Application of Project-based Teaching in Instrumental Analysis Course

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Abstract. In this paper, the project-based teaching methods were applied to the course of analysis experiment. In the application of teaching content was designed as many independent projects, select the appropriate school teaching project, organize the project teaching activities in an orderly manner, and achieve the project teaching goals. The research showed that the application could stimulate students’ interest in learning, transform passive learning into active learning, improve students’ ability to analyze and solve problems in practice, fully mobilize students’ learning enthusiasm, strengthen the ability, improve students’ ability to analyze and solve problems and achieved good teaching effect.

Introduction

The change in the teaching method of this course can largely meet the new goals of teaching reform, help to complete the conversion of teachers and students, change the traditional single teaching mode of teacher-based teaching or presentation, and can restore students. In the protagonist status of learning, the teacher has become a bystander of teaching, mainly playing the role of supervision, assistance and auxiliary guidance. This teaching mode can maximize the opportunities for students to learn independently, think independently, and train independently. This method can effectively mobilize students’ enthusiasm and comprehensively exercise their various hands-on, communication, analysis, and cooperation skills. Ultimately promote the integration of self-quality.

Project Teaching Method

Project teaching method is a professional teaching method based on the action-oriented complete work process. The project teaching method is to allow students to complete a complete working process to learn professional knowledge and professional skills, and to achieve the connection among knowledge, the specific application of knowledge in production, the practice of skills in specific operations, and the extension and development of skills. It organically combines theory with practical teaching, train students to organize and implement the learning process.

From the perspective of professional and technical education, project teaching is an ideal method of teaching technology courses which is concentrated embodiment of the problem-oriented technology teaching model. The project teaching method is based on the project and can accommodate other teaching methods. It integrates and uses other professional teaching methods in the specific implementation of project teaching. The project is the selected result of the actual research of production, which comes from the actual production or life. Not only must it have certain applicability and teaching feasibility, but also have the carrying capacity of knowledge and skills. Through the process of project completion, students can learn relevant knowledge and master relevant skills. The project can be implemented in the school by setting up teaching scenarios, or it can be implemented in the actual production environment of the enterprise.

Enterprise Project-based Teaching

Project teaching generally can be divided into project teaching combined with the actual production of the enterprise and project teaching selected in the school according to the needs of teaching content. In enterprise project teaching, project is a learning process with a working nature. In
addition to learning professional knowledge and professional skills through the project, it can also cultivate students’ working attitude and enable students to acquire social adaptability through participating in social practice. At the same time, students can recognize and learn to use a variety of problem solving strategies and methods at different stages of the project. In enterprise project teaching, students can be exposed to complex task situations, and they can cultivate students’ self-organization and resilience. Enterprise project teaching is generally divided into five stages: determining the project, making a project plan, project decision-making, project implementation, and evaluation summary.

Project-based Teaching in Schools

The project-based teaching in school also basically has five stages of enterprise project teaching. The determination and selection of projects in the school are based on the training objectives of the talents. The projects that can not only combine professional knowledge learning with production practice, but also cultivate students’ engineering and technical abilities, should have a specific product as the result of the project. The project-based teaching method in the school must first select and design a suitable teaching project based on the training grounds of the school, the equipment and the actual situation of teachers, and according to the training equipment of professional knowledge and skills. The design of the school's teaching project focuses more on the comprehensive training of theoretical knowledge and practical skills.

Create a good learning atmosphere through project teaching to stimulate students' enthusiasm for learning. The project has trained students' professional skills, improved students' understanding of enterprise production requirements, and enhanced their adaptability to future work.

Instructional Design of Instrumental Analysis Project

Core knowledge and Skills of the Course

Instrumental analysis is a basic course for chemistry majors. The teaching content includes several methods such as optical analysis, electrochemical analysis, and chromatographic analysis. In order to help students better learn and master basic theory, basic calculations, and instrument operation, the course layout should follow the design from four sectors: entry projects, foundation projects, free projects and comprehensive projects. Among the entry projects, some classic analysis methods can be selected, which should be combined with the actual production of the enterprise as far as possible, and then integrated design and layout based on the content of the textbooks and national testing standards. This selection method can also effectively reduce the difficulty of reform and effectively promote the rapid development of the reform of instrumental analysis project teaching.

Project Teaching Task Design

In-school project teaching generally uses school-based teaching materials to design teaching projects and carry out project-based teaching. In the whole process of project teaching, the project is often broken down into multiple sub-projects or sub-tasks. The sub-projects or sub-tasks constitute periodic learning tasks and completion as the goal, so that students learn new knowledge based on existing knowledge and skills. In the teaching of instrumental analysis, the determination of the preservative sodium benzoate is used as the main training line to drive the study of the high-performance liquid chromatography process, the composition of the instrument, the basic operating procedures and the principles of separation. Task 1: Introduce the theme. Teachers will introduce the role of preservatives in food and the harm of preservatives that exceed the standard. The main training task of this project is to add the food additive sodium benzoate to the soy sauce produced by a food factory. Take several samples of soy sauce randomly. According to national health standards, test whether sodium benzoate exceeds the standard. Consider the following questions: (1) What are the main methods for measuring food preservatives? (2) What is the maximum amount of benzoic acid and sorbic acid in common foods? Choosing a test item that is close to life can stimulate students’ learning interest. Task 2: Study of related knowledge. Teachers
use PPT to explain the analysis process of high performance liquid chromatography in combination
with selected projects. The structure and use of HPLC are interspersed with students' speeches and
discussions. The abstract operation process from the content of the specific image to the detection
project makes it easier for students accept. Task 3: Students are grouped into groups of 3 to 5. Each
group consults relevant information based on what they have learned and the pre-class arrangement,
and proposes an experimental plan. The teacher selects several groups of students to explain the plan,
discusses between students, and the teacher proposes the feasibility of the process plan. Task 4:
Students perform experiments under the guidance of teachers, mainly completing the preparation of
reagents required for the project, pretreatment of samples and mobile phases, debugging of the
chromatograph, injection testing, and data processing. Teachers provide guidance during this process.
Task 5: Evaluation feedback, each group exchanges test results for evaluation, the teacher evaluates
each group, makes a comprehensive evaluation of the performance of each student during the
implementation of the experimental project, the teacher summarizes the knowledge points of the
project, and the student writes an experimental report. This link is mainly to allow students to learn
autonomous learning and inquiry learning, and cultivate teamwork spirit.

Project Teaching Method Design

In teaching method, one is "explain first, then practice." When students just start learning tasks,
they usually learn the content of the project before carrying out actual operations. Get professional
skills training and vocational skills training from theoretical learning to practical operation, learn
instrument usage methods and sample testing during the test try skills. Another method is "practice
first, then explain." On the basis of students already having certain professional knowledge and skills,
they can first carry out project practical operations, such as high-performance liquid chromatography
for the determination of sodium benzoate. Students first perform experimental tests under the
guidance of teachers, and explain based on instrument operation and data output. The composition of
the instrument, the working principle of each part and the parameter requirements of the components,
etc., can quickly complete the teaching task, and can fully mobilize the students' manual brain and
autonomous learning.

Project Teaching Considerations

Pay Attention to Application Problem Orientation

Project teaching method is suitable for analyzing and solving complex problems. The problems to
be solved in the project are related to the problems faced by the enterprise. From the process of asking
questions to guiding students to solve problems, develop students' ability to analyze and solve
problems. Proper implementation of project teaching methods can stimulate students' enthusiasm for
learning, and enable them to consciously learn and complete project training with high quality.

Pay Attention to Cultivate Autonomous Learning

Let students operate autonomously, complete the content of teaching projects independently, and
cultivate students' independent learning habits and learning abilities.

In project teaching, the learning process becomes a creative practice activity that everyone
participates in. Through this project, students must recognize and discover their abilities and at least
actively do it. They should use professional skills to complete project tasks and realize their ideas. Go
seek some knowledge that you want to know. The project teaching method aims to achieve the
independence of the organization and implementation of the students' learning process.

Project teaching focuses not only on the end result, but also on the process of completing the
project.

Pay Attention to Train Students to Make Full Use of Existing Experience and Knowledge

Students conduct practical learning in an environment close to the actual work environment, fully
explore the creative potential of students, and improve students' comprehensive ability to solve
practical problems. Particular attention is paid to the application and development of students'
self-experience. When discussing problems, let students fully express their opinions and suggestions. If differences of opinion arise, respect the students' opinions, recognize and solve problems in practice. Cultivate students' communication skills, emotional intelligence and organizational skills, and develop the ability to take responsibility.

**Pay Attention to the Project's Production Orientation**

School project teaching should pay attention to the project has a clear time stipulation, in the process of project practice, the application of enterprise production requirements or standards for management and requirements, and pay attention to training students' basic quality of enterprises.

**Pay Attention to Strengthen Teachers' Guidance and Monitoring Management**

In the course of implementation of the project teaching method, due to the group implementation method, monitoring and management must be strengthened. On this basis, the guidance of different basic students should be strengthened, so that students at all levels can gain, and improve the quality of teaching.

**Pay Attention to the Cultivation of Attitudes, Emotions and Values**

During the implementation of the project teaching method, the teaching goals must be completed. Groups of students work together to complete tasks, support, encourage and praise students for their solidarity and cooperation, pay attention to student emotions in teaching, pay attention to students' understanding of work, society, and work hard. Cultivate students' correct values and outlook on life. Only by combining knowledge and skills with a good working attitude can the professional work ability required by society be formed.

**References**


