

On the Role of Science and Technology Innovation in the Curriculum System Based on Engineering Certification

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Abstract: Under the background of engineering certification, the curriculum system is an important link to realize the concept of engineering certification. Many colleges and universities attach great importance to the supporting role of science and technology innovation on the concept of engineering certification. Based on the analysis of the important role of science and technology innovation, the implementation of the graduation requirement index point analysis is discussed in this paper by taking "Material Engineering Design Competition" as an example. The results show that it is necessary to set up science and technology innovation links in the curriculum system under the background of engineering certification.

1. Introduction

Curriculum system is the guiding ideology of teaching activities in colleges and universities, the concretization and support of training objectives, and it stipulates the planning scheme for the implementation of training objectives. The curriculum system is mainly composed of specific curriculum objectives, curriculum content, curriculum structure and curriculum activities. Scientific and reasonable setting is the basis to support the achievement of graduation requirements. According to the requirements of engineering certification, four categories of courses must be set up for the curriculum system: general education (humanities and social science courses), basic education (mathematics and natural science courses, engineering basic courses and professional basic courses), professional education and practical education, which support 12 graduation requirements from different aspects. In order to adapt to the new situation, the traditional curriculum system and teaching content of material science and engineering must be reformed^[1-4].

With the rapid development of modern high technology, higher requirements are put forward for undergraduate education. On the one hand, it is necessary to strengthen the cultivation of students' basic theories, basic knowledge and basic skills, and on the other hand, it is necessary to strengthen the cultivation of students' innovative ability. The cultivation of college students' innovative ability is mainly achieved through creative curriculum system and teaching content^[5-7]. Under the background of engineering certification, in order to cultivate innovative talents, it is necessary to carry out scientific and technological innovation activities for college students. Various scientific and technological competitions and extracurricular scientific and technological activities for college students can cultivate students' innovative spirit, stimulate their learning potential and creativity. It plays a positive guiding role in improving students' scientific thinking, innovation ability, team spirit, practical problem solving and practical ability, etc. Generally, colleges and universities have all included them in the second classroom teaching links, and rarely included them in the curriculum system^[8-12]. Therefore, it is a beneficial attempt to introduce innovation into the curriculum system.

2. The implementation of scientific and technological innovation

2.1. The significance of the implementation of science and technology innovation link

In order to promote the innovation and entrepreneurship education of college students, strengthen the training effect of innovation and entrepreneurship ability, and cultivate innovative and entrepreneurial talents to meet the needs of the construction of an innovative country and the development of all walks of life, the university has issued the Project Management Measures for the Innovation and Entrepreneurship Training Program for College Students of Panzhihua University. The course "Material Engineering Design Competition" set by this major belongs to the innovation training project, and all students of this major must participate in it. This course focuses on engineering design of one or several important links in the production process of a product. Through the material engineering design competition, the students are educated in modern engineering design ideas and design methods. In addition, students can understand the basic content, design procedures and methods of material science design, so as to improve their engineering design and calculation ability. Therefore, by the link of scientific and technological innovation students can be trained to establish the perspective of economy, security, environmental protection and sustainable development, students' ability of drawing can be cultivated by means of computer aided design, and also to solve engineering problems with comprehensive application of all aspects of knowledge and skills, engineering consciousness, innovation consciousness and team spirit, so as to achieve the graduation requirements.

2.2. Science and technology innovation link implementation process

The "Material Engineering Design Competition" is implemented in the form of a team, mainly organizing students to participate in scientific research, development or design work, and cultivating students' innovative thinking, practical ability, expression ability and team spirit. For specific operation, students are organized in teams of 4 to 5, and each team is equipped with an instructor. "Material Engineering Design Competition" mainly trains students to understand the research background and development situation of a specific new material through literature retrieval and analysis, master its production process, choose appropriate equipment for the production of qualified products, and then design the layout of workshop or workshop in line with the production scale. Through a series of design processes, finally get a reasonable and useful conclusion; In the process of design, students should also understand the impact of engineering practice in the field of material science and engineering and solutions to complex engineering problems on society and environment. Therefore, students' team spirit, professional ethics and other qualities, as well as their communication and communication skills, are fully cultivated in the process of material engineering design.

2.3. Evaluation of the implementation of science and technology innovation

The innovative practical teaching activities completed in the form of team in the "Material Engineering Design Competition" are shown in Table 1, which involve teaching content and teaching methods as well as assessment and performance evaluation methods. The performance evaluation method adopts three assessment links: "usual performance (10%)", "design works (40%)" and "defense (50%)". Reverse design according to the output-oriented OBE philosophy for the four graduation requirements of the course (7. Environment and sustainable development, 8. Professional norms, 9. Individual and team, and 11. Project management) are decomposed into four graduation requirements index points. Accordingly, four course objectives are determined, as shown in Table 2.

The assessment methods and weight allocation for the course objectives are shown in Table 3, and the scoring standards for design works and defense are shown in Table 4.

Table 1 Innovative practice teaching activities of materials engineering design competition completed in the form of team

Name of the link	Content requirements and teaching methods	Credits (/hours or weeks)	Assessment and assessment methods
Material Engineering Design Competition	<p>Content requirements: according to the design task, consult the relevant materials, demonstrate and select the process method, write the process design demonstration report, and determine the final process flow; For material balance and heat balance calculation, complete the design calculation and selection of main equipment, using the software with the control points of process flow diagram (including instrument and the design of the automatic control system), use software rendering the workshop equipment layout, use of workshop safety and technical knowledge, workshop safety measures are put forward (fire, explosion, gas and labor protection). Make use of the knowledge of environmental protection, put forward effective measures for the treatment of three wastes in the production of the product, make the economic and technical budget of the product (estimate of project investment budget and product cost, estimate of environmental protection related expenses), complete the writing of the design specification, arrange and bind the drawings according to the standard.</p> <p>Teaching method: teachers guide + students work independently in a team.</p>	2 credits /2 weeks	<p>Assessment content: daily performance, design works, defense.</p> <p>Grade composition: performance evaluation score ×10%, review and review of design works ×40%, defense team score ×50%.</p>

Table 2 The corresponding relationship between the course objectives and graduation requirements of the Material Engineering Design Competition

Graduation requirements	Indicator points for graduation requirements	Teaching objectives of the Engineering Design Competition
7. Environment and Sustainable development: able to understand and evaluate the impact of professional engineering practices on the sustainable development of society, resources and the ecological environment in response to complex engineering problems such as material design, preparation and processing.	Index 7.2: From the perspective of environmental protection and sustainable development, can think and evaluate the possible damage and hidden dangers to human beings and the environment caused by engineering practices of complex engineering problems of materials.	Course Objective 1: In material engineering design, I can correctly understand the relationship between engineering practice to solve complex engineering problems and environmental protection and sustainable development, and can analyze and evaluate the losses caused by environmental damage from the economic level.
8. Professional norms: have humanities and social science literacy, social responsibility, can understand and comply with engineering professional ethics and norms in the practice of material science and engineering, and fulfill social responsibilities.	Index 8.3: Understand the engineer's social responsibility for public safety, health and environmental protection, and be able to fulfill the responsibility consciously in engineering practice.	Course Objective 2: To fully understand the significance of safety, health and environmental protection in the practice of material engineering design, and to undertake the corresponding social responsibilities.
9. Individuals and teams: Able to assume the roles of individuals, team members, and leaders in a multidisciplinary team setting.	Index 9.2: Ability and quality as an individual, team member or leader in a team, able to take on corresponding roles in a multi-disciplinary team and work independently or cooperatively.	Course Objective 3: In the process of material engineering design, we can give full play to the role of individuals and cultivate the ability and quality of different roles in the team. We should not only highlight the ability and quality of individuals, but also pay attention to strengthen cooperation in the work.
11 Project management: Understand and master engineering management principles and economic decision-making methods, and can be applied in a multidisciplinary environment.	Index 11.1: Understand and master the basic knowledge of management principles and economic decision-making methods involved in material engineering projects.	Objective 4: To master the basic knowledge of engineering project management principles and economic decision-making methods involved in the process of material engineering design.

Table 3 Assessment methods and weights of course objectives in Material Engineering Design Competition

Course objectives	Support the graduation requirements indicator points	Assessment links and Composition of results (%)		
		Performance at ordinary times	Design work	Plea
Course Objective 1	Graduation requirement index point 7.2	20	30	30
Course Objective 2	Graduation requirement index point 8.3	30	20	20
Course Objective 3	Graduation requirement index point 9.2	15	20	30
Course Objective 4	Graduation requirement index point 11.1	35	30	20
Total		100	100	100

Table 4 Scoring standards of Material Engineering Design Competition

Course Objectives	Scoring standards					Weight(%)	
	90-100	80-89	70-79	60-69	0-59	works	Plea
Course Objective 1	It can fully express the relationship between complex engineering problems and environmental protection and sustainable development, calculate the relevant economic indicators in detail, and analyze and calculate the environmental losses caused.	It can express the relationship between complex engineering problems and environmental protection and sustainable development, calculate the relevant economic indicators, and analyze and calculate the environmental losses caused.	It can basically express the relationship between complex engineering problems and environmental protection and sustainable development, can calculate relevant economic indicators, and can basically analyze and calculate the environmental losses caused.	It can basically express the relationship between complex engineering problems and environmental protection and sustainable development. The calculation of relevant economic indicators is not complete, and the analysis and calculation of environmental losses caused are not sufficient.	It cannot express the relationship between complex engineering problems and environmental protection and sustainable development. It does not calculate relevant economic indicators. It does not analyze and calculate environmental losses from the economic level.	30	30
Course Objective 2	In material engineering design, safety, health and environmental protection are fully reflected, and a strong social responsibility is expressed.	In material engineering design, safety, health and environmental protection are fully reflected, and corresponding social responsibility is expressed.	In material engineering design, safety, health and environmental protection can be basically reflected, and corresponding social responsibility can be basically expressed.	In material engineering design, safety, health and environmental protection are reflected, and corresponding social responsibility is expressed.	In material engineering design, safety, health and environmental protection are not reflected, and corresponding social responsibility is not expressed.	20	20
Course Objective 3	In the process of material engineering design, we give full play to the role of individuals, with outstanding individual ability and quality, and pay special attention to strengthening team cooperation.	In the process of material engineering design, give full play to the role of individual, individual ability and quality are outstanding, and pay attention to strengthen team cooperation.	In the process of material engineering design, I can play an individual role, with outstanding individual ability and quality, and also pay attention to strengthening team cooperation.	In the process of material engineering design, I can basically play an individual role, with average individual ability and quality, and average teamwork.	In the process of material engineering design can not play the role of individual, individual ability and quality is poor, lack of team cooperation.	20	30
Course Objective 4	The economic decision-making method and engineering management principle knowledge are properly applied in the design scheme, and the results have good practical value.	It is of practical value to apply the economic decision-making method and the knowledge of engineering management principle properly in the design scheme.	It is of practical value to apply the economic decision-making method and the knowledge of engineering management principle properly in the design scheme.	Using certain economic decision-making method and engineering management principle knowledge in the design scheme, the result has certain practical value.	Economic decision-making method and engineering management principle knowledge are not applied in the design scheme.	30	20

Based on the group assessment of 35 students in the class, the scatter diagram of their achievement of each course goal is drawn as shown in Figure 1, and the achievement value is set as

0.65. It can be seen from the figure, except for a few scattered data of the achievement value of course goal 1 below or near 0.65, it indicates that these students still have some lack of understanding of course goal 1. However, the achievement value for other course goals is more than 0.65. From the bar chart of the achievement of each course goal, it can be seen from Figure 2 that all course goals are effectively achieved. From the assessment effect, the overall is good. It is fully demonstrated that after the instructor gives engineering design guidance to the students, with the efforts of the students, the students have achieved ideal results, so as to achieve the realization of each course goal.

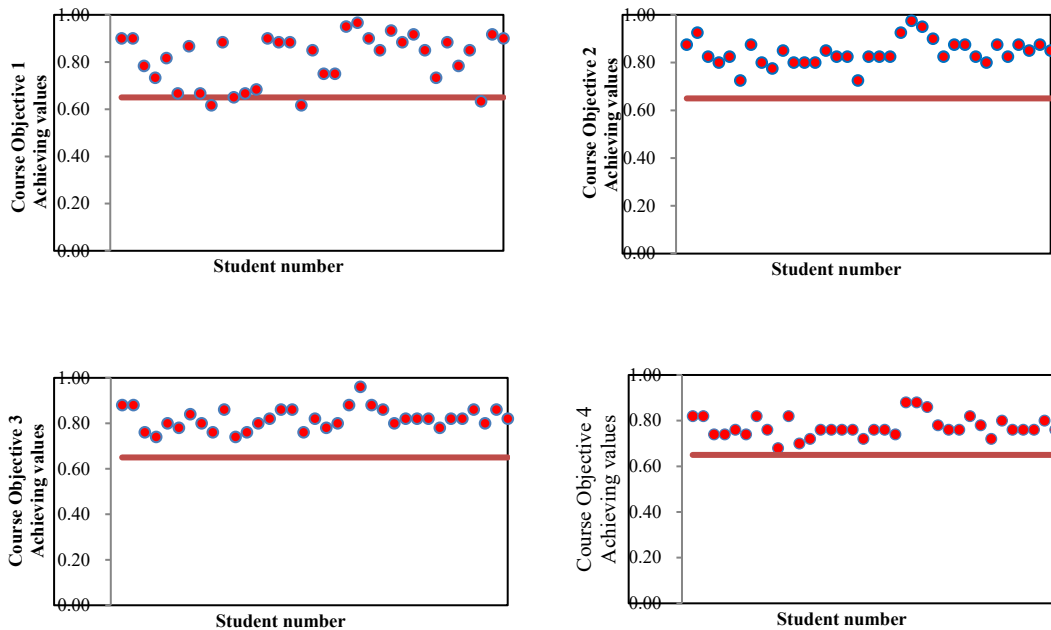


Figure 1 Scatter plot of the attainment value of each course objective

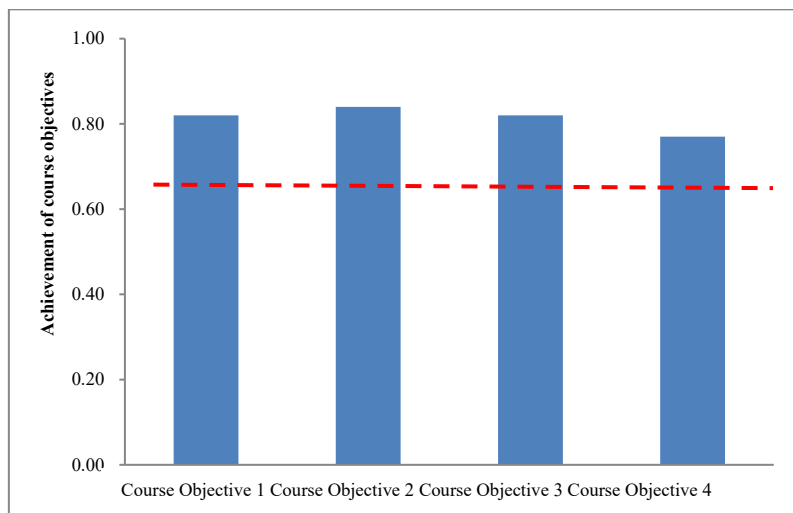


Figure 2 Evaluation results of achieving course objectives

2.4. Feedback and reflection on the implementation effect of science and technology innovation link

In order to better grasp students' understanding of the course objectives of "Material Engineering Design Competition", the way to achieve the evaluation and the effect of their own ability, indirect evaluation of this course was organized and carried out by designing questionnaires. The contents of the survey are mainly from the aspects of curriculum objectives, process organization and

management, quality control, teacher guidance, comprehensive use of knowledge, ability training and so on. Through statistical analysis, the main results are as follows: all the students attach great importance to the teaching work of the material engineering design competition course, can understand the objective connotation of the course, and under the guidance of professional teachers, work together, take the initiative to carry out the work, learn professional knowledge, and develop the ability to analyze and solve problems.

According to the requirements of the four course objectives, students have a high degree of recognition of the corresponding training effects. Through the teaching of this course, students have outstanding training effects in understanding the sustainable development of environment and society, establishing the concept of sustainable development, effective communication among team members, team spirit and cooperation consciousness, which is of great significance. However, it is not enough to think and evaluate the impact of engineering practice on human society from the perspective of environmental protection and sustainable development in engineering practice related to complex materials engineering problems, which needs to be further improved and improved. Secondly, there are still insufficient aspects in the application of engineering management principles and economic decision-making knowledge.

"Materials Engineering Design Competition" as a course is a beneficial attempt to cultivate students' creative thinking and innovative consciousness, especially under the background of engineering certification. It is very important for a college teacher how to truly implement the concept of "student-centered, output-oriented, continuous improvement", as a part of scientific and technological innovation, this course plays an irreplaceable role in the whole curriculum system, providing a good support for the completion of graduation requirements.

3. Conclusion

Under the background of engineering certification, it is a beneficial attempt to incorporate the course "Material Engineering Design Competition" into the curriculum system as a link of scientific and technological innovation. From the teaching effect, students are highly motivated to learn, stimulate their interest in using professional knowledge to solve problems, and give full play to their teamwork spirit. It exercises students' innovative thinking and cultivates students' ability to explore new knowledge and new technology.

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