Exploration of Teaching Reform in Higher Mathematics Based on OBE Concept

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Abstract: *Based on the OBE concept, the teaching reform takes ability cultivation as the core, takes "learning output" as the goal, changes from quality monitoring to continuous improvement, and pays attention to the all-round development of students. Advanced mathematics is a necessary analytical tool for all majors of science and engineering in colleges and universities. Through the study of advanced mathematics, students can acquire the necessary basic theoretical knowledge and master the commonly used operational methods. Aiming at the characteristics of higher mathematics teaching such as high abstractness, wide application, strict logic and rigorous theory, this paper puts forward the teaching reform path of higher mathematics curriculum based on OBE concept: Reshape the student-centered teaching mode, cultivate students' thinking ability by using analogical transformation, expand teaching space to improve students' application ability, simplify complex knowledge by using micro-lessons, help students understand mathematical concepts by using software, and carry out curriculum thinking and politics in the process of mathematics teaching.*

Keywords: *OBE Concept; Higher Mathematics; Teaching Reform; Thinking Ability; Reform Path*

1. Introduction

Higher mathematics is a necessary mathematical tool for all majors of science and engineering in colleges and universities. It is an essential and important link to train talents needed to adapt to modern science and technology and social development. It is also an extension and development of elementary mathematics. Through the construction and setting of problem situations, teachers conduct gradual training of thinking mode and ability, guide students through in-depth thinking and reflection on problems, drive students to understand knowledge and flexibly apply knowledge, and then achieve the goal of innovative application of knowledge. Through advanced mathematics learning, students can acquire the necessary basic theoretical knowledge, master the commonly used operational methods, cultivate their operational ability and preliminary abstract thinking, logical reasoning and spatial imagination ability, so as to train their initial ability to solve practical problems and lay a mathematical foundation for the study of professional courses.

OBE (Outcome Based Education) refers to the goal of instructional design and implementation that is the final learning outcome achieved by students through the educational process. Since it was proposed by Spady et al in 1981, the OBE concept and method have been recognized as an effective way to pursue excellence in education and have been valued by famous universities around the world. The reform of higher mathematics course teaching based on OBE concept should be carried out to cultivate students' thinking rigor and creativity, trigger students to gradually form a progressive way of thinking about problems, form a more systematic, complete and vivid knowledge framework, and stimulate students' good habits of innovation and development. Reconstruct the new knowledge system, gradually form a variety of methods for analyzing, exploring and solving problems, improve students' basic quality and application innovation ability, and comprehensively improve the quality of talent training.

2. The Characteristics of Higher Mathematics

Compared with elementary mathematics, which takes invariants as the research object, higher mathematics has more distinct characteristics. Studying the characteristics of higher mathematics is of great significance for learning higher mathematics. By participating in relevant literature, the

characteristics of higher mathematics are summarized as four aspects: high abstractness, wide application, strict logic and rigorous theory [1-3].

2.1 High Degree of Abstraction

Abstract means that you can't see it in person, and you need to make full use of your mind. Compared to elementary mathematics, advanced mathematics is more abstract. Advanced mathematics is different from elementary mathematics. Elementary mathematics takes constants as the object of study, while advanced mathematics takes variables as the object of study on the basis of elementary mathematics. The research content is mostly some concepts that cannot be intuitively perceived, including limit, derivative and integral. Learning advanced mathematics requires strong logical thinking ability and the ability to understand and apply abstract mathematical concepts and methods.

2.2 Wide Range of Applications

The tradition of higher mathematics gives students not only important knowledge, but also the way of thinking cultivated through independent thinking, and the Angle of looking at the world and problems. With the rapid development of economy, the application of higher mathematics in life is becoming increasingly prominent. Mathematical theories and methods are more and more widely used in different disciplines such as physics, chemistry, biology, medicine, economic management and military, as well as in daily life, whether mathematical modeling or business management, or economic analysis, mathematics is very important.

2.3 Strict Logic

Logic means that the development process conforms to the logical system, has logical characteristics and abides by logical rules. In the induction and arrangement of mathematical theory, no matter the concept and description, or the reasoning and judgment, it embodies the strict logic of mathematics. The proof of a theorem is based on the conditions of the theorem, known axioms and theorems, and leads to a conclusion by rigorous logical rules and reasoning methods. A conjecture that has not been proved in a mathematical sense cannot be a theorem.

2.4 Rigorous Theory

A theory provides a means by which people accept the inference and further exploration of a theory. Mathematics is a subject with high theoretical requirements. Advanced mathematics is more rigorous in theory and requires rigorous proof to deduce and verify mathematical conclusions. Learning advanced mathematics requires a certain mathematical reasoning ability, to understand and apply mathematical theorems and proof methods. In the teaching process, it is necessary to optimize the method constantly, abandon the one-sided pursuit of the integrity of pure mathematical knowledge, and simplify the tedious theoretical derivation and operation skills.

3. The Foundation of OBE Philosophy

The goal of teaching design and implementation based on OBE is the final learning outcome achieved by students through the educational process.

3.1 Theoretical Framework of OBE

The theoretical framework of OBE is summarized as follows: one core objective, two important conditions, three key premises, four implementation principles and five implementation points. Among them, a core goal: all students achieve peak results. Two important conditions: First, to draw a blueprint for learning outcomes, establish a clear blueprint for learning outcomes, and outline what are the necessary abilities and content, is to determine the ability structure that students should achieve when they graduate. The second is to create a successful environment to provide suitable conditions and opportunities for students to achieve expected results. Three key preconditions: First, all students can achieve the expected results through learning, but not necessarily at the same time and in the same way. Second, success is the mother of success, and success in learning will promote more successful learning. Third, the school should be responsible for the success of students' learning, the school holds

the conditions and opportunities for success, and directly affects the success of students' learning. Four implementation principles: Clear focus, expand opportunities, raise expectations, and reverse design. Five implementation points: identifying learning outcomes, building a curriculum system, identifying teaching strategies, self-referential evaluation, and reaching the top level.

3.2 OBE Ability Cultivation Model

OBE, as a new educational concept, organizes, implements and evaluates education with expected learning output as the center, and is a structure and system in which learning output drives the whole curriculum activities and students' learning output evaluation. OBE cultivates four kinds of abilities through three kinds of education, and the model of ability cultivation is shown in Figure 1.

3.3 Characteristics of OBE

The OBE concept summarizes and absorbs the connotation of educational goal theory, competency-based education, mastery education and criterion-referenced assessment and other theories, and summarizes the "three elements", namely student-centered, output-oriented and continuous improvement [4]. OBE has the following characteristics: First, the teaching result is clear. In the teaching process, the teacher clearly knows what kind of knowledge or skills need to be imparted to the students, and both the teacher and the students are very clear about the final result that the course needs to achieve. Second, the teaching mode is flexible. There is no fixed teaching mode under the guidance of the output-based education concept. As long as the students are willing to accept it and the learning effect is good, they can adopt it. Third, improve the participation of teachers and students, students have high participation in independent learning in the teaching process, and teachers can participate in the evaluation mechanism to a greater extent.
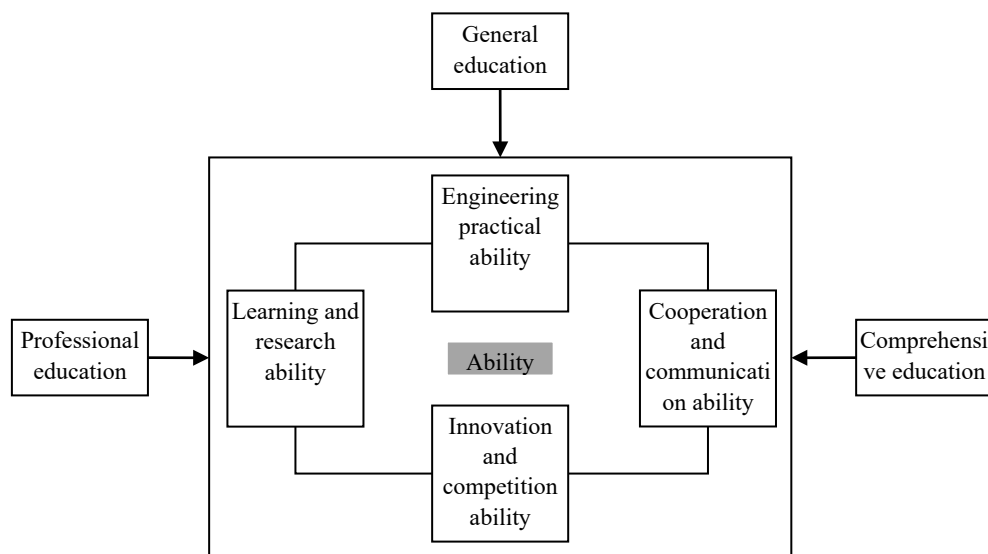

Figure 1: Ability training model of OBE

4. Teaching Reform Path of Higher Mathematics Course Based on OBE Concept

OBE teaching model has been widely used in western countries such as Australia and the United States, which attaches importance to the actual output in the learning process, reverse planning teaching structure and related evaluation mechanism, and promotes the improvement of teaching quality in a short time.

4.1 Reshape the Student-centered Teaching Model

The concept of student-centered education has been gradually accepted by higher education in

recent years. The core of OBE concept is student-centered, which is embodied in three aspects: First, teaching decision-making is student-centered. In the planning of teaching plan, teaching means, teaching methods and teaching management, according to the specific situation and actual needs of students, the corresponding design arrangements are made to help students obtain the expected learning results. Second, the allocation of curriculum resources is student-centered. The classroom based on the OBE concept will change from closed to open, students' access to knowledge will not be limited by time and place, and the frequency of communication and interaction with teachers will increase. Students can learn online independently, and the resulting problems will be solved through the online platform communication with teachers, and the model based on teacher "teaching" will be transformed into one based on student "learning". Thirdly, the teaching evaluation system should be student-centered. Teaching evaluation is no longer based on the final exam, but on students' learning results. It changes from knowledge assessment to ability assessment and comprehensively evaluates students' ability to apply knowledge, so as to evaluate whether students have achieved the expected learning results.

4.2 The Students' Thinking Ability is Cultivated by Analogical Transformation

Analogical transformation method is to transform the problem to be solved into a problem that has been solved or easily solved through some transformation process, and finally solve the original problem. Analogical transformation method is based on the idea of universal connection. Teachers guide students to analyze and dig the connection between knowledge points, and convert unknown content into existing knowledge by analogy, so as to achieve the purpose of active learning and deep learning. For differentiation of multivariate functions, whether from the definition of functions, limits and continuities, or partial derivatives and total differentials of multivariate functions, they should be analogically transformed into related contents of unary functions [5]. Through analogy guidance and discussion, students are encouraged to discover and analyze problems and develop their logical thinking ability. For multiple integrals, from concept introduction to integral calculation, there are definite integrals everywhere. Therefore, students are guided to discuss the volume of the curved top cylinder from the classical problem of the trapezoid area of the curved edge that can be solved by the definite integral, which is transformed into the expression and calculation of the definite integral problem, so as to introduce the concept and calculation method of double integral. By digging deeply into the relationship between integrals, it can also be extended to more general curve and surface integrals.

4.3 Expand Teaching Space and Improve Students' Application Ability

Based on OBE concept, make full use of modern information technology, combine online teaching with offline teaching. By using the online platform, the interactive communication in class can be extended to the network space to realize interactive discussion and learning, promote the initiative of students, help teachers effectively organize and present teaching resources, timely understand the learning status and difficulties encountered by students, and then propose targeted solutions. The classroom teaching is divided into pre-class preparation, pre-class preview, classroom teaching, homework and grade evaluation. In the pre-class preparation, push preview materials to students so that students can grasp the classroom teaching content in advance. In the classroom teaching, the key points and difficulties of students' knowledge are explained in a concise way, and more time is left for students to discuss and practice. In the homework section, assign practical teaching content related to classroom teaching content to improve students' practical ability. The teaching evaluation adopts the combination of process evaluation and result evaluation to highlight the principal position of students and exercise their ability to solve professional problems with mathematical knowledge [6,7].

4.4 Use Micro-lessons to Simplify Complex Knowledge

Micro-lessons are structured digital resources that use information technology to present fragmented learning content, process and extended materials according to cognitive laws. Advanced mathematics itself has a strong abstract and logic, including a large number of formulas, definitions and algorithms, each chapter of the teaching content will involve a lot of definitions, theorems and exercises, students will be afraid of higher mathematics learning. In order to help students overcome their fears, teachers can flexibly use the unique independence, demonstration and completeness of micro-lessons to simplify abstract and complex higher mathematics problems [8]. For example, micro-lesson videos can be used to show the formation process of mathematical theorems and

definitions in a vivid way, or slice a specific mathematical knowledge and problems to point out the key points and difficulties, so as to help students better understand and master this abstract mathematical knowledge. Teachers can also send micro-lesson videos to WeChat groups and let students watch them repeatedly after class according to their learning needs until they understand the math knowledge in the videos.

4.5 Use Software to Help Students Understand Math Concepts

The most important prerequisite for the application of mathematical knowledge is to understand mathematical concepts, but many students do not really understand mathematical concepts, so they cannot learn mathematics. For example, function is an important part of calculus. If students lack a correct understanding of the definition of function, then calculus learning will face difficulties. Teachers can use Mathematica software [9]. Mathematica is a scientific computing software that combines a numerical and symbolic computing engine, a graphics system, a programming language, and a text system with advanced connections to other applications. Mathematica has high precision computing power, which can help students find the right conclusion quickly, and can also present complex mathematical problems in a visual and animated way. As a result, students are able to understand complex mathematical problems more deeply and study the connections between concepts more visually. The most common way to represent a function is a graph, and the teacher can sketch the properties of the function for the student to represent. With the introduction of computer software, we can deepen the teaching of function properties by drawing the method of function sketch, and then conduct the property research by drawing the method of software, which can achieve twice the result with half the effort.

4.6 Carry out Curriculum Thinking and Politics in the Course of Mathematics Teaching

Curriculum thinking and politics refers to a comprehensive educational idea which takes "cultivating morality and educating people" as the fundamental task of education in the form of building a whole-course, whole-course and whole-course education pattern, which makes all kinds of courses and ideological and political theory courses walk in the same direction, forming a synergistic effect. Curriculum thought and politics is a kind of education in essence, in order to achieve moral cultivation. "Educating people" first "educating morality", pay attention to the organic integration of preaching and teaching to solve doubts and educating people and talents. It is an important carrier and channel to make use of moral education factors of mathematical values. The ideological and political links of the curriculum should not be blunt, but should be carefully designed, quietly integrated into the knowledge imparted, and imperceptibly improve the students' mathematical cultural accomplishment in the course of teaching. Through the comparison of Chinese and Western achievements in mathematics, students' patriotic feelings are aroused. The rule of law consciousness of students should be enhanced through the teaching of formulas and rules, because the remarkable feature of mathematics is rigor. In the process of deducing mathematical formulas, only reasonable evidence can be obtained in every step [10]. Through the teaching of theorems and propositions, we cultivate students' scientific spirit, emphasizing that rationality and substantiality are the core of scientific spirit, and exploration and innovation are the vitality source of scientific spirit.

5. Conclusions

Based on the OBE concept, educators must have a clear idea of the ability and level that students should achieve, and then seek to design an appropriate educational structure to ensure that the expected goals are achieved. Student output, not textbooks or teacher experience, is what drives the education system. In this sense, OBE education model can be considered as an innovation of education paradigm. The higher mathematics course teaching reform based on the OBE concept needs to constantly adjust the teaching method and teaching system, create teaching methods that are consistent with the actual situation of students, improve the teaching quality, so that students can feel the important value of mathematics in the process of receiving education, and realize the ultimate goal of teaching and learning. Based on the concept of OBE, personalized independent learning is advocated, and the classroom is no longer static but open, and students will become the protagonists of the classroom. Teachers carefully design and expand application and discussion problems, and students try to solve them, so that students fully understand the application of higher mathematics in solving practical problems, so as to improve students' ability to analyse and solve problems.

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