

Study on Modular Teaching of Engineering Mathematics Based on OBE Teaching Mode

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Abstract: With the development of higher education, there are some problems in application-oriented universities, such as uneven quality of students and personality problem of students, and the traditional teaching mode of engineering mathematics no longer meets the needs of current teaching development. In order to meet the needs of the current development of engineering mathematics and the requirements of OBE teaching concepts, this article discusses the teaching curriculum of the modular teaching mode. This article points out the teacher's confusion about the engineering mathematics curriculum and the degree of engineering certification, and proposes the engineering mathematics curriculum and teaching strategies under the OBE teaching philosophy.

1. Introduction

After outcome based education (OBE) was proposed by Spady and others in 1981, it soon became the mainstream concept of education reform in many countries such as the United States, Britain, Canada, etc. The connotation of OBE is that the goal of teaching design and teaching implementation is the final learning achievement that students achieve through the education process. OBE emphasizes the following four issues: what are the learning outcomes we want students to achieve? Why should students achieve such learning results? How to effectively help students achieve these learning results? How to know that students have achieved these learning results?

As China was accepted as a signatory member of the "Washington Agreement" in 2013, Chinese universities began to introduce the OBE concept to guide engineering education reform. At the same time, combining with the background of higher education reform, most colleges and universities are transforming towards applied undergraduate colleges, propose new applied undergraduates and result-oriented talent training programs, and strengthen the cultivation of college students' ability to apply knowledge. The transformation of application-oriented talent training programs in higher undergraduate colleges is first manifested in the reform of the construction of various professional courses, and then manifested in the changes in the classroom teaching mode, as well as the changes in class hours and credits. Modular curriculum does not emphasize the integrity and systematicness of knowledge, but organizes the teaching content from the reality, emphasizes the application of knowledge and the improvement of ability, emphasizes the necessity and sufficiency, and integrates professional knowledge and professional skills effectively [1]. Modular teaching mode no longer attaches importance to the imparting of knowledge, but pays attention to students' learning experience, so as to achieve the final learning results of students.

2. Problems in Course Design of Engineering Mathematics Modular Teaching under OBE Teaching Concept

Under the teaching concept of OBE, to implement modular teaching, the first thing is to reintegrate the engineering mathematics curriculum, which is undoubtedly a great challenge to teachers. The main problems are manifested in the following aspects:

Firstly, problems in learning achievement detection.

Determining learning outcomes and final learning outcomes is both the end and the starting point

of OBE. Learning outcomes should be clearly stated and directly or indirectly measured, so they are often converted into performance indicators. The requirements and expectations of educational stakeholders should be fully considered in determining learning outcomes. These stakeholders include not only the government, schools and employers, but also students, teachers and parents.

Secondly, problems in modular course system setting of engineering mathematics.

It is particularly important to construct a curriculum system and fully understand the graduation requirements of each major in engineering certification. Learning outcomes represent a kind of ability structure, which is mainly realized through course teaching. Therefore, the construction of the curriculum system is particularly important for achieving learning outcomes. There should be a clear mapping relationship between the ability structure and the curriculum system structure, and each ability in the ability structure should be supported by a clear curriculum. In other words, each course of the curriculum system must have a definite contribution to the realization of the ability structure. The mapping relationship between the curriculum system and the ability structure requires students to have the expected ability structure after completing the curriculum system.

In combination with engineering certification requirements, the teaching of applied undergraduate colleges emphasizes knowledge and professional fit, and focuses on cultivating students' ability to use corresponding knowledge to discover, analyse and solve problems. At the same time, application-oriented undergraduate colleges and universities have many misplaced problems in the training of talents, professional positioning, ability analysis, curriculum system and teaching methods, so that the application cannot be truly implemented in teaching. It can be seen that students of various majors of science and engineering have different needs for engineering mathematics, so the teaching modules should be set according to the needs of students of each major, which has become the primary problem in the teaching process of the modular curriculum system [2].

Thirdly, problems in engineering mathematics textbook.

The existing textbooks issued by the publishing house are arranged in accordance with the traditional advanced mathematics, linear algebra, probability theory and mathematical statistics, which are difficult to meet the needs of modular teaching reform. Therefore, it is difficult to order teaching materials, and one course corresponds to the content of several teaching modules. Under the current circumstances, it is necessary to integrate the course content of engineering mathematics to develop modules, and the compilation and development of teaching materials is a very urgent and necessary issue [3].

3. Correspondence of Instructional Design under OBE Teaching Concept

Traditional education is subject oriented, which follows the principle of dividing specialties according to disciplines. This kind of education mode is a scientific model to solve certain, linear, static and closed problems, and its knowledge structure emphasizes the integrity and systematicness of subject knowledge system. The traditional teaching design only pays attention to the needs of subjects, but ignores the needs of majors. Compared with traditional education, OBE concept follows the reverse design. Reverse design starts from the internal and external needs. The training objectives are determined by the needs, the graduation requirements are determined by the training objectives, and the curriculum system is determined by the graduation requirements. While positive design starts from the curriculum system, reverses the process to the graduation requirements, to the training objectives, and then to the needs. Therefore, traditional education can only “adapt” to external needs (state, society and industry, employers, etc.), but it is difficult to “meet” [4]. Different from traditional education, OBE is reverse design and positive implementation. Demand is not only the starting point but also the end point to ensure the consistency of educational objectives and results to the greatest extent. Therefore, the key point of achievement OBE design is to determine the following corresponding relationships:

Firstly, correspondence between internal and external needs and training objectives.

The training objectives should be adapted to the internal and external needs. The principle of OBE teaching is reverse design, and teaching design starts from demand. The internal demand depends on

the laws of education and teaching, the school's idea, the orientation of running a school and the needs of teaching subjects. The traditional education and teaching design is based on the internal demand, but the external demand is often ignored by the traditional education and teaching design. The demand of the state and society is the macro demand, which is the main basis for the establishment of school talent training objectives; the demand of the industry and the employer is the micro demand, which is the main basis for the establishment of professional talent training objectives. The demands of politics, economy, science and technology, culture and so on are the needs of the country and society, with variability and diversity characteristics. The structure of professional education knowledge, ability and quality is an important basis for the needs of industries and enterprises. When determining the training goal, we should correctly deal with the contradiction between utilitarian pursuit and value rationality of demand, and between professional pursuit and professional adaptability.

Secondly, correspondence between training objectives and graduation requirements.

The basis of graduation requirements is the training objectives, and it is the support to achieve the training objectives. The general description of the professional and professional achievements that graduates can achieve about 5 years after graduation can be regarded as the training goal. Graduation requirement is the general program of professional personnel training, and is the basis for constructing the structure of professional knowledge, ability and quality, forming curriculum system and carrying out teaching activities. The skills, knowledge and ability that students master through the study of this major are the learning results that students should obtain when they finish their studies. Graduation requirements include knowledge, ability and realm. The purpose of mastering knowledge is to apply and create knowledge, and then reach the required skills and creativity; realm is the degree or height of the mind's comprehension of various phenomena. Therefore, the training goal objectives more attention to what students can do, while graduation requirements pay more attention to what students can have.

Thirdly, correspondence between graduation requirements and curriculum system.

The basis of curriculum system is graduation requirements, while the support of graduation requirements is curriculum system. Graduation requirement is a specific requirement for the knowledge, ability and quality structure that graduates should possess, which can only be realized in teaching through the corresponding curriculum system. The corresponding relationship between graduation requirements and curriculum system should be expressed in matrix form, that is, curriculum matrix. The curriculum matrix can clearly show the contribution of each course teaching in the graduation requirements, and can be used to study the relationship between courses. Through the course matrix, we can analyze whether the knowledge points of each course are complementary, deepened or simply repeated, so as to provide the basis for restructuring and optimizing the teaching content. In the construction of curriculum system, we should pay attention to the vertical and horizontal relationship of knowledge, ability and quality structure. In addition, we should also properly handle the following relations: first, deal with the relationship between various courses. Reasonably determine the credit proportion of various courses, and increase the proportion of elective courses as far as possible under the premise that students have complete knowledge structure. We should carefully sort out the elective courses, form course modules, and prevent the fragmentation and separation of knowledge. Second, deal with the relationship between in class and after class. It is necessary to change teaching concepts, reform teaching methods and correctly handle the relationship between classroom teaching and extracurricular learning. Teachers should promote research-based teaching mode, turn knowledge class into knowledge class, extend teaching content from class to class in time and space, and let students become masters of learning. Third, deal with the relationship between explicit curriculum and recessive curriculum. Explicit curriculum refers to traditional curriculum, while the second classroom is an important carrier of hidden curriculum. We should pay full attention to the educational function of the second classroom, attach importance to the curriculum construction, and enhance the educational effect.

Fourthly, correspondence between graduation requirements and teaching content.

The basis of the teaching content is the graduation requirement, and the support of the graduation

requirement is the teaching content. For the correspondence between graduation requirements, teaching content and curriculum system, the former is partial, which is the correspondence between a certain graduation requirement or a certain course or a certain course; while the latter is a holistic one, which requires the graduation requirements to be implemented one by one in the syllabus of each course, so as to clarify the contribution of the teaching content of a specific course to the graduation requirements. The correspondence between graduation requirements and teaching content provides a basis for determining the teaching content and teaching hours of the course. The content and teaching hours of traditional education courses are determined based on teaching materials. Each course emphasizes the systematicness, integrity and continuity of its own knowledge system, so that the content of the course is increasing, the teaching materials are thicker and the class hours are getting bigger and bigger. The OBE model breaks the barriers between courses, weakens the system, integrity and continuity of the courses themselves, and strengthens the relevance and cohesion between courses. It can achieve a certain or several main lines of graduation requirements, and then form a course string and a course group. Then, determine the teaching content and teaching hours of each course in the course string and course group according to the contribution to graduation requirements. In this way, the knowledge system of a course may be fragmented or modular, but the overall knowledge structure is more reasonable and complete.

4. Curriculum Setting and Countermeasures of Modular Teaching Mode of Engineering Mathematics under OBE Teaching Concept

Under the modular teaching mode, it has great theoretical and practical significance for teachers' engineering mathematics curriculum development. It can not only develop a set of teaching materials for the modular teaching mode of engineering mathematics, but also guide teachers' teaching practice. In the long-term education and teaching process, it helps the theoretical model and practical teaching to complement each other, and the initial problems become increasingly clear in the continuous exploration.

Firstly, turn complexity into simplicity, emphasize skills more than theory.

The traditional engineering mathematics teaching model focuses on indoctrination, scores and inheritance, but ignore thinking, skills and innovation. Therefore, in applied undergraduate colleges, it is necessary to dilute mathematical argumentation, strengthen geometric description, and emphasize image understanding, so as to liberate students from tedious mathematical derivation and mathematical skills. Emphasize understanding of mathematical knowledge and correct mathematical thinking, so as to improve students' creative skills, and strive to form the engineering mathematics modular teaching curriculum system of “problem and situation-model establishment-interpretation, application and expansion”.

Secondly, combine with expertise.

In the teaching process, teachers should also pay attention to the degree of integration with professional knowledge, and explain the necessity of mathematical knowledge from the perspective of professional knowledge. For example, for the modules selected by students majoring in software engineering, teachers should focus on teaching content that is closely related to “Data Structure”; in the teaching process of “Mathematical Statistics”, case can be used to introduce social hot issues of related majors, guide students to actively think and participate, stimulate students' interest in learning, and cultivate the ability to apply mathematical knowledge, analyze and solve practical problems.

Thirdly, implementation of PBL+ modular teaching mode teaching.

Most of the existing PBL teaching cases in engineering mathematics start from the students' knowledge background. They are highly readable and interesting, but they are not well-suited to the profession and cannot reflect the applicability of course teaching. Class teachers can communicate with professional teachers, analyze the related content of professional courses and engineering mathematics, and use typical theories and cases to carry out classroom teaching and realize the combination of teaching content and case secrets [5].

Fourthly, implementation of the examination and evaluation plan for engineering mathematics

modular teaching.

Change the test content and assessment method, the content of the proposition determines the teaching orientation. The proposition should not only test the students' mastery of the basic knowledge of engineering mathematics, but also test the students' ability to apply and analyze basic knowledge and solve practical problems. The content of engineering mathematics examination should follow the following principles:

- a) Pay attention to the foundation and highlight the key points;
- b) Focus on thinking more than skills;
- c) Pay attention to and investigate application capabilities;
- d) Diverse content and flexible form;
- e) Optimize question types and flexible exam questions.

Fifthly, establish an effective evaluation system.

Gradually perfect the scientific and effective evaluation system in teaching practice. Transform the evaluation method of knowledge points into the ability evaluation method, focusing on the initiative and participation of students in the learning process. Teachers should not only cultivate students' communication skills, expression skills, cooperation skills and innovation skills, but also train students' ability to analyze and solve problems [6].

Sixthly, enrich teaching methods.

Currently in the era of rapid development of the Internet, the networking and diversification of educational methods has formed a new educational trend, and the way students acquire knowledge has also changed a lot. Teachers can rationally use the networked teaching platform to enrich the teaching content, break through the geographical and time constraints, fully mobilize students' learning enthusiasm, and improve teaching effects.

5. Conclusion

The modular teaching of engineering mathematics follows the development requirements of application-oriented undergraduate colleges, stimulates students' enthusiasm for learning, and effectively integrates the professional needs. It not only cultivates students' ability to analyze and solve problems, but also cultivate students' innovative thinking and critical thinking. At the same time, the confusion of modular teaching will not only become the driving force for the curriculum, but also provide ideas for the innovation of teaching methods. Engineering mathematics classroom is the main form of teaching implementation. Classroom teaching is the foundation for students to meet graduation requirements and achieve training goals. However, current classroom teaching has not yet shaken off the fetters of scientific education methods. Therefore, in order to meet the requirements of outcome-oriented education, at least the following five changes must be realized: transition from indoctrination classroom to dialogue classroom, transition from closed classroom to open classroom, transition from knowledge classroom to ability classroom, transition from emphasizing learning and neglecting thinking to combining learning and thinking, transition from emphasizing education and neglecting learning to teaching master in learning.

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