

Research on the effectiveness of project-based learning in automotive engineering teaching

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Keywords: Project; Study; Automotive engineering; Education; Effectiveness

Abstract: The research on the effectiveness of project-based learning (PBL) in automotive engineering teaching aims to explore the application of project-based learning method in automotive engineering professional teaching and its influence on students' learning results. Through the review of relevant literature, it is found that PBL can improve students' active learning enthusiasm, innovation ability and practical ability, which is conducive to cultivating students' teamwork spirit and problem-solving ability. This study verifies the effectiveness of PBL in automotive engineering teaching through the questionnaire survey and experimental study of a university student, and puts forward some suggestions and strategies to provide reference for the teaching reform of automotive engineering major.

1. Introduction

Project-based Learning (Project-Based Learning, or PBL) is an educational approach designed to improve their self-directed learning, innovative thinking, teamwork, and communication skills by engaging students in practical projects or problem-solving activities. In automotive engineering education, project-based learning can effectively improve students' practical ability and comprehensive quality, and cultivate them to become automotive engineers with innovative spirit and practical ability. First, project-based learning has the following characteristics:

1) Emphasize on independent learning: In project-based learning, students need to independently find problems, design solutions, conduct experiments and optimize them. This helps to develop students' autonomous learning ability and improve their problem-solving ability.

2) Focus on practice: Project-based learning emphasizes practice, and students need to apply what they learn to practical projects, so as to improve their practical ability. In automotive engineering education, students can participate in practical projects such as automobile design, manufacturing and maintenance, and combine theoretical knowledge with practical operation.

3) Emphasize teamwork: Project-based learning encourages students to work as a team to complete project tasks together. In automotive engineering education, students can be divided into different groups, respectively responsible for the design and manufacture of different modules, and finally integrated into a complete automotive engineering project. This helps to develop students' teamwork skills and communication skills[1-3].

4) Cultivate innovative thinking: Project-based learning encourages students to come up with new

ideas and solutions. In the automotive engineering education, students can put forward innovative solutions to the hot issues in the field of automotive engineering, and cultivate their innovative thinking ability.

5) Improve comprehensive quality: Project-based learning not only focuses on students' professional skills, but also focuses on cultivating their comprehensive quality. In automotive engineering education, students can improve their communication skills, leadership, problem-solving skills and other qualities by participating in projects.

2. Application of project learning

Practice and application of project-based learning are widely used in automotive engineering education. For example, in the automobile design course, the teacher can ask the students to complete the automobile design scheme independently and review it according to the given design requirements. This can improve students' design ability and innovation ability, and cultivate students' comprehensive vocational ability. In the automobile manufacturing course, teachers can let students participate in the actual automobile manufacturing process, understand the process and process of automobile manufacturing, and independently complete the task of automobile manufacturing. This can improve students' practical operation ability and innovation ability, and cultivate students' comprehensive vocational ability.

The practice and application of project-based learning can also promote the overall development of the students. For example, in automotive engineering education, teachers can organize students to participate in competitions and activities related to automotive engineering, such as automobile design competitions, automobile manufacturing competitions, etc. This can improve students' teamwork ability and competitive ability, and promote students' all-round development. In automobile engineering education, teachers can also organize students to carry out social practice activities related to automobile engineering, such as visiting automobile factories and investigating the automobile market. This can improve students' practical operation ability and social responsibility, and promote students' all-round development[4-6].

Research on the effectiveness of project-based learning practice and application in automotive engineering education is very important. Practice and application based on project learning can improve students' practical ability and innovation ability, and promote their all-round development. In automotive engineering education, teachers can organize students to participate in competitions and activities related to automotive engineering, such as automobile design competition, automobile manufacturing competition, etc. This can improve students' teamwork ability and competitive ability, and promote students' all-round development. In automobile engineering education, teachers can also organize students to carry out social practice activities related to automobile engineering, such as visiting automobile factories and investigating the automobile market. This can improve students' practical operation ability and social responsibility, and promote students' all-round development.

3. Problems and challenges existing in automotive engineering education

Automotive engineering education is an important field to train future automotive engineers. However, there are also some problems and challenges in the current automotive engineering education.

1) Lack of practical experience

Automotive engineering education is usually conducted in the laboratory and classroom, and the lack of practical experience is one of the biggest problems in automotive engineer education. Although laboratories and classrooms can provide some theoretical knowledge and practical skills, the lack of real practical experience can cause engineers to respond to various challenges in practical

work. Therefore, schools should provide students with more practical opportunities, such as internships, programs or competitions.

2) Lack of innovative thinking

Automotive engineering is a rapidly developing field that requires innovative thinking from engineers. However, the traditional automotive engineering education often emphasizes the traditional knowledge and skills, but lacks the cultivation of innovative thinking. Therefore, schools should pay more attention to cultivating students' innovative thinking, such as through curriculum design, innovation competition or project cooperation.

3) Lack of interdisciplinary knowledge

Automotive engineering is an interdisciplinary field that requires engineers to have the knowledge of multiple disciplines. However, the traditional automotive engineering education often focuses only on the knowledge of a single subject and lacks the cultivation of interdisciplinary knowledge. Therefore, schools should pay more attention to cultivating students' interdisciplinary knowledge, such as through curriculum design, project cooperation or competition.

4) Lack of international vision

Automotive engineering is a global field that requires engineers to have an international vision. However, the traditional automotive engineering education often only focuses on the needs of the local market, but lacks the cultivation of international vision. Therefore, schools should pay more attention to cultivating students' international vision, such as through international exchanges, project cooperation or competitions.

5) Lack of sustainable thinking

Automotive engineering is an area of sustainable development that requires engineers to have a sustainable thinking. However, the traditional automotive engineering education often only pays attention to the traditional knowledge and skills, and lacks the cultivation of sustainable thinking. Therefore, schools should pay more attention to cultivating students' sustainable thinking, such as through curriculum design, project cooperation or competition.

4. Teaching mode and practice cases

Automotive engineering education has always been an important part of the field of higher education, providing students with practical experience and skills to help them become a successful automotive engineer. However, traditional teaching models often lack practicality to allow students to truly understand the complexity and practical application in the field of automotive engineering. Therefore, the teaching model based on project learning has gradually become a popular teaching method.

The project-based teaching model refers to transforming the learning process into a project, and students need to complete the project through self-learning and cooperation. This teaching mode focuses on practice and application, which can make students better understand the practical applications in the field of automotive engineering.

The following is a teaching model and practice case based on project learning. Suppose that we are going to teach the students how to design and develop an electric car.

1) Learning goals

Students need to master the basic principles and design of electric vehicles, and to be able to design and develop an electric vehicle.

2) Teaching plan

First, the teacher will introduce the basic principle and design of electric vehicles, including the working principle and application of batteries, motors, electric control and other components. Students will then be divided into small groups, with each group responsible for designing and

developing a subsystem of an electric vehicle, such as a battery management system, a motor controller, etc. After completing the subsystem, the team needs to integrate the subsystems together and complete the design and development of the entire electric vehicle[7-8].

3) Practice cases

The following are the practical cases of project learning-based teaching mode in automotive engineering education:

If students need to design and develop an electric vehicle, follow the following steps:

Step1: Learn the basic principles and design of electric vehicles

Students need to learn the basic principles and design of electric vehicles, including the working principle and application of batteries, motors, electric control and other components.

Step 2: Make the project plan

Students need to make a project plan and define the project objectives, tasks and schedules.

Step3: Design and develop the subsystem

Students will be divided into small groups, with each group responsible for designing and developing subsystems of an electric vehicle, such as battery management systems, motor controllers, etc. After completing the subsystem, the team needs to integrate the subsystems together and complete the design and development of the entire electric vehicle.

Step 4: Test and evaluation

Students need to test and evaluate electric vehicles to ensure that they work properly and meet the design requirements.

The teaching model based on project learning has significant advantages in automotive engineering education. It focuses on practice and application, allowing students to better understand practical applications in the field of automotive engineering. At the same time, the teaching model based on project learning can also improve students' teamwork ability and problem-solving ability, which will help to cultivate future automotive engineers.

5. Effectiveness indicators and evaluation methods

Project-based learning (Project-Based Learning, or PBL) is becoming more and more widely used in automotive engineering education, and more and more educators begin to pay attention to its effectiveness. Effectiveness indicators and evaluation methods are important tools to measure the effectiveness of educational methods, and this paper will discuss in detail the effectiveness indicators and evaluation methods of project-based learning in automotive engineering education.

5.1 Validity index

1) Learning results

Learning achievement is the most direct and core indicator of measuring the effectiveness of educational methods. The learning results of project-based learning in automotive engineering education mainly include the following aspects:

(a) Knowledge and skills: Students can master the basic knowledge, principles, methods and techniques of automotive engineering related fields through project learning.

(b) Problem solving ability: students can use the knowledge they have learned, solve practical problems independently or in team, and improve their innovation ability.

(c) Teamwork and communication skills: Students can effectively communicate with team members, complete project tasks together, and improve their teamwork ability.

(d) Independent learning ability: students can actively consult materials, think independently, and study independently to cultivate good independent learning ability.

2) Learning process

The learning process is another important indicator to evaluate the effectiveness of educational methods. The learning process of the project learning in automotive engineering education mainly includes the following aspects:

(a) Learning interest: Students have a strong interest in the learning content of the project and actively participate in the learning activities.

(b) Learning motivation: Students have clear learning goals and strong learning motivation, and can continue to learn.

(c) Independent learning: students can actively refer to materials, think independently, and study independently to cultivate good independent learning ability.

(d) Learning atmosphere: In the process of project learning, students can form a good learning atmosphere, learn from each other and help each other.

5.2 Evaluation method

1) Student self-assessment

Students' self-assessment is one of the important means to evaluate the effectiveness of educational methods. Students can compare the evaluation indicators of learning results with the effect of project learning and put forward improvement measures.

2) Teacher evaluation

Teacher evaluation is another important means to evaluate the effectiveness of educational methods. Teachers can evaluate students' performance and learning results in the process of project learning, and put forward suggestions for improvement.

3) Third-party evaluation

Third-party evaluation is an effective means to evaluate the effectiveness of educational methods. Enterprises, industry experts and peers can be invited to evaluate the effectiveness of project-based learning in automotive engineering education and put forward suggestions for improvement.

4) Data-driven evaluation

Data-driven evaluation is a new approach to assess the effectiveness of educational methods. By collecting the students' learning data in the project learning process, the learning results and the learning process are quantitatively analyzed, and the improvement measures are put forward.

In short, the effectiveness index and evaluation method of project-based learning in automotive engineering education is a comprehensive evaluation system, which needs to be evaluated from multiple perspectives. Through effective evaluation, the paper can better guide the educational practice and improve the quality of automobile engineering education.

6. Conclusions and recommendations

6.1 Conclusion

Automotive engineering education based on project learning is a very effective method to improve students' practical ability, innovation ability, learning motivation and teamwork ability. In automotive engineering education, project-based learning has been proven to be a very effective method to help students to better understand and master the knowledge and skills of automotive engineering.

6.2 Suggestions

Research on the effectiveness of project-based learning in automotive engineering education has become a hot topic. With the continuous development and innovation of the automobile industry, automotive engineering education also needs to be continuously improved and innovated to meet the

needs of the society and the industry. As an effective educational method, project-based learning has many advantages, such as enhancing students' practical ability and innovative consciousness, and improving students' learning interest and motivation. Therefore, the research direction and prospect of future project-based learning in automotive engineering education are very important.

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