

Teaching and Quality Evaluation of Basic Technology Course for Mechanical Specialty Based on OBE Concept

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Abstract: This paper aims to strengthen ability training, mobilize students' enthusiasm and initiative in learning, focus on students' learning achievements through teaching activities, and promote the achievement of training objectives. This research focuses on the teaching and quality evaluation of mechanical courses based on the concept of student-centered and output oriented. Professional courses play an important role in the curriculum system of talent training programs and provide an important basis for achieving the training objectives. The curriculum teaching objectives are designed according to the supportability and implement ability of the teaching objectives to the graduation requirements. Direct and indirect methods are adopted to evaluate the teaching quality so as to clarify the learning effect and ability achievement of students. Good effect is presented by teaching implementation and case analysis. The research provides the reference for the ability training of engineering students which based on the OBE concept curriculum teaching and quality evaluation curriculum.

Keywords: OBE Concept; Mechanical Specialty; Course Teaching Objectives; Course Quality Evaluation

1. Introduction

Outcome based education (OBE), also known as output-oriented education, capability-oriented education and goal-oriented education, was proposed by Spady in 1981. Its core is student-centered and result-oriented. This concept has become the mainstream concept of education reform in the United States, the United Kingdom, Canada and other countries.

In June 2013, China was accepted as a signatory member of the "Washington Agreement", and it is of practical significance to guide engineering education reform with the results-oriented education concept. Based on the concept of OBE, domestic scholars have studied the achievement of curriculum objectives carried out teaching design and built a teaching quality management system and an evaluation system to constantly promote the improvement of teaching quality.

Taking students as the core, define training objectives and graduation requirements. Establish a supportive relationship among graduation requirements, teaching content, and course objectives through teaching content design, assessment, and evaluation, and evaluate the achievement of teaching objectives based on this framework [1]. By designing a case-based innovation and integration practice teaching platform, students' enthusiasm for participating in practical courses is enhanced, and their professional ability cultivation and innovation and entrepreneurship capabilities are developed [2]. Based on the OBE educational concept, explore a teaching quality management model and construct a teaching quality management system by determining teaching quality standards, formulating teaching quality management objectives, establishing an organizational structure, strengthening resource guarantees, and improving monitoring and evaluation mechanisms [3]. From the perspective of quality management, this paper constructs a quality management system structure relationship model, including organizational structure, teaching resources, teaching process, and quality evaluation, and defines its specific components. Through implementation, societal

satisfaction with the quality of talent training has been improved [4]. Under the OBE educational concept, the teaching quality evaluation system needs to be comprehensively reconstructed to meet the new requirements of higher education development. Involve employers, students, and other stakeholders in the evaluation process, strengthen the diversification of participants in quality evaluation, and establish a comprehensive feedback mechanism [5]. In teaching quality evaluation, the scope should be expanded. Under the OBE concept, the evaluation system should be reconstructed by comprehensively considering various factors such as background evaluation, input evaluation, process evaluation, and outcome evaluation, thereby forming an operable teaching quality evaluation system [6].

There is a clear mapping relationship between the realization of students' ability goals and each course in the curriculum system, and the curriculum objectives under the OBE concept are clearly defined. The current curriculum teaching objectives are the only way to achieve the cultivation of students' ability [7-9]. This paper provides the studies of the course teaching and quality evaluation course based on OBE concept by taking the basic technical course of mechanical specialty as an example and also provides the reference for the ability training of engineering students [10-12].

2. Design of Curriculum Teaching Objectives Based on OBE Concept

2.1 Curriculum Teaching Objectives Effectively Support Graduation Requirements Index Points

Professional personnel training objectives determine the vocational ability and career achievements of graduates about five years after graduation and training objectives are the result of graduation requirements. Graduation requirements can fully and accurately reflect the training objectives, and graduation requirements are decomposed into measurable and evaluable index points, each supported by 3-5 courses. Each course in the curriculum system plays a unique role in the realization of training objectives and graduation requirements. The design of course teaching objectives can reflect the achievement of the corresponding abilities in graduation

requirements, occupy different weights, and effectively support the achievement of the corresponding indicators of graduation requirements. Taking the course "Interchangeability and Measurement Technology", which covers a wide range in the basic course of mechanical professional technology as an example, the overall design is carried out according to professional graduation requirements and course system. Six teaching objectives of this course are set, corresponding to engineering knowledge, problem analysis, design/development solutions, research, use of modern tools, engineering and society in graduation requirements, as shown in Table 1. Among them, the support for designing/developing solutions, using modern tools, and engineering and society are strong supports with weights of 0.2, 0.2, and 0.3, respectively, while the others are weak supports.

Table 1. Contribution of course teaching objectives to graduation requirements

Graduation requirements	1-3	2-3	3-3	4-2	5-2	6-1
Teaching objectives						
Objective 1	L					
Objective2		L				
Objective3			0.2			
Objective4				L		
Objective5					0.2	
Objective6						0.3

Note: L indicates that the contribution of teaching objectives to graduation requirements is weak.

2.2 Curriculum Teaching Objectives Can Be Implemented

2.2.1 Integrated cultivation of knowledge, ability and quality

The teaching content of basic technical course of mechanical specialty is divided into theory teaching and experiment teaching. Theoretical teaching is mainly to realize knowledge learning and partial ability and quality training. The experimental teaching mainly realizes the application of knowledge and the cultivation of most abilities and qualities, and realizes the integration cultivation of knowledge, abilities and qualities through theoretical teaching and experimental teaching. In terms of the realization of teaching objectives, theoretical teaching supports the cultivation of engineering knowledge, problem analysis, design/development of solutions, engineering and society and part of the ability to use modern tools, and experimental teaching

supports the cultivation of research and most of the ability to use modern tools.

2.2.2 Teaching content supports the teaching objectives of the course

The teaching content of "Interchangeability and Measurement technology" focuses on the geometric accuracy and mutual cooperation of mechanical parts, the basic knowledge, basic theory and basic skills of measurement technology, and the basic training of parts precision design skills and testing skills in training practical ability. It includes the basic knowledge of standard, standardization and priority number system, the basis of geometric measurement, dimensional accuracy design, geometric accuracy design, surface roughness and precision design of typical mechanical parts, etc. The above teaching content is divided into 7 teaching units, including teaching unit C1 course Introduction, teaching unit C2 geometric quantity measurement basis, teaching unit C3 dimensional accuracy design, teaching unit C4 geometric accuracy design, teaching unit C5 surface roughness, teaching unit C6 commonly used typical parts accuracy design, teaching unit C7 dimensional chain. The teaching units correspond to different curriculum teaching objectives and graduation requirements, and realize the overall teaching objectives of the course by the learning of specific teaching contents.

3. Course Performance Assessment and Teaching Quality Evaluation based on OBE Concept

3.1 Course Performance Assessment

The course assessment includes the final examination paper scores, usual scores (homework, reading notes), and experimental scores. Exam scores account for 70% of the total score and usual scores account for 30% in which 10% for homework, 10% for notes and 10% for in-class experiments (including presentations). In addition, for in-class experiments, the experimental process accounted for 50%, and the experimental report accounted for 50%.

3.2 Evaluation of Curriculum Teaching Quality

3.2.1 Evaluation methods

Two methods of direct evaluation and indirect evaluation were adopted to evaluate the overall

quality of the course. Direct assessment mainly focuses on papers, assignments and reading notes; the indirect evaluation was completed by questionnaire survey. Different teaching objectives support different specific teaching content. The evaluation methods and weights also have different emphasis, Teaching objectives 1, 2, 3, and 6 were comprehensively assessed based on test papers, homework assignments, reading notes, and questionnaire surveys, with respective weights of 0.6, 0.2, 0.1, and 0.1. The evaluation of teaching objective 4 considered the experimental process, experimental report, and questionnaire survey, with corresponding weights of 0.5, 0.4, and 0.1. Teaching objective 5 was evaluated using five indices: the experimental process, experimental report, test paper, reading notes, and questionnaire survey, with respective weights of 0.3, 0.4, 0.1, 0.1, and 0.1. The detailed contents of the assessment for all six teaching objectives are presented in Table 2.

3.2.2 Evaluation criteria

According to the teaching objectives, scientific and comprehensive evaluation criteria have been established for each phase of learning, including standards for assessing daily homework, reading notes, experiments, final examination papers, and overall performance. Through multi-dimensional evaluation, students' learning outcomes and ability development are comprehensively measured. The criteria for evaluating homework focus on both completion and quality, primarily assessing whether students submit assignments on time, as well as the accuracy and logical coherence of their answers. The evaluation of reading notes examines students' comprehension, analytical skills, and application abilities in relation to the teaching content, with an emphasis on content completeness, summarization, and depth of thought. Regarding experimental evaluation, the process includes 20% for hands-on skills, 10% for teamwork, and 20% for problem-solving abilities. The experimental report accounts for 20% accurate data, 20% experimental analysis and processing, and 10% completeness of content, focusing on the assessment of students' operational skills, collaborative abilities, and problem-solving capabilities.

Through these detailed and quantifiable evaluation criteria, students' learning

performance can be assessed more scientifically, promoting their overall development while providing a robust foundation for improving teaching practices. This evaluation system not only supports the

achievement of teaching objectives but also fosters students' enthusiasm for learning and creativity, laying a solid groundwork for cultivating high-caliber talent.

Table 2. Evaluation of Achievement of Curriculum Objectives

Teaching objective	Course weight	Relationship with graduation requirements	Teaching content	Evaluation method and weight
Objective 1	0.1	1-3	Teaching Units C1 to C7	Test paper 0.6, homework 0.2, reading notes 0.1, questionnaire 0.1
Objective 2	0.1	2-3	Teaching Units C5 to C7	Test paper 0.6, homework 0.2, reading notes 0.1, questionnaire 0.1
Objective 3	0.1	3-3	Teaching Units C3 to C6	Test paper 0.6, homework 0.2, reading notes 0.1, questionnaire 0.1
Objective 4	0.2	4-2	Teaching Units C3, C4, C6	Experimental process 0.5, experimental report 0.4, questionnaire 0.1
Objective 5	0.2	5-2	Teaching Units C2 to C6	Experimental process 0.3, experimental report 0.4, test paper 0.1, reading notes 0.1, questionnaire 0.1
Objective 6	0.3	6-1	Teaching Units C1, C3 to C7	Test paper 0.6, homework 0.2, reading notes 0.1, questionnaire 0.1

4. Analysis of application examples

Taking the course of "Interchangeability and measurement technology" as an example, the evaluation values of the six teaching objectives

of the course were 0.7914, 0.7346, 0.7760, 0.8276, 0.8690 and 0.6782, respectively.

The score bar chart of each index point is shown in Figure 1.

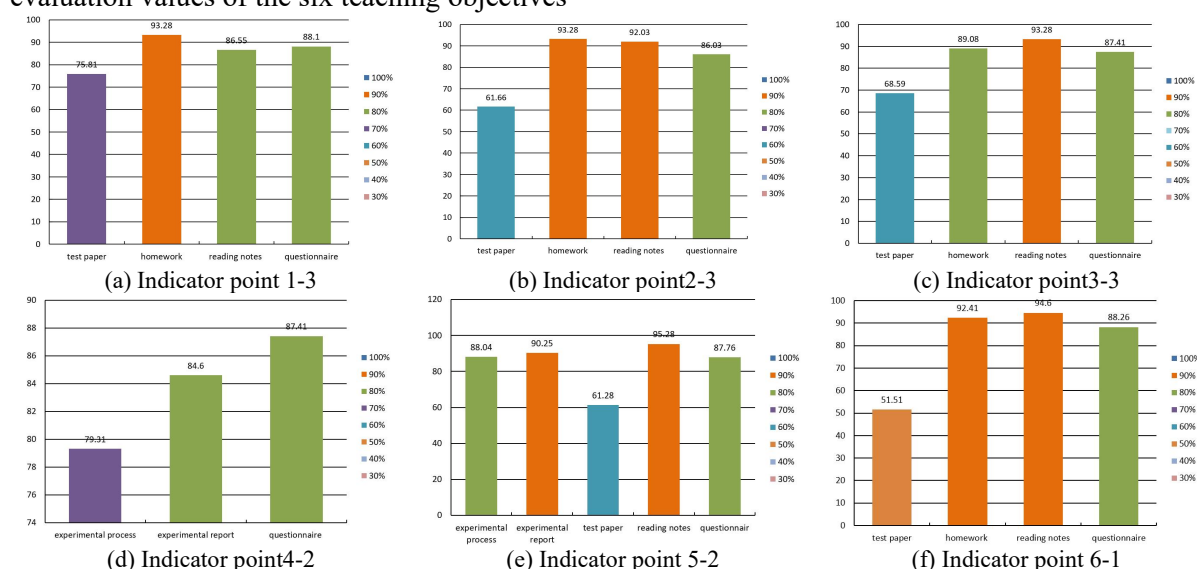


Figure 1. Bar Chart of Index Points

It can be seen that the evaluation value of index points 1-3 is 0.7914, which is slightly higher than the evaluation value of course achievement. The score rates of homework and reading notes were 93.28% and 86.55% respectively, indicating that students had a good awareness of active learning and could master relevant knowledge combined with practice. The evaluation value of index points 2-3 is 0.7346, and the score rate of the paper is only 61.66, which indicates that the students do not grasp the basic concepts of interchangeability and measurement technology firmly. The evaluation value of other indicators is over 0.8, indicating that students have the ability to analyze factors affecting the dimensional accuracy, geometric accuracy and surface roughness of parts. The evaluation value of index point 3-3 is 0.7760

and the evaluation value of index point 3-3 exceeds 0.7 except for the examination paper indicating that the students have the ability to design the product accurately. The values of index points 4-2 and 5-2 are higher, 0.8276 and 0.8690 respectively, indicating that students have strong practical ability and are proficient in experimental operation. The evaluation value of index point 6-1 is 0.6782, and the evaluation value of test paper is only 0.5151, indicating that students need to improve their mastery of relevant knowledge points in the field of standardization and metrology. The evaluation value of homework, reading notes, and questionnaire is above 0.8.

The course achievement rating is:

$$0.7914 \times 0.1 + 0.7346 \times 0.1 + 0.7760 \times 0.1 + 0.8276 \times 0.2 + 0.8690 \times 0.2 + 0.6782 \times 0.3 = 0.7730$$

The evaluation result is achieved.

5. Conclusion

Engineering education professional certification is an internationally accepted engineering education quality assurance system. The three core concepts it follows are result-oriented, student-centered and continuous improvement. Among them, results-oriented education has become the mainstream concept of education reform in the United States, Britain and other countries, which has practical guiding significance for China's engineering education reform.

The research is oriented by learning outcomes, and the teaching objectives of the curriculum are designed to reflect the achievement of the corresponding abilities in the graduation requirements. Each teaching goal has different weight, so that the teaching goal can effectively support the graduation requirement index point, and realize the integration of knowledge, ability and quality. This study evaluates the course performance and adopts direct and indirect evaluation methods to evaluate the overall quality of the course based on the concept of OBE. The study analyzes and evaluates the realization of the six teaching objectives of the course with teaching examples, and provides reference for the implementation of the teaching process and the evaluation of the quality of the course.

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