

Practice Exploration of Term Project Teaching Method for Electric Elements of Power Plant Course

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Abstract: On the basis of analyzing the deficiency of the traditional assignment, the term project driven teaching method is proposed for electric elements of power plant. The differences in the content and depth of term project can be tailored to students at different levels. It is good for effectively promoting students to complete their assignments independently, exercising their comprehensive application design ability, and improving the learning effect. Taking the course of electric elements of power plant as an example, the term project research content and specific implementation steps is designed. Through the implementation of the term project, the advantages of the term project driven teaching method and its influence on the subsequent courses and practice of the major are analyzed.

1. The Deficiency of Traditional Assignment and the Proposal of Term Project Mode

1.1. The Deficiency of Traditional Assignment

The teaching of science and engineering courses is mainly based on the knowledge points in each chapter of the syllabus. The assignment is mainly reflected in strengthening the knowledge points, arranging the important concepts, calculation formulas and typical examples. The traditional assignment has some disadvantages in teaching.

1.1.1. Traditional Assignment Is Not Easy to Attract Students' Interest

The traditional assignment for strengthening knowledge points is mainly in the form of textbooks or after-school exercises. The specific types of assignment are choice, fill-in-the-blank and calculation, which are basically completed in the form of written homework. Such forms of assignment often make students less interested, more likely to be despised and cope with the treatment, resulting in knowledge points cannot be effectively understood and digested.

1.1.2. The Pattern of Uniform Assignment Content Has a Higher Potential Rate of Plagiarism

The forms of assignment are fixed, and the textbooks are updated less frequently, thus the exercises and assignment content assigned by the students of several classes have little change. At

the same time, the assignment content of the students in the class remains the same. As a result, some students do not pay attention to the assignment, and the potential assignment plagiarism rate is high when the assignment is submitted to complete the task ^[1]. It is not conducive for teachers to evaluate the real learning effect of students.

1.1.3. Traditional Forms of Assignment Often Fail to Exercise Comprehensive Application Ability

Teachers usually assign assignment in time according to the teaching content, but the assignment content of each chapter is relatively independent. Although each assignment can help students timely consolidate the knowledge points learned in the class, such assignment content usually fails to connect the knowledge points of each chapter from the overall consideration. It is not conducive to cultivate and exercise students' comprehensive design and application ability.

1.2. Teaching Reform of Term Project Mode

Based on the deficiency of the traditional assignment mode, teachers are actively exploring the term project mode in the teaching reform ^[2-4]. Compared with traditional assignment, term project has the following characteristics. First, the content setting of term project is flexible and personalized, which is easy to attract students' interest and facilitate students to complete their assignments independently. At the same time, it can improve the phenomenon of mutual plagiarism among students. Second, the term project integrates the knowledge points of multiple chapters of the course, and the completion time is longer than the traditional assignment. It is beneficial to cultivate and exercise students' comprehensive analysis, design and application ability. Thirdly, through the completion of term project, teachers can test students' learning attitude, diligence, knowledge acquisition and digestion, and this work improves the teaching effect.

2. Design of Term Project Content for College Specialized Course

The course of electric elements of power plant is an important course for electrical engineering ^[5]. Taking the course of electric elements of power plant as an example, there are three major contents for the term project, as shown in Figure 1.

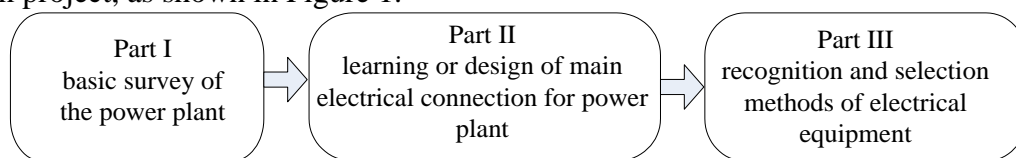


Figure 1: Term project content design

2.1. Part I for the Basic Survey of the Power Plant

The first part of the assignment design requires students to understand the basic situation of any power plant at home and abroad by means of internet search, literature review and other methods. This part focuses on cultivating students' ability of information collection, information sorting and processing. In this process, students can not only consolidate the types and characteristics of the power plant in Chapter 1 through their own information search, but also combine the knowledge of the textbook with the actual the power plant to learn the theoretical knowledge in the textbook better.

It can be seen from the term project report submitted that the students investigated a large number of power plants, involving more than 100 power plants in China, such as Neimenggu

Shangdu power plant, Tuanyulang power plant, Zhanghewan pumped storage power plant, etc. The type of power plant investigated involves hydroelectric power plant, thermal power plant and pumped storage power plant. The part I of term project has a good extension of the power plant type related knowledge of Chapter 1 of the textbook. This content cultivates the ability of information search processing and increases the students' knowledge.

2.2. Part II for Learning or Design of Main Electrical Connection for Power Plant

The course of electric elements of power plant mainly includes four contents. They are type and basic composition of the power plant, the characteristics and design of the main electrical connection, the selection method for electrical equipment in the main electrical connection, and the reasonable placement of these equipments in the power plant. The main electrical connection is the backbone and focus of the whole course. The second part of the term project focuses on the characteristics of the main electrical connection. Students are asked to further learn the main electrical connection of the power plant based on the basic information of the power plant. Learning the main electrical connection scheme of the power plant and drawing the main electrical connection scheme with professional drawing software. More competent students can choose to independently design 2 or 3 kinds of main electrical connection schemes of the power plant according to the content of Chapter 3 of main electrical connection design, and compare them.

It can be seen from the term project report submitted that most of the students completed the drawing of the main electrical connection diagram of the power plant. A small number of students independently designed the main electric connection 2 to 3 schemes, and selected the best scheme. Students of different levels choose different difficulty levels to complete the term project according to their own conditions. The core contents of the main electrical connection scheme of each student in the class for 118 students are not repeated, which realizes the independent completion of the term project and cultivates the comprehensive engineering design ability.

2.3. Part III for Recognition and Selection Methods of Electrical Equipment

The voltage level of the main electrical connection of the power plant is high ^[6-7]. The high voltage electrical equipment connected to the bus can be tens or hundreds of thousands of volts. Such high voltage electrical equipment can only be learned from books, and the students hardly have close contact and operation of the real equipment. In class, the students are not familiar with high-voltage electrical equipment, which is not conducive to in-depth understanding of the selection and calculation process of electrical equipment. Hence, it is a difficult point in the teaching process. In the third assignment, students are required to collect at least 4 physical pictures of any kind of electrical equipment in the main electrical connection of the power plant. For example, if the electrical equipment the student chooses to recognize is a circuit breaker, the student will collect pictures of the circuit breaker to have a comprehensive and in-depth understanding of this electrical equipment. On the basis of the above work, students are further required to explain the selection method of the electrical equipment corresponding to the collected objects, and talk about the understanding and knowledge of this electrical equipment.

The electrical equipments collected by the students from the term project report included generators, main transformers, house service transformers, circuit breakers, arresters, high voltage fuse, isolation switches and electric reactors. Circuit breakers and main transformers are the most popular among students. The students collected a lot of pictures of electrical equipment. Parts of physical electrical equipments collected by the students are shown in Figure 2. The pictures were organized by the teacher and displayed to the students. The students learned from each other and had a new understanding of electrical equipment through the physical pictures of the power plant

equipment. In the process of searching for pictures of objects, students can explore actively, which is conducive to improving their interest in learning. By collection and learn of the electrical equipment, students can deepen their understanding of theoretical method of the equipment selection in class, so as to improve the class teaching effect.

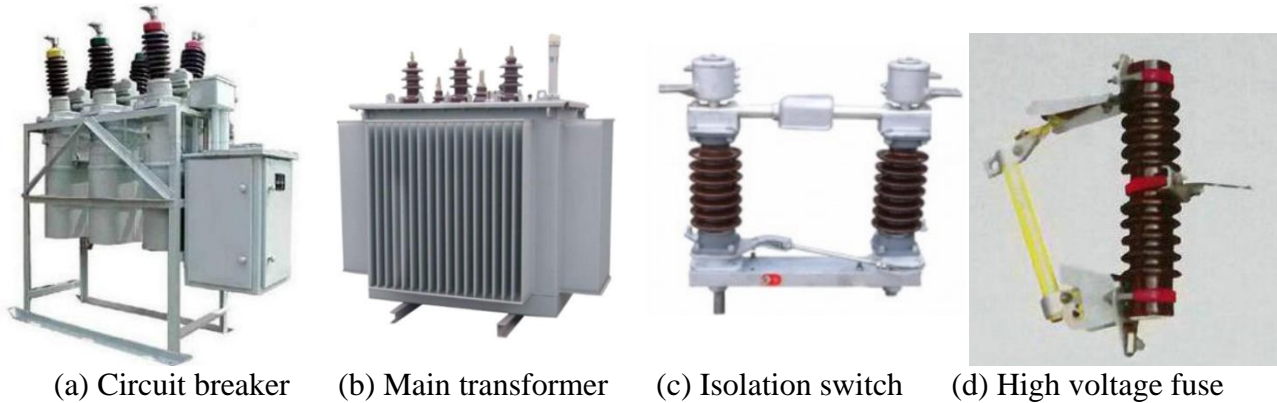


Figure 2: Physical display of part of electrical equipments collected by the students

3. Advantages of Term Project Teaching Mode

3.1. Personalized Content of the Assignments Is Conducive to Promoting Students to Complete Assignment Independently

The content of the term project is personalized, and the content of each student in the class is different. No one can copy from each other directly like traditional assignment. This forces students to focus on term project and encourages them to spend some time in searching literature, reviewing what has been taught in class, thinking positively, and working diligently and independently on term project. At the same time, the term project model encourages students to explore in the learning process. In the design of the term project content, students are encouraged to decide the topic content independently under certain conditions. For example, in the first part of the term project, some students did not survey and outline the existing domestic and foreign power plants. Instead, they set up the basic data of a power plant based on their own understanding of the types of power plants, and independently designed the main electrical connection of the power plant based on the setting basic data. Term project can not only improve students' learning interest, but also make students gain confidence after completing the design independently, which is conducive to improving the initiative of learning.

3.2. The Difference of Content Depth Is Beneficial to Improve the Learning Effect of Students

There are individual differences among students. Some students feel easy, while others feel it difficult. Therefore, it is very necessary to arrange assignment in different levels^[8-9]. The term project content is designed in layers for students with different learning abilities, so that students at different levels can choose the assignment content suitable for their own difficulty. Depth differentiation of content is beneficial to improve the learning effect of students.

(1) Part I of the term project

Students at the first level only need to investigate and master the basic overview of any power plant at home and abroad, including the position of the power plant in the power system, the number and capacity of generator units, voltage level, load and other information. In addition to the basic information, Level 2 students should try their best to grasp more information of the power

plant they are investigating. Taking the generator set as an example, the students at the first level only need to know the number and capacity of the generator set, while the students at the second level should also master the model and rated parameters of the generator set. On the basis of comprehensively mastering the basic situation of the power plant investigated, the third level students can combine with the textbook, summarize the characteristics of the power plant, and draw up the basic information of a power plant to be planned and designed from the designer's perspective.

(2) Part II of the term project

Students at the first level only need to learn the existing investigated main electrical connection of the power plant and draw it with professional drawing software. The students of the second level can independently design 2 or 3 kinds of main electrical connection schemes of the power plant investigated according to the content taught in class, and then draw the main electrical connection diagram. Students at the third level can not only independently design 2 or 3 kinds of main electrical connection schemes, but also complete the comparative analysis of schemes from the three perspectives of reliability, economy and flexibility, and then draw the optimal main electrical connection diagram.

(3) Part III of the term project

First level students collect the physical pictures of the electrical equipment of the main electrical connection, and simply understand the characteristics of the electrical equipment and the method of equipment selection. Students at the second level learn the electrical equipment corresponding to the collected pictures in depth, summarize the characteristics of the electrical equipment, and master the selection method of the electrical equipment. Compared with the students of the former two levels, the students of the third level can expand to two or three kinds of electrical equipment, so as to fully master the characteristics and selection methods of multiple electrical equipments.

3.3. Term Project Is Conducive to Teachers' Fair Evaluation of Students' Attitude and Effect

The learning attitude, diligence, knowledge acquisition and digestion reflected in the term project provide a reference for judging for teachers to fairly evaluate the learning effect of students. The term project mode is conducive to optimizing the assessment method of the course examination. The assessment composition of the course of electric elements of power plant is shown in Figure 3. Compared with the traditional assignment mode, the assessment adjustment of the term project mode is as follows:

(1) Moderate reduction of final examination results

Some students usually do not work hard, but they make a surprise battle when it is close to the exam. Although sometimes they can get a good score, the short-term attack usually is not good for mastering knowledge well. The score of final exam written test is reduced appropriately, and the assessment score in the learning process is improved. It promotes students to take seriously in the whole learning process, which is conducive to students really grasp the knowledge of the course.

(2) Moderate reduction of regular results

The regular grade consists of attendance and class performance. However, due to the large number of students in class, it is difficult for teachers to grasp the real learning status of most of the students except those who actively perform in class. Hence, their regular grade score is reduced from 20 points to 15 points.

(3) Improvement of the assessment score of the learning process by adding the term project

The content of term project design runs through the whole learning process, and it is easier for teachers to assess students' learning attitude, and diligence through the completion of term project. Compared with most of the other students except those with active performance in class, the term

project can be more objective to score and evaluate the learning status of these students. The term project is set at 15 points.

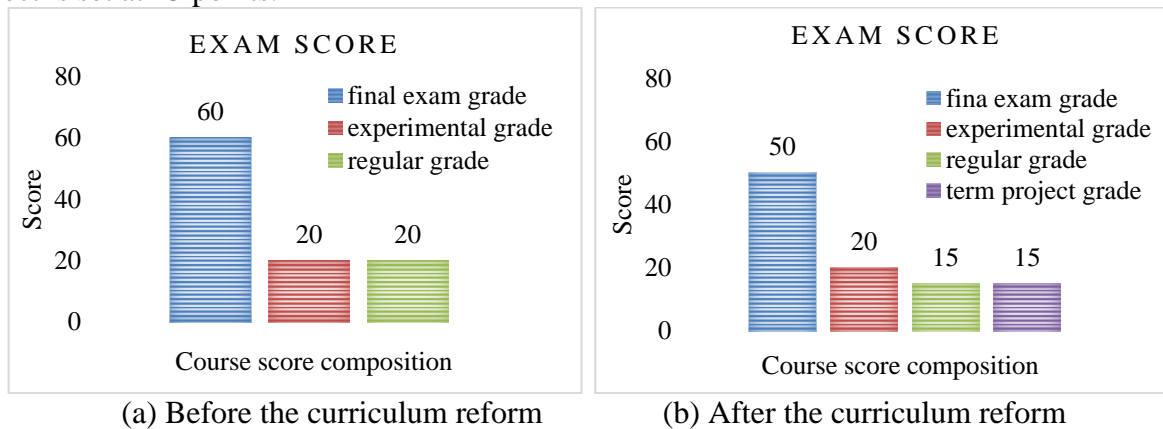


Figure 3: The diagram of the score adjustment of course assessment distribution.

4. The Influence of the Term Project in Electric Elements of Power Plant on the Subsequent Study of Its Major

Taking the electrical engineering and automation major of the school of mechanical and electrical engineering of Heilongjiang University as an example, the term project design content of the electric elements of power plant can not only improve the teaching effect of this course, but also have a certain impact on the subsequent study of its major.

4.1. Training the Ability of Writing Report Format Is Conducive to the Writing of Subsequent Course Reports

Course reports are an important way to demonstrate research outcomes and personal abilities [10]. In addition to the assignment of the report content, the teacher also explained to the students the integrity of the report, the size, line spacing and other typesetting precautions, especially the writing standard of the chart and table. The course of electric elements of power plant is a major course in the third year of university. The subsequent courses that need to write reports include professional course design report, professional orientation training, production practice report and graduation design paper report, etc. The completion of the term project of this course can improve the ability of writing the report format, which is conducive to the writing of the subsequent course report.

4.2. The Content of the Term Project Can Be Expanded to the Content of the Diploma Project

On the one hand, the introduction of term project can consolidate the theoretical foundation of the course of electric elements of power plant. On the other hand, the enhanced version of term project can be directly extended as the topic of diploma project, and it brings benefits to students who have relatively short time for postgraduate entrance examination and job hunting in the fourth year of university. The topic about the power plant for diploma project usually includes introduction, main electrical connection scheme design, short-circuit current calculation and electrical equipment selection. The term project involves the basic information and most of the main electrical connection scheme design, involving part content of the electrical equipment selection and short circuit current. Further dig and perfect of the term project can be used as the diploma project topic. Take the author as an example. The author supervises 8 students in 2019 to do their undergraduate diploma project, and 5 of them selected topics from the extension term project. The postgraduate

examination is in December, and the diploma project is from November to May. The diploma project coincides with the review of the postgraduate examination from November to December. Among the 5 students, 4 students said that they can focus on postgraduate review in November and December. They will work hard on diploma project after the examination in December. Because of the basis of term project, the diploma project can be successfully completed. That is, the student can pursue dreams by reviewing for the postgraduate entrance examination, and they do not lag behind the progress of the diploma project. The implementation of the term project has played a positive role. Another student said that he would take part in the exam of state grid corporation of China. The term project content is not only helpful for the completion of the diploma project, but also helpful for improving the score of the state grid corporation of China exam.

4.3. The Term Project Is Conducive to Improving the Learning Effect of the Practical Teaching of the Major of Electrical Engineering

The follow-up practice teaching of electric elements of power plant in Heilongjiang university includes professional orientation training and production practice. About 20 % of the topics in the professional orientation training practice course are designed about the power plant every year, and the term project content is conducive to improving the learning efficiency and training effect of these students. At present, the production practice of electrical engineering major is arranged in Mudanjiang Bohai hydropower plant for three weeks. In the process of production practice, the study on term project will play a positive role in learning the main electrical connection form of the power plant, visiting and learning the power electrical equipments of the power plant, and understanding and mastering the physical electrical equipments in the power plant.

5. Conclusions

The comprehensive and designed term project mode of the course is conducive to improving students' interest and promoting students to complete assignment independently through content differentiation and personalized assignment. The content of the term project can effectively integrate the knowledge points in each chapter of the course, which promotes the students' understanding of the theoretical knowledge of the electric elements of the power plant, and exercises the ability of engineering design and comprehensive analysis. The implementation of term project can not only improve the teaching effect, but also play a positive role in the practical teaching of the specialty.

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