Double Tutor System with Project Based Teaching Mode and Creative Talents Cultivation

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Abstract. Double Tutor System with Project Based Teaching Mode is derived from long term teaching practice. It means to cultivate the students’ capabilities through the cooperation between the universities and the enterprises by using the projects as the motivation under Double Tutor System. The system is the product of the research study and the cognition apprenticeship during the course of their localization in Chinese higher education. It is meaningful to the integration of character cultivation and teaching practice. And it is also helpful to unify the subject creation and academic innovation in order to enhance the cultivation quality of the college students.

Introduction

Student Tutor System was pioneered by William Wickham who was the bishop of Winchester and it originated in Oxford University. In the system, the teachers at high profession level and with good characters are selected to be the tutors of the undergraduate students under the condition of two-way choice between the teachers and the students. They should also individually guide the learning, characters, living and psychology of the corresponding students.

Project Based Teaching Mode is a teaching method including CDIO (Conceive, Design, Implement and Operate) based on Constructivism Teaching Theory [1, 2]. The overall quality and ability of the students can be improved in Project Based Teaching Mode. Constructivism was firstly proposed by the famous Swiss psychologist named J. Piaget [3, 4]. In the theory, the learners obtain knowledge by the meaning construction with the help of the others and the necessary learning data in the certain social background instead of the tutors’ teaching. Construction means not only the construction of the significance of new knowledge, but also the transformation and reconstruction of the original experience. Constructivism holds the opinion that the goal of learning has directivity. Only if the learners were clearly aware of their learning goals, and achieved the desired results, learning would be successful. Project Based Teaching Mode is a method built on the base of constructivism theory. In the method, learning is designed to finish a real project and learners are encouraged to explore by themselves during the course [5]. Student-centered teaching philosophy is highlighted to stimulate students’ interests in self-learning, self-exploration, problems analyzing and problems solving skills.

Student Tutor System and Project Based Teaching Mode are both proved effective to improve the quality of undergraduate students. It might be more effective if the two methods were combined. Wuhan University of Science and Technology was elected to attend the emerging strategic mainstay industry talent training plan of Hubei Province of China in 2011. Double Tutor System with Project Based Teaching Mode has been proposed and implemented since then.

The Research Learning of the Undergraduate Student Based on Projects

Research learning is also named as inquiry learning or learning based on questions. It is a transition learning process between the reception learning and independent discovery. The aim is to stimulate the transformation from learning the truth of the science to exploring it [2]. Some scholars define the research learning in the university as college students apply various methods positively to
explore the uncertain things under the guidance of the tutors in order to form a new ability to solve the difficult problems [3].

In fact, the research learning of the college students is the course that they apply the learned scientific knowledge to explore the uncertain world. The essence is to learn by discovery. The discovery learning is proposed by Bruner in 1960s. The method is to induce the students to apply the learned knowledge or the guidance materials offered by the tutors to propose the model to solve the problem, learn how to transfer and organize the information and solve the problem by reading, observing, thinking, discussing and doing experiments in order to acquire the knowledge and develop capabilities [4].

In 1998, Boyer Commission released the report of reconstruction of the undergraduate student education-the blueprint of the American research university. The instruction that the research universities should establish the learning by discovery was mentioned. It was believed that all of the universities should offer a new undergraduate learning experience in the report. For the case, the Symbiotic Relationship among the college teachers, college students and the college staff should be established. The persons who have the ability to teach, create and apply the knowledge are qualified to be faculties in universities. It is necessary for the students to transfer from receivers to explorers. Chances should be provided for the students to achieve success in every course [5]. It is believed that undergraduate students should explore the unknown fields except their own major in order to expand their knowledge structure. Teachers should apply different methods to encourage students to learn and create independently when they are freshman or sophomore in the college. And they also need to induce the students to discover the relationship among the nature science, society science and the humanity science. The discovery learning should also be considered with the union of projects and cooperation.

One of the main contents of the Double Tutor System with Project Based Teaching Mode is the discovery learning. Projects act as a bridge between the general knowledge and the application. The projects originate from the real demands of the enterprises. Students need not only to try to make full use of their learned knowledge but also supplement the related new knowledge. The mode is the proper answer to how to realize the scale effect in the premise of guaranteeing quality [5]. In 2006, being inspired, the Chinese Ministry of Education implement a program named teaching quality improvement and reform of higher education. The college student innovative experiments projects is one of the important contents of the program. The mode of discovery learning not only sets a model for the higher education but also promotes the teaching reform at the national level. The effects are positive and lead to great social value.

It is emphasized that the assignment should derive from the actual engineering project in Project Based Teaching Mode. The School of Traffic and Vehicle Engineering of WUST (Wuhan University of Science and Technology) and the enterprises Co-sponsored projects from actual engineering project for the students to explore and study according to their knowledge, experience and interests. The key point of Project Based Teaching Mode is to lead the students to study the courses further with the advance of the projects. The valuable point of it is to encourage the students to learn by studying through the stimulation and guidance of the enterprise tutors and the college tutors. The students should learn to identify problems proactively and analyze the problems jointly during the studying course. They should also learn to obtain the necessary knowledge to solve the problems at the end. During the course of solving the problems, the students enrich and enhance their knowledge, experience and skills. They might personally recognize and appreciate the value and meaning of teamwork through cooperating and discussing to overcome the difficulties encountered. At the same time, the students’ team spirits are trained and exercised, their confidences were enhanced and their innovative spirits were developed, as shown in Fig.1.
The Practice of the Double Tutor System

In fact, Double Tutor System is a kind of modern edition of the cognitive apprenticeship. Cognitive apprenticeship is a mode to foster the cognitive capability which includes the expert cogitation, facing problems and dealing with complex tasks by combining the traditional apprenticeship with the modern school education. It is emphasized that the students should stimulate the inner motivation to cooperate and compete with the others as apprentices by observing, training, practicing, communicating, summarizing and exploring in order to grasp the domain knowledge and strategic knowledge to improve the practicing ability.

The cognitive apprenticeship is the localization form of the application of Chinese higher education. The key point is that one student has two tutors. It demands that a lot of real projects from the enterprises should be induced into the education mode. The students can communicate with the engineers who act as enterprise tutors besides their college tutors. During the course, the students may figure out the thought of the engineers and learn a lot of knowledge and techniques out of the classroom. It is the essence of Double Tutor System and the traditional meaning of the system is expanded.

In the school of Traffic and Vehicle Engineering of WUST, college tutors concentrate on professional guidance for the students during their first two years in the institutes. From the third year, they would have the enterprise tutors to guide their vocational education. The persons who have senior professional titles and rich experience in the enterprises may be selected to be the enterprise tutors. One student has two tutors at the same time at the last two years. He or she can combine theory with practice and combine the professional learning with capacity building by such an institutional arrangement and corresponding operating mechanisms.

In the Double Tutor System, the most important thing in improving the innovative capacity of the students is to give them the academic guidance. The efficient way is to establish more than 15 different research interest teams according to the students’ interests, such as surface engineering team, casting team, mold design team, welding technology team, metal materials team, green building team, CAD (Computer Aid Design) team etc. There are less than 5 students in one team. The students are guided by both the college tutors and the enterprise tutors to learn by practicing and practice by thinking. They reconstruct their knowledge structure, expand their study views, and cultivate their own critical thinking skills and spirits of doubt.

Figure 1. The flow chart of Double Tutor System with Project Based Teaching Mode.
Effects of Training Students' Abilities

After Double Tutor System with Project Based Teaching Mode was implemented, the innovative learning abilities of the students were improved notably. They also made remarkable progress in instrument operation, experimental design, and other aspects of thesis writing. In recent 3 years, the college students took part in the National Undergraduate Mechanical Creative Design Competition, FSAE (Formula SAE), logistics design contest, transportation science and technology competition, Honda saving energy competition and won more than 20 national or provincial awards in various competitions. The competition scores are 1.5 times the previous one. At the same time, the employment rate of the senior students was improved rapidly from 80% to 95%. More and more famous vehicle enterprises and manufacturers began to accept our students. And the employers also sent us the positive feedback that the students were better than before.

Table 1. The comparison of students before and after the training mode changes.

<table>
<thead>
<tr>
<th>Grade of undergraduate</th>
<th>Median GPA</th>
<th>Competition Awards (%)</th>
<th>Paper publication (%)</th>
<th>Patent application (%)</th>
<th>Employment rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>3.08</td>
<td>18</td>
<td>6</td>
<td>4</td>
<td>87</td>
</tr>
<tr>
<td>2015</td>
<td>3.52</td>
<td>33</td>
<td>11</td>
<td>15</td>
<td>95</td>
</tr>
</tbody>
</table>

Summary

In Double Tutor System with Project Based Teaching Mode, utilizing projects to attract the students to participate the practice initiatively is an effective way. The way can excite active learning, thinking and creating potential of the students. It can also cultivate the critical thinking capability and creativity of the students. If the practice teaching would not be paid enough attention to, the real creative engineers would not be brought up easily overall.

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References