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Project-oriented Learning Process Analysis in PBL Approach for "Emerging Engineering" Education

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Abstract. The problem itself can drive the learning process. In order to cultivate the abilities to systematically analyze the problem and solve the complex problems, the projects containing the real problems are carried out in PBL approach. The problem-based and project-oriented mode can improve the cultivation quality of the electromechanical talent. Especially, project training can promote the construction of "Emerging Engineering" in the electromechanical field, such as "intelligent manufacturing", "robot", and so on. This paper discussed the principle of the project design, project work and project estimation in Problem Based Learning (PBL) approach in the electromechanical talent cultivation. It can supports a reference for the application of Problem-based and Project-oriented approach in the construction of "Emerging Engineering".

Introduction

PBL(Problem-based learning) is a world popular approach in engineering talent cultivation[1]. It is an educational concept to organize the learning content by the inquiry of the problem. It emphasizes participant-led learning principles, solving problems through group collaborative learning, and focuses on the interdisciplinary content integration and problem solving [2]. A problem is something needed to be solved in the real world. The real problem is not designed by the teacher, and it is not well-structured. In the process of learning, students need to construct the problem itself. Students need to construct a language of their own, solve problems in a collaborative way, and require a thorough problem analysis [3]. The problem is the start point of the learning process. PBL approach is generally applied used in the engineering field by the project-organized way. The projects in PBL approach should contain the problems which can drive the students to begin learning process. In electromechanical talent cultivation, "Emerging Engineering" are developing rapidly in recent years, such as "intelligent manufacturing", "robot", and so on. "Emerging Engineering" has a characteristic of technological innovation and interdisciplinary. By studying the PBL approach in Aalborg University in Denmark, it is found that project plays an important role in the learning process. Project is the carrier of the problem. By doing the project work, the students' ability of systematically analyzing and solving the complex problems can be cultivated. This paper analyzes the Problem-based and Project-oriented approach by three aspects: project design, project work and project estimation.

Project Design

The projects can be derived from production practices in the industrial factory, or from the actual life of the students. The students can propose some projects by their interest. When a series of projects were proposed and collected, a team should discuss and decide which project to choose and implement. The projects can be divided from three types: assignment project, subject project and problem project [4]:

The assignment project is carefully planned and designed by the teacher. In an assignment project, the problem and the learning content are selected before the class. Assignment project is easy to control and manage, but the motivation of the students is relatively weak.

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Subject project has a clear field in the subject, it is more difficult to control and manage the learning process than the assignment project, but the motivation of the students is stronger than the assignment project.

In the problem project, teachers are no longer in a dominant position in the project work. Problem project is the most difficult to control and manage the learning process， but the learning motivation of students is the strongest.

When the Problem-based and Project-oriented approach is used in the “Emerging Engineering”, the assignment can be applied firstly in the class, and then the subject project and problem project can gradually applied.

Project Work

How to start a project? Don't get too entangled in a perfect plan. The learners can start the project with the easiest problem. Through action and reflection in the group work, the learners can gain experience for the next step of action, and the project can be promoted step by step.

How to facilitate the learning process? A group should make a schedule, which is about the individual work and the meeting. The supervisor and the opposition group can help to facilitate the learning process. They can make comments to the group work, and the team should give a response or explanation. If there is a problem in the project work, it should be modified and improved according to the opinion. The supervisor and the opposition group can also give some advices or suggestions to help promote the team work.

How to manage the learning process in the group work? The supervisor should treat different students by different ways. For the task assignment, it is not necessary to evenly assign the tasks. The task can be assigned in accordance with the student's situation to maximize the ability of students and stimulate students' interest and sense of accomplishment. For the timid student, the supervisor should encourage him/her. For the pride student, the supervisor should point out problems and deficiencies in his/her work. For the students which have strong ability and vitality but weak self-control, the supervisor should be good at guiding them. Otherwise, they often make opposing opinions and affect group work. The supervisor can give him/her more challenging tasks in the project, or improve the target according to the progress of the project. There are different principles for assigning tasks. The principle of completing tasks as quickly as possible can be applied, or the principle to improve the student’s individual ability can also be applied.

How to treat a project with no result? Firstly, do not give up easily. If through various methods, it is still proved that this project cannot be completed, and it is also a result of the project work. For example, a school designed a trip to the Summer Palace to catch butterflies to make specimens. It was found that there were no butterflies at all in the Summer Palace. Why? It is a good problem. From the plant characteristics of the Summer Palace, the learners can study in-depth that why there was no butterfly. The students learned a lot of knowledge by doing this project, although there is no result for this project.

Project Estimation

How to evaluate the project work completion and the students’ performance in the group work? There is no written test for the project, but the team must do a presentation and everyone should answer the questions from the supervisor and the opposition group. The presentation generally includes two kinds of reports: project report and the process analysis report. The process analysis report is a process analysis of the group work. It is very important to improve the quality and effectiveness of the project work next time. The project work estimation includes project reports and oral exams. The exam consists of two parts, the group score and the individual score to comprehensively consider the overall performance of the team and the contribution of each student to the group.

Conclusion

PBL approach was firstly used in medical education. How to use the PBL approach in engineering education? Project-oriented learning is a suitable method for the application of PBL approach in the engineering education. The project is the carrier of the problem and an important part of PBL teaching. The projects containing the real problems are carried out in PBL approach. Problem-based and project-oriented approach can help students improve academic interest and help form good behavior habits [5]. And, in the "Emerging Engineering", problem-based and project-oriented approach can cultivate the students' ability to systematically analyze the problem and solve the complex problems. This paper analyzes the design, implementation and evaluation of the project, and provides a reference for the application of Problem-based and Project-oriented approach in the construction of "Emerging Engineering".

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