On Practice of Promoting Learning by Competition in Software Engineering

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ABSTRACT

This paper analyzes the status quo of practical teaching in software engineering, explains the significance of carrying out "promoting learning by competition", and puts forward a software engineering talent training program based on "promoting learning by competition", and has practiced in software engineering, got a good result. This study examines current teaching of software engineering and analyzes the implications of promoting learning by competition.

In recent years, “study to promote learning by competition”, “to practice by competition” and “training by competition” have become an important means for the cultivation of practical ability of college students. A large number of college teachers engaged in teaching work have carried out theoretical, applied research and practice on "study to promote learning" from different angles.

Lao Yi et al analyzed the theoretical connotation of the idea of “study to promote learning” and the significance of competition. It is believed that colleges and universities should pay attention to the training method of “promoting learning by competition”, and should adhere to the guidelines of competition and teaching, and promote learning in the game. "The mode of improving the faculty level" [1]; Zhu Lina, Qiu Shufen, and Mao Ning each conducted research and practice on the training mode of "professional training" in clothing-related majors, and found that they were supplemented by "sports training" in teaching. Teaching methods can improve students' design practice and innovation ability, and students can better adapt to market demand [2-4]; Ma Xiaomin and other researches find that “to practice by competition, training by competition” can strengthen the teaching ability of physical education teachers [5]. On the basis of analyzing the current situation of student competition and learning, Zhang Yingxi proposed to rationally formulate computer training programs and competition plans, and improve the competition mechanism to ensure the implementation of the teaching mode of the game, and believe that the significance of promoting the game is Change the
teacher’s knowledge structure, improve students’ study habits, interests and methods, and reform school teaching organization and management [6].

In the software engineering profession, the authors practiced the students in different grades in the form of “promoting learning by competition”. The specific practice is to directly promote the professional basic courses for the lower grade students, such as the ACM programming competition that can promote the learning of C programming courses, Java programming contest can promote the learning of Java related courses, computer works competition can promote students to improve their comprehensive ability, etc.; for senior students, set up professional clubs, participate in professional competitions in groups, improve comprehensive ability, achieved good results.

1. THE CURRENT SITUATION OF SOFTWARE ENGINEERING PRACTICE TEACHING IN COLLEGES AND UNIVERSITIES

In recent years, some teachers in our school have conducted field visits to some universities at home and abroad. The author concludes that the current practical teaching modes of software engineering in domestic universities are as follows:

(1) Studio system
A student studio is set up, and the teacher directs the indoor students to engage in software development that is similar to the real environment of the enterprise.
This approach requires a high level of teacher competence, while each teacher has limited energy and cannot guide too many students at the same time. Current graduate education is essentially similar to this model.

(2) Training courses
Most schools offer practical training courses. According to the teaching plan, the teacher’s guide the students to develop the simulation project.

The effect of this method is relatively poor. After all, there is a big gap between the simulation project and the enterprise project. It is still difficult for students to meet the enterprise requirements after completing the simulation project.

(3) School-enterprise cooperation
Students are sent to the company for internships, or enterprise engineers are invited to the school to offer training courses.

This method is very popular at present. First of all, students have been doing business internships for decades. But the problem is that traditionally, students always go to the company for internship before graduation. Is this time reasonable? In fact, in each stage for student at school, you should get a real enterprise-level exercise. Secondly, there is no essential difference between the engineer’s invitation to the school to set up a practical training class and the teacher’s training course. On the one hand, if the company can send an all-round engineer, and the second, for various reasons, the actual project of the engineer’s company cannot be brought to the school for disclosure.
2. THE MEANING OF "PROMOTING LEARNING BY COMPETITION"

The use of the "promoting learning by competition" model is not to negate the above-mentioned studio system and other means, but to strengthen the "promoting learning by competition" and "to practice by competition" based on the combination of existing practical teaching methods. The author believes that this approach has at least the following advantages or meanings.

(1) **Improve students' enthusiasm for learning**

Participating in the competition can greatly increase students' self-confidence and increase their enthusiasm. For students who are new to college, learning has no direction and purpose. It is a continuation of high school life and mechanical learning for learning. After the students were included in the competition team, on the one hand, the senior students showed up, the students can find the direction and motivation of the study. On the other hand, the competition award has become one of the goals of learning, and the initiative and enthusiasm of learning have been improved.

(2) **Promote students' self-learning ability**

In order to participate in the competition, the author set up a professional club to integrate students into the club's unified management. A considerable part of the knowledge used by students to participate in the competition comes from courses outside the classroom or later, and an introductory lecture is given by teachers or senior students. After that, the students are self-study. Students can arrange the content of the study, the time of study, the place and method of study according to the content and progress of the competition. Through the promotion of the competition, students' self-learning ability has been greatly improved.

(3) **Improve student teamwork ability**

Most of today's students are only children. They don't know how to communicate with others. They don't even know how to work with others to complete a task. Their ability to write code may be strong, but they can't complete a large-scale software. To participate in the competition, it must be a team battle. If one link is not completed, the overall score may not go up. The software that participates in the competition is often not developed by a person in a short period of time. By joining the team, the students know the importance of teammates, know how to get along with others, are no longer so self-conscious, and can consider others when writing code, ultimately improved teamwork capabilities.

(4) **Improve students' social practice ability**

When we just recruited the students, we had to talk with them, understand their abilities and ideas, and found that a considerable number of students had grandiose aims but puny abilities. Speaking of the knowledge they learned may be clear and logical, but they don’t know how to get the specific questions. Part of the competition is from the enterprise and comes from the society. In order to complete such a project, it is impossible to build a car behind closed doors. It is necessary to go to the society and go to the enterprise to do the demand research. The students follow the instructor to the relevant enterprises to visit and do the
demand analysis. The ability of social practice has been significantly improved; at the same time, in this process, book knowledge also has the opportunity to effectively integrate with social practice, avoiding the disconnection from reality.

(5) To be a powerful complement to classroom teaching

The courses related to practice in colleges and universities include course experiment, training course and graduation design. The main function of the course experiment is to strengthen and verify the knowledge points of the course; and the training course is generally completed by completing a relatively complete experimental project to integrate the knowledge of a course; graduation design is a test of the application of the professional knowledge. Compared with the above practical courses, competition training is often more targeted. It does not necessarily require all the professional knowledge that the major has learned. For example, the programming competition does not require much engineering literacy, but only for a specific aspect. This kind of investigation is more comprehensive than the course teaching. It participates in different levels of competition, and trains all aspects of literacy to achieve the training effect that classroom teaching can't reach.

(6) Training teachers

To guide students to develop software, first of all, they must develop software themselves. However, most of the teachers in colleges and universities directly enter the teacher position after graduating from college. They have been engaged in theoretical teaching and research for many years. They have not experienced software development in enterprises. By instructing students to participate in software professional competitions, teachers are forced to exercise their software engineering practice skills spontaneously.

On the other hand, there are many types of professional competitions, from basic programming skills, software development to innovation and entrepreneurship, from a single computer science competition to a multidisciplinary integration of computers and Internet of Things, machinery, etc., teachers are required to have divergent and innovative thinking. Teachers must strengthen their learning and improve their knowledge structure in order to be qualified for professional competition guidance.

(7) Promoting the construction of school practice environment

Participating in the discipline competition can promote the school to increase investment and build a practical environment. The school also loves face to hope that students can win more trophies for the school. When students are motivated to participate in the competition, it is a matter of course to build a corresponding learning and practice environment. For example, our students have to sign up to participate in the National College Robot Competition, but we do not have a corresponding robot training room. After reported by the instructor, the school approved the corresponding funds and quickly established the training room. The training room can also be used as a regular robotic experimental training room after the game.
(8) Promote the talent training model for enterprises

Most of the subject competitions involve enterprises, such as the China University Student Service Outsourcing Innovation and Entrepreneurship Competition. The Group A topics are all provided and explained by the company. Students participate in the competition and complete the project development according to the requirements of the enterprise, regardless of the final result of the competition, students will eventually know their own deficiencies, find their own development direction, and eventually become talents that meet the needs of enterprises.

3. TRAINING IMPLEMENTATION PLAN OF “PROMOTING LEARNING BY COMPETITION”

We propose three options: tutor system for new students, the general program, and the excellent student program.

3.1 Tutor System for New Students

Assign a professional tutor to each new student to guide students to study in this major. The original intention of this is to consider that students are completely unfamiliar with the university in high school. The learning methods and contents of the university are far from the high school. The professional tutor helps students understand the various directions in the profession, develop professional plans, and find their own interests point, and establish a reasonable learning method, so that every student can be interested in this major and love this major.

3.2 General Plan

This program is for all students in the program. Organizational competitions generally focus on more basic courses, such as the ACM Programming Contest, the Computer Design Contest, and the Java Programming Contest. By participating in such competitions, students can better consolidate the professional basics of C programming, Java programming, data structure and other courses, and enhance their interest in learning such basic courses.

The way of team formation is to voluntarily sign up for students to participate in the team, the teacher assists in the adjustment, try to arrange based on the scores of the courses, so as to learn from each other's strengths and weaknesses. Here, teachers need to do their best to solve the psychological problems that the top students are worried about being “pushed”. In fact, the ability of top students to guide other students is also a kind of exercise and improvement. The ability of students to exercise is not only the ability to do questions or write code; on the other hand, if a team always fails, it is necessary to find out Reasons, if necessary, personnel adjustments, so as not to lose confidence.
3.3 Excellent Student Program

From the software engineering majors, the professional interest clubs will be established in the form of “voluntary registration, merit-based admission”. Each club can have 1-3 instructors. Under the guidance of the instructors, the students will participate in industry or professional competitions. For example, the National Undergraduate Innovation and Entrepreneurship Competition, the National College Student Service Outsourcing Contest, the Challenge Cup, the Chongqing Service Outsourcing Software Contest, the Youth App Contest, the Robot Design Contest, etc., are more professional in this type of competition, and some topics are even derived from the production environment of industrial enterprises. It can excellently train students' comprehensive ability, so that students can better meet future employment requirements.

Other students who have not joined the professional club can team up and hire (free) instructors or unsupervised teachers to lead the competition.

Because the students who participate in this program are generally more professional, they will not consider the professional scores when they team up. Instead, they will be teamed up according to the characteristics of the players. Each team must have at least one team member who is good at copywriting and a strong verbal ability. Depending on the type of competition, each team may also join other professional players. For example, the robot contest may need the mechanical professional classmates; and projects that do smart tourism may join the students of the Tourism College, etc.; each team must carry out a reasonable division of labor, the instructor must pay attention to monitoring, prevent the division of labor from being unreasonable, some students are very busy, and some students have nothing to do. Finally, the enthusiasm is attacked. In addition, each participating team tries to join the students of different grades. During the competition, the senior students can help guide the lower grades, and finally form an echelon and form a virtuous circle to establish a good learning and competition atmosphere.

4. "PROMOTING LEARNING BY COMPETITION" TRAINING MODE IN PRACTICE

4.1 Implementation Measures

First, the freshmen and other students are treated separately, and each freshman is assigned a professional tutor. In the second grade, the outstanding students are introduced into the professional clubs according to the students' interests. The author applied to the college to establish the “android and algorithm club”. The general manager was elected in the club and operated according to the enterprise model. The instructor guided or organized the lecture according to the needs of the club; under the guidance of the instructor, The students of the club regularly
conduct basic knowledge training for the freshmen and specify the content that
needs to be learned at each stage; the competitions to be participated are issued by
the instructor, and the general manager of the club (or its affiliates) organizes and
implements the management. In addition to the competition, the club also
undertakes some software development services within its ability, that is, training
itself and serving the society. In accordance with a similar model, other teachers
have also set up clubs of various other themes to facilitate the participation of
students of different interests and achieved good results.

In order to encourage students to participate in the competition, the school also
has a policy to stipulate that participating in a certain level of competition to win
awards, or to obtain better results (such as patents, copyrights), appraised by the
academic committee of the college, can replace graduation design or other course
results, which greatly improve the enthusiasm of students.

4.2 Implementation Effect

From March 2013, the author began to carry out practical research on the
training mode of the 2010 computer science and technology professional software
engineering direction, and then added the 2011-2014 software engineering major’s
students. The implementation process has been continuously improved, and the
current plan has been formed, and good results have been achieved. The specific
results obtained only by the author as a mentor are as follows:

Successfully applied for a national-level university student innovation plan
project (No.: 201310642002), Chongqing University Student Innovation and
Entrepreneurship Project (No.: 201310642006), Chongqing University of Arts and
Sciences Student Research Project Nine (No. Z20130013, etc.), successfully
applied for software copyright More than 20 (registration number: 2014SR022852,
etc.), are applying for four invention patents, have successfully applied for four
utility model patents, participated in various competitions and won more than 100
person-times, and participated in the “Clouds in Guizhou” Big Data Business
Model Competition won "Excellent project (400)" certificate of honor.

More than 200 students participated in the practice of this model. From the
perspective of the learning effect of the single course, in order to participate in the
ACM programming competition, the enthusiasm of the students’ C programming
course has been significantly improved. From the perspective of the game effect,
the author Instructed students to participate in the three ACM competitions (2012 -
2014), the first time only the third prize, the second time the second prize, the third
time won the first prize; from the quality of graduates, the employment rate of 99
%, the remaining one took the civil servant, and the average salary of the initial
employment was more than 5,000 yuan (2014-2015), far exceeding the average
salary of the first-time employment of the students in the school.
4.3 Problems to Be Solved

The author has achieved good results in the practice process and encountered some problems, such as:

(1) How to solve the problem of students skipping classes
   There are three possible situations in which students skip classes:
   The first is to use entrepreneurship as an excuse. The scheme proposed in this paper is to train students' learning ability on the one hand, and encourage them to develop in different directions on the other hand, encourage students who are not interested in professional skills (such as writing code) to develop in other directions, and encourage students to innovate and start their own businesses, but Students must have time conflicts in the process of starting a business, cannot enter the classroom, how to calculate student performance.
   The second is that the students have completed the study of professional knowledge through self-study in the club. Then it is necessary to sit down to the teacher to listen to the teacher's lectures. If not, they will violate the relevant regulations of the school.
   The third is to use the club as an excuse. Actually, it is lazy and unwilling to go to the classroom. This is of course to be resolutely stopped.

(2) How to define the graduation design alternative
   At present, all Chongqing professional competitions above the city level can replace the graduation design. Is this reasonable? The program design competition has achieved good results, obviously cannot represent its software development ability is very strong, so this one-size-fits-all has obvious problems; on the other hand, students entering the first grade may be taking a ride from a senior classmate. At this point, it is clear that their graduation design can be left unsuccessful, and will it lose the motivation to continue their efforts.

(3) Establish incentive mechanism
   Although the college has taken practical measures to replace the graduation design to encourage students to enter the innovation and practice, but this is not enough, because the software development activities of the club are relatively hard and boring, this will seriously affect the enthusiasm of students to join. Students who have achieved certain results will also appear to be reluctant to make new projects and not willing to bring new students, resulting in a disconnection of personnel structure. More incentives are needed to improve the enthusiasm of students. At the same time, certain measures must be taken to carry out more and more activities to attract more students to join, which requires further exploration.

5. CONCLUSIONS

In the past six years, the author has carried out the software engineering talent training reform practice by adopting the mode of “Promoting Learning by Competition”, and trained the students according to the pre-designed training program, which has achieved good results and encountered many problems.
Through practical research, the author finds that the training method of “study to promote learning” is worthy of recognition. It can be promoted in engineering majors, but there are also some problems that can’t be solved by individuals alone, such as: (1) Schools need to introduce relevant policies, with regard to graduation design substitution, and even further, can replace professional courses; (2) the criteria for judging the curriculum replacement, what kind of competition results can be substituted for what kind of curriculum, this need Strict identification does not result in professional shortcomings for substitute students; (3) the division of competitions, the ability to exercise in different competitions is not the same. These will also be the focus of my next research.

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REFERENCES