaching characteristics, the system, integrating teachers’ teaching and students’ practice, enjoys the following traits:

1) Teachers’ teaching

In the aspect of teachers’ guidance and teaching, its features are as follows:

Firstly, teachers can expound through system cases. In the system, instead of nuncupation in a traditional way, teachers will analyze the whole project that is on a certain stage in detail according to requirements, such as the stage of demand analysis, the stage of writing code, etc. That makes it possible for teachers to give thorough explanation more pointedly so that students will pay more attention to details of different stages during the process of learning software development.

Secondly, teachers can give constructive advice to the students who are practicing in cases. Among the traditional project teaching methods, although students can improve by discussion in groups, their practice is always separate. But in the absence of teachers’ authoritative guidance, students will be always deviating from main line gradually in the process and have bad documents and program in the end. However, this system can offer valuable suggestions for students by observing their development condition at different stages of the project. So students can enjoy double results by doing half the work.

2) Students’ practice

In the aspect of students’ practice, its features are as follows:

Firstly, a student can choose a role to play in the project, like Project Manager, Quality Assurance, etc. Because of the

![Figure: 1. The Form of Project ---- a PERT Map](image1)

![Figure: 2. Activity Diagram for Teacher in PBCLS](image2)
different roles that students play in the development of a project, their duties and tasks will be varied. That human resources are organized in the form of project groups and various roles are set for students to choose from will make them more familiar with team’s division of tasks and collaboration under real circumstances, which helps them understand and adapt to their work quickly in companies in the future.

Secondly, students can choose cases compiled with different models of software development on the basis of their own demands. Owing to the varieties of software development methods, like RUP, XP, prototype development, waterfall model, etc, it is impossible to know all the development methods with a single case, so different development methods of different cases are different. Students can continue to learn other methods after mastering one, which helps them, have access to the current international software development methods that are popularly used so that they can be well equipped for the future work to some extent.

3) Other characteristics
   a) Cases are designed in the form of project.

   Because project management has some fixed patterns, every student has to consider elements, like practice, resource, budget, etc, in the process of project management during the learning and practising period of this system. Moreover, project management has a project cycle including project startup, project planning, project implementation, project acceptance, etc, so students should think about the tasks carefully with a better understanding of their roles and the relevant period of the project. There are corresponding milestones as tags in the system at the end of every project phase so that students can know the progress of the whole project easily. It is quite helpful for them to learn the critical path in project management.

   b) Roles played by computers automatically

   Roles which are not played will be played automatically by computers based on original cases. In the real world, students will take an active part in studying and in classes the number of the students in study groups probably cannot meet the required of the project groups. At that time, by playing the remaining roles automatically, it makes convenience for students to study on their own and project practice will not be invalid because of the shortage of students, which is truly significant for students’ self-study and practice of classroom teaching.

   c) Development tools integrated

   The development tools which are used in the development of software engineering, like version control server, document management, demand management tool, etc, are also available. The system provides these tools to help students be acquainted with the circumstance of teamwork and division of tasks so that they will not feel strange about these tools when they set foot into enterprises or companies in the future.

IV. CONCLUSION

The text describes the project based case learning system to software engineering teaching. The advantage of the system is the combination of the merits between traditional case learning method and project teaching method. The main idea of “Learning by doing” makes it possible to reproduce the classic for students with project to enhance their enthusiasm, rather than the traditional teaching style that teachers explain cases only in an oral way in classes. In addition, projectized cases help teachers save more time for designing project in traditional “Learning by doing” teaching. They will have more time to guide students, which highly represents the core concept of “Learning by doing”——learner-based teaching.

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