Analysis of the function of course groups for material science and engineering specialty under the background of engineering certification

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Keywords: Engineering certification, Course group, modular, Materials science and engineering

Abstract: Engineering certification highlights the three major theories of "Student-Centered, Outcomes-based Education and Continuous Improvement". The course group, as a modular division of the course system, is conducive to the cultivation of students' comprehensive quality. In this paper, based on materials science and engineering specialty course system as an example, the course of the implementation of OBE concept, course system optimized, the curriculum target optimized, teaching reform promoted and continuous improvement are analyzed. The curriculum system is divided into course groups, research shows that the effectiveness of teaching has been improved, it has a very obvious effect on improving students' comprehensive ability through the course of operation.

1. Introduction

The course group is characterized by modularization and composed of several related or similar single courses[1-2]. It has the characteristics of reasonable structure, mutual correlation, mutual dependence and mutual influence. The course group is not limited to how many courses there are. In order to reach a certain goal, it fully embodies the curriculum knowledge, methods, requirements between logical link for spot. It forms a relatively independent curriculum system for the same subject or interdisciplinary courses design and integration, which reflects the meaning of a course to another course in the same group.

For a professional curriculum system, there are four different types of courses including math and science classes, engineering foundation, professional basic and professional courses, engineering practice and graduation design (paper), and a general education courses in the humanities and social sciences, but this classification does not reflect the connection between the various courses[3-4]. The course groups can realize the modular management, and the relationship between courses is very clear. In addition, the curriculum group plays a very obvious role in realizing the three concepts of engineering certification, optimizing the curriculum objectives and promoting the curriculum teaching reform.

2. The role of course groups

In the context of engineering certification, course group plays a more important role. Specifically, course group plays an irreplaceable role in the following aspects.

2.1. The curriculum is more conducive to the implementation of the OBE concept

Outcome based Education (OBE) is also called outcome oriented education, ability oriented education, goal oriented education or demand oriented education[5-7]. OBE education concept is a construction concept of curriculum system based on results-oriented, student-oriented and reverse thinking [1]. As an advanced educational idea, results-oriented education is the correct direction of higher engineering education reform. After modularizing the curriculum system, the results-oriented form is clearer and easier to implement. The course material performance and the test curriculum group is formed by several courses including “Material Properties”, "Material Mechanics", “the Material Analysis and the Research Method”, “the Material Preparation, Processing, and

  DOI: 10.25236/aeiit.2022.018

Comprehensive Practice Performance Test", "the Material Engineering, Virtual Simulation and Comprehensive Practice". The output goal is clear, which is through the study of these courses, students are required to master the material performance characteristics, being able to use certain instruments and equipment for detection and characterization. After the establishment of the curriculum group, teachers engaged in teaching can clearly understand how to implement output-oriented teaching. Meanwhile, they also know the role of different courses in the curriculum group and how to organically connect different courses to truly realize the OBE concept.

2.2. The curriculum group is beneficial to optimize the curriculum system

The curriculum system of materials Science and Engineering is to realize the cultivation of materials talents, including the direction of metal materials and inorganic nonmetals. In the process of reverse design of the curriculum system under the concept of OBE, all elements of the curriculum are arranged and combined. In the dynamic process, all curriculum elements are unified to realize the training goal of materials application-oriented senior professionals. The curriculum system is the carrier to achieve training objectives, which is the key to ensure and improve the quality of education. As the curriculum system is a relatively large project in the talent training program, the curriculum group obviously plays a very important role in how to realize the optimization of the curriculum system. In the construction of the curriculum system, a certain curriculum group should be constructed according to the training objectives first, and then courses of different nature should be placed in the curriculum group. Through repeated discussion and argument, the assimilation phenomenon of some courses can be effectively avoided, so as to realize the goal of the optimization of the curriculum system.

2.3. Group of courses helps to optimize course objectives

Course goal refers to the specific goal to be achieved by the course itself, which is the degree that students at a certain stage of education are expected to achieve in knowledge, intelligence, morality, physique and other aspects after learning the course. In order to achieve different teaching objectives, different courses will set different course objectives. However, some courses do not take the relationship with other courses into consideration when setting the course objectives, so they are not comprehensive enough. In view of this, the course objectives can be optimized from the perspective of course group. For example, "Material Analysis, Testing and Research Methods", which is one of the core courses of material Science and Engineering, two course objectives are set. One of the course objectives is to master the basic principles and application methods of modern material analysis and testing techniques commonly used, such as electron microscopic analysis, XRD, spectral analysis and thermal analysis. Modern materials analysis and testing equipment can be able to correctly be selected and be used to analyze and study complex engineering problems in the field of materials. The graduation requirement is "Indicator Point 5.2: Modern instruments, engineering tools and information technology tools can be able to correctly be selected and be used to analyze, research and calculate complex engineering problems in the field of materials". Engineering certification evaluation expert thinks that the connotation of the objective of this course, can not fully support the corresponding contact graduation requirements index points, influence graduation requirements related to achieve effect. Because this course belongs to the material performance and the test curriculum group, course objectives cannot be set in isolation. And then the course group of all the teacher are called together to discuss the course objectives. Finally the course objectives are adjusted into " microscopic analysis, XRD, spectral analysis, thermal analysis must be mastered to analyse materials such as the basic principle of modern analytical techniques and the using method, correctly choosing and using modern materials analysis test instruments and equipment, which can be able to take advantage of modern analysis software, or map, images, and other test results; which can also be able to research and design test schemes for complex materials and analyze and calculate complex test results for material preparation and performance testing results." Later, the rationality of the course objective was recognized during the examination of the expert group. Thus, it can be seen that the use of the collective wisdom of the course group, is to optimize the course objectives, so as to achieve better results.

2.4. The curriculum group is conducive to promoting teaching reform

With the development of The Times, more and more advanced teaching method applied in the teaching, such as blended teaching, split classroom, flipped classroom, etc., the commonness of the teaching method is the potential to activate the classroom teaching, fully exert students' subjective initiative, which make students become active learners, rather than the past "cramming" passive. Due to the unique advantages of the course group, teachers in the same course group can conduct fruitful discussions with each other through mutual observation or open classes, so as to explore the most effective teaching methods and means suitable for individuals. With the increasingly strict management of classroom effectiveness in colleges and universities, it further urges teachers to continuously strengthen teaching reform and improve the quality of classroom teaching. So course group can undoubtedly play a very beneficial role as a link.

2.5. The curriculum is conducive to continuous improvement

Continuous improvement is one of the core concepts of engineering education certification, which runs through teacher education, student learning, talent cultivation plan formulation, curriculum system construction, teacher team construction and support conditions guarantee, etc. For a single class, it can be obtained continuous improvement in teaching methods, examining ways, evaluation process, evaluation results analysis, but after all, a course hit a range of knowledge is limited, if only for a course itself to obtain continuous improvement, it is easy to split is closely linked with other courses, leading to continuous improvement is one-sided. Therefore, it is necessary to carry out continuous improvement in the form of a group of courses. Take "Heat treatment Principle and Process" as an example, it is closely related to the first course "Fundamentals of Materials Science", and closely related to the follow-up course "Engineering Materials". The knowledge of pearlite transformation, bainite transformation and martensite transformation in Heat Treatment Principle and Process needs the professional knowledge of solid phase transformation and diffusion in Fundamentals of Materials Science, and also provides the basis for material selection and heat treatment means in Engineering Materials science. Therefore, in the continuous improvement of the learning effect of Heat Treatment Principle and Process, we can make use of the role played by the course group, which can not only put forward some requirements for the knowledge framework of Fundamentals of Materials Science, but also pave the way for the knowledge framework of Engineering Materials Science. In this way, to ensure the continuity and effectiveness of students' learning, effectively reduce the burden of students' learning.

3. Course Group construction

3.1. Course group building process

At present, all colleges and universities are promoting teaching reform, among which the integration and optimization of curriculum system is particularly important. In teaching, how to effectively improve the teaching quality of the course, so that students can get their expected knowledge and ability through the learning of the course, must form advantages in the course construction through continuous practice and exploration, under this background, the formation of characteristic course group emerges at the historic moment. In fact, the purpose of course group construction is to better solve the contradiction of more teaching content but less class time, at the same time to strengthen the cultivation of students' self-study and hands-on ability, and complete the training of vanadium and titanium material professionals. The major of materials science and engineering is mainly divided into two directions: metallic materials and inorganic nonmetallic materials. Except for some general courses and subject foundation courses, other courses are carried out by the faculty of the department. The scale of course group construction should neither be too large nor too small. If it is too large, it will lose the characteristics of the course group itself, and it is difficult to promote the effective operation of the course group. If it is too small, the knowledge framework will certainly not be complete, so it will lose the significance of building the curriculum

group. Through careful analysis and sorting of the curriculum system, 9 course groups are finally determined. See Table 1 below for the specific grouping of course groups.

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Tab.1 Course group and responsible person

Serial Number	Course Group Name	Curriculum within Course Group	Course Group Leader
1	Chemistry class	Material Chemistry, Material Chemistry Experiment, Physical Chemistry, Physical Chemistry Experiment, Analysis and Inspection Professional Skills Practice	MS. Ma
2	Machinery class	Engineering Drawing and CAD, Fundamentals of Mechanical Design, Fundamentals of Mechanical Design, AutoCAD	Mr. Wu
3	Management class	Engineering Project Management, Safety, Environmental Protection and Energy Saving Project	Mr. Zhang
4	Basic materials science class	Fundamentals of Materials Science (experiments included),Fundamentals of Materials Engineering (experiments included), Principles of Inorganic Nonmetallic Materials Synthesis, Fundamentals of Heat Transfer, Frontiers of Disciplines	Mr. Wang
5	Heat treatment of metals class	Heat Treatment Principle and Process, Metal Heat treatment Experiment, Engineering Material Science	Ms. Sun
6	Process and equipment class	Material Preparation and Processing, Inorganic Nonmetal Synthesis Principle, Titanium and Titanium Alloy/Vanadium Titanium Product Production Process and Equipment, Heat treatment Workshop Design/Introduction to Inorganic Nonmetal Factory Design	Mr. Li
7	Material properties and testing class	Material Properties, Material Mechanics, Material Analysis, Testing and Research Methods, Comprehensive Practice of Material Preparation, Processing and Property Testing, Comprehensive Practice of Material Structure Microscopic Analysis, Comprehensive Practice of Material Engineering Virtual Simulation	Mr. Chen
8	Design, practical training, science and technology class	Graduation Project (thesis), Material Science and Engineering Course Design, Product Engineering Training, Scientific and Technological Literature Retrieval, Material English	Mr. Peng
9	Internship class	Understanding Practice, Production Practice, Graduation Practice	Mr. Yang

3.2. Analysis of course group operation results

After the course groups are functioning effectively, teachers and students are very satisfied with the modular management of the course. The teachers can play the role of the course syllabus for the reasonable establishment with the help of curriculum group, then they will use a variety of effective teaching methods in the teaching, improve the teaching effect. The teachers will pay attention to what they teach that course before the knowledge system. After the operation of course group, the teachers will pay more attention to what they teach that class, which forms a connecting link between the preceding. After using the group of effective communication, they have a deeper understanding of the courses they teach, and what is more commendable is that many teachers have sublimated their understanding of the continuous improvement of the courses, and the measures for continuous improvement are no longer confined to the courses they teach. Quite a few students have more self-confidence for professional learning, they believe that knowledge of the course system is more reasonable, some professional knowledge of repetition is also avoided. They have more time and energy to think about how to improve the ability of the individual, including the ability to analyze and solve complex engineering problems and practical ability.

4. Conclusions

Through the analysis and research of the curriculum group, the following conclusions are drawn:

(1) In the context of engineering certification, curriculum group plays an important role in realizing the three concepts, so curriculum group should be vigorously constructed.

(2) Curriculum group plays an important role in implementing OBE concept, optimizing curriculum system, optimizing curriculum objectives, promoting teaching reform and continuous improvement.

(3) The curriculum group should be built according to the internal relationship of different courses. After the operation of the curriculum group, it has been recognized by teachers and students, which fully shows that the construction of the curriculum group is necessary.

This paper is grateful for the key project of University-level teaching research and Education reform of Panzhihua University, "Construction and Implementation of Curriculum System of Materials Science and Engineering Under the Background of Engineering Certification". The project number is JJ2004-2020.

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