Problems and Countermeasures of Project Based Teaching Pattern in Implementation of College Public Basic Courses

Cui MENG\textsuperscript{1}, Wu-jiang ZHANG\textsuperscript{2,\*} and Pei-qun WU\textsuperscript{3}

\textsuperscript{1}Department of Fundamental Courses, Beijing Electronic Science and Technology Institute, Beijing 100070, China

\textsuperscript{2}Department of Humanities and Social Sciences, Beijing Electronic Science and Technology Institute, Beijing 100070, China

\textsuperscript{3}Department of Fundamental Courses, Beijing Electronic Science and Technology Institute, Beijing 100070, China

*Corresponding author

Keywords: Project based teaching pattern, Public basic courses, Curriculum renovation and construction, Projects, Interdisciplinary.

Abstract. Project based teaching pattern is an effective teaching model. We have implemented project based teaching pattern in college public basic courses, through appropriate reconstruction and construction on the traditional curriculum, We have changed them into a theoretical and experimental combined parallel interdisciplinary curriculum. Successfully implement of project based teaching pattern needs two necessary conditions: using teachers' interdisciplinary academic resources as reference, well-designed projects for driving teaching.

Introduction

Project Based Teaching Pattern is a teaching method based on Constructivism theory, which is also advocated by the CDIO (Conceive, Design, Implement, Operate) concept.\textsuperscript{[1]} Implementation of the project based teaching means that the teachers should guide the students to combine teaching content with research projects (or research questions), and guide the students to master teaching content in the process of the completion of the research project. In this process, the students' research projects initiated by the internal needs of the students, which becomes the biggest motivation to learn the teaching content; in this process, "research projects" become the "test situation" of curriculum study. Based on this "situation", the students experience success, their confidence and interest in learning will increase, the overall quality, innovative consciousness and ability of the students will also get improved accordingly. This is the very power of project driven teaching mode. Project Based Teaching Pattern should be greatly advocated in the teaching of university.

Practice

Many colleges and universities in China applied this teaching model to specialized core courses of graduates and undergraduates, especially in professional practice courses and achieved good results.\textsuperscript{[2][3][4]} But as for the undergraduate basic courses, very fewer teachers adopt this teaching pattern and integrate it with students' research projects. This is mainly due to the reason that basic courses for lower grades students in colleges emphasize more on providing fundamental knowledge for professional learning. Some courses like mathematics has the features of strong logicality, high abstractness, and the teaching content is far from the real world, these courses are difficult to implement project based teaching pattern. However, with the advance of popularization of higher education, problems in learning interest and study motivation of college students become more prominent, which pose a great challenge for successful and innovative teaching personnel training objectives in colleges and universities. To overcome the difficulties in the implementation of project...
based teaching pattern in these courses is an important way to respond to this challenge. Since 2002, In view of the schools and students practical, We have adopted the basic idea and method of project driven teaching mode, transform the course of "Probability Theory and Mathematical Statistics" which is established for specialty of administration into the interdisciplinary course which involves mathematics, statistics and computer, combining the course which is mainly related to "the method and technology of processing information " with the course of "Social Survey Research Methods" which is mainly related to "the method and technology of collecting information" , We adopt project driven teaching mode to transform the courses , the two courses are built into characteristic "group of courses" in Beijing Electronic Science and Technology Institute, We reform the evaluation mode of student results: the report of project study as the main material of students learning evaluation, the evaluation result to join in the course grade. It greatly stimulates the enthusiasm of students learning and active exploration, innovation consciousness and ability.

We also apply the experience of course group construction and teaching reform to the other courses such as the course of "mathematical modeling", We adopt "case teaching method", every mathematical model is based on a specific problem and project teaching, after completing a few case teaching ,We guide the students to put forward to his own problems of modeling, the paper of the modeling finished by the student on his questions is the basis of teacher’s evaluation of the results by the end of term. Engineering students oriented "higher mathematics" and "probability and mathematical statistics" course, the teachers design a few small "project" for classroom teaching, guide students to find and choose a few "small project" (actual problems) after class, combined with the mathematical software to complete the study of the selected issues, and encourage students to write papers on the results, the teacher add the evaluation results of the paper to the students' total mark. In addition, We also further guide the students to apply accumulated research resources and experience in mathematical modeling contest, undergraduate innovative entrepreneurial training plan research in the extracurricular activities of science and technology, the results is effective, in 2008, We guided the students' modeling team to participate in American undergraduate Interdisciplinary Contest In Modeling obtained Honorable Mention prize given by COMAP (the Consortium for Mathematics and Its Application) and NSA (the National Security Agency), it was the first international award for the students in our school , and won the good reputation for the innovative talent training in our school. We guide the students of modeling teams to attend CUMCM (China Undergraduate Mathematical Contest in Modeling), They won the second grade prize in China, the first and second grade prize in Beijing. We encourage and guide the students to take part in China undergraduate mathematical contest, also they obtain the first and second grade prize in Beijing. According to project driven teaching model ,We guide the students to engage in six scientific research projects ("Comparative research of the scientists’ road to success with the political elite in China", "Investigation on confidential security talent demand of the party and government organs", "Research on university rankings", "Data mining on air quality in national 31 cities", "Research on tuition fee of university", "Research on academic experience of the teachers for information security professional in China"), which have been approved as national or provincial undergraduate innovative entrepreneurial training program, and five of them have been successfully concluded. On the basis of these research projects, the students have published some academic papers.

On the other hand, we adopt project based teaching pattern based on a series of teaching reform activities. The teaching method applied in open class became highlight in" 2014 the Tenth Beijing Prominent College Teachers selection", and one of the authors was awarded the honor for her special contribution to teaching. The honor further enhances the reputation and influence of project based teaching pattern in public basic courses in and out of our college.\[5\]

**Problems and Countermeasures**

Based on 14 years of implementation of the project based teaching pattern in course construction and teaching reform practice, We believe that the implementation of challenges and countermeasures in
teaching model facing public basic courses lies in the following three aspects: course transformation, project driving teaching, and teachers’ or the teaching group's academic background.

First, it is necessary to transform public basic curriculum into parallel interdisciplinary courses which include theory and experiment (practice) courses. China’s traditional higher education is basically organized in accordance with the organization’s disciplinary system, which is followed by the Soviet university model, and this is particularly evident in public basic courses. In this system, each course is based on only one discipline courses and the curriculum organization is limited in this narrow area, which is a big challenge for the implementation of a project-driven teaching mode. The "project" to drive teaching should be real social problems, and the solution to the problems can't depend on only one discipline, and often depend on multiple disciplines. Therefore, in order to carry out project based teaching pattern of basic courses, traditional public courses should be transformed into an interdisciplinary subject. In addition, according to the characteristics of the big data era, using computer software and hardware technology, combining computer science with the curriculum is the most basic work, this will inevitably make the traditional public basic pure theory course change into theory and experimental combined parallel course. Students' practical abilities are essential to project based teaching pattern, therefore, some of the traditional theory courses should become a theory and experimental combined parallel course.

For example, we reform the teaching of "Probability Theory and Mathematical Statistics" and transform the course into theory and experimental combined parallel courses. In the combined parallel courses, theory course mainly include probability basics and applications as well as basic statistical methods, and experimental course include the use of statistical software the method. After such transformation, the course becomes an interdisciplinary curriculum which involves mathematics, general statistics and computer science, theoretical and experimental parallels. We increase mathematics experiment class include software-based mathematics content (i.e., " Mathematical Experiment") in the courses such as "Advanced Mathematics "and" Probability Theory and Mathematical Statistics" for the students of engineering college.

Second, "projects" for driving teaching. First, one of the basic functions of "projects" for driving teaching is to become the motivation and guidance which leads students to participate in the process of teaching and learning curriculum content. Therefore, the project may not be as innovative and effective as the state or provincial-level research projects which applied by scientific and technical personnel, so long as the projects are new and effective to students' curriculum learning. Secondly, the organization of projects research can be diverse. Each student can have his own different "projects", or share one project by a group and complete the project together. The projects can base either on the contents of " Social Survey Research Methods", " Probability and Statistics " which runs through the whole process of study or on the problems of " Probability Theory and Mathematical Statistics", and " Advanced Mathematics" for engineering students which exists in each teaching unit. In addition, although the "Project" comes from the students' major is much better, but due to the reason that these public basic courses are opened prior to specialized courses in their major, students at this time does not have the knowledge of their major, so projects which come from the practice of social life are better.

Third, teachers' interdisciplinary academic accumulation. Successful projects driven teaching must be based on the premise of teachers' project research. If teachers themselves are rarely engage in research projects or simply not engaged in research projects, how to select and guide students to complete the project? At present, China's colleges and universities, especially some teaching-oriented colleges and universities, there are still a considerable number of "teaching oriented faculty" who always through traditional forms of teaching methods to teach students basic knowledge and basic skills. However, it becomes difficult as for how to solve students' learning motivation and capacity issues through the implementation of innovative learning project-driven teaching mode. Therefore, teachers who want to implement the project-driven teaching mode should carry out scientific research work in order to accumulate their own research experience and resources, and strive to achieve a high level of scientific research to support high-quality teaching.
On the other hand, "project" in project-driven teaching mode is often an interdisciplinary problem. Therefore if teachers have interdisciplinary research background, the successful implementation of the project-driven teaching mode is greatly advantageous. However, the academic organizational forms of universities in China are basically "disciplinary" system, rather than "academic chair system" (or "Institute system") in Europe (or in Japanese universities). In "disciplinary" system, curriculum and teaching are basically organized according to discipline, teachers undertake the task of curriculum construction and their academic backgrounds are generally limited to the major, which is the challenge of implementation of the project based teaching pattern. This problem can be solved in three ways. First, teachers should involve more interdisciplinary academic research activities. Second, the evaluation of the results of student projects should be judged by teaching support team with multi-disciplinary academic background, which can overcome some drawbacks of evaluating only by one teacher. Third, teaching team should include experts on higher education, which can help teachers make teaching reform develop from conscious to spontaneous development. The success and experience for the educational reform is also indispensable.

If we take measures from the above approaches, and begin with our teaching reform from curriculum reform and construction, continuously strengthen the academic interdisciplinary background of the teachers and teaching team, pay attention to well-designed projects for teaching, then the project-driven teaching model can successfully be applied to all public basic courses, which will achieve the goal of effective teaching and training of innovative talents.

Acknowledgement

This research was financially supported by the following Project Fund: Human and Social Science Funding Project granted by the Ministry of Education " Empirical Study on University Teachers’ Flow under the System of Appointment " (No.12YJA889124), Beijing Municipal Government Supported Central Universities Jointly-Funded Project (Jointly-Funded Talent Cultivation–Prominent Teacher Project) " Academic Development Research of Prominent Teacher in Beijing " (No.201501), Fundamental Research Funds for the Central Universities “Research on Graduate Mathematical Modeling and Innovation Ability” (No.328201556).

References


