Cultivating the Mathematics Application Ability Based on the Literature Review Method

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Abstract. As an important part of the higher education, the mathematics courses in university serve for cultivating the application consciousness and application ability of mathematics for university students. This paper clarifies the basic concept and characteristic of the application consciousness and application ability in the field of college mathematics, then analyzes the cultivation situation and existing problems, and finally proposes the cultivation approach of the application consciousness and application ability based on the literature review method. This method has the following characteristics: putting study into practice, all students involved, consciousness enhancement, ability improvement. Beneficial from the literature review training, most students improved a lot in the application consciousness and application ability of mathematics. After the second literature review training, almost all the students have the primary application consciousness and half of students have the primary application ability, which demonstrates the great advantage of literature review method in cultivating students' mathematics application consciousness and application ability.

Keywords: College mathematics; Mathematics application consciousness; Mathematical application ability; Literature review method

1. Introduction

The application consciousness and application ability of mathematics are the basic skills for the science and engineering students in university. Due to the tight class time and heavy tasks, it is difficult to train students' application consciousness and application ability of mathematics in university mathematics courses. This paper explores the utilization of literature review method to cultivate and enhance students' application consciousness and application ability of mathematics.

2. Mathematics Application Consciousness and Application Ability

2.1 Mathematics Application Consciousness

The mathematics application consciousness [1-2] is in essence a kind of specific cognitive activity, which is also a kind of special and spiritual psychological consciousness. Concretely, the application consciousness of mathematics refers to the understanding level to the application significance and value of mathematics knowledge in the practical problems, which shows the unity performance of knowledge, emotion and volition. The knowledge refers to the subject's pursuit of knowledge and rationality in the objective world from the perspective of mathematics. The emotion refers to the subject's feeling and evaluations when solving the objective problem utilizing mathematics knowledge. The volition refers to the subject's spirit state performed as self-discipline, perseverance, confidence, and tenacity when pursuing a certain purpose or ideal. The application consciousness of mathematics not only includes the consciousness and purposefulness of mathematics application, but also includes the understanding and initiative towards the mathematics ideas, methods, and tools in the practical problems.

The mathematics application consciousness mainly has the following characteristics:

The first characteristic is the conscious awareness of practical problems. The subject is able to consciously and keenly perceive the necessity and value of mathematics application in the practical problems, and actively seek and analyze the mathematics factors in the practical problems. It's a tendentious psychological activity, which reflects the subject's inner desires and needs.

The second is the active intension to apply mathematical concepts and methods. The subject possesses the subjective and proactive awareness of applying mathematical knowledge, ideas, and methods to practical problems. And with the learned mathematical knowledge, ideas and methods, the subject has the intention to actively analyze and solve the problems.

The third is the mathematical thinking ability. The subject possesses the mathematical thinking ability such as critical thinking, creative thinking, and deductive thinking. And the subject is able to utilize the mathematical thinking to analyze and solve problems.

The fourth, the application consciousness has the characteristic of flash. The subject's thinking and ideation process exhibit impulsivity, that is, during the continuously stimulated thinking, there is an alternation between peaks and troughs of ideation. When the process is stimulated by an idea, a peak of thinking occurs, which leads to the flash of consciousness. This repetitive thinking process same as circular represents the dialectical epistemological idea of practices, cognition, re-practice, and re-cognition.

The mathematics application consciousness is that the subject possesses the psychological tendency to solve problems with mathematical knowledge, ideas, and methods. It's also rational understanding obtained from analyzing practical problem from the perspective of mathematics.

2.2 Mathematical Application Ability

The mathematical application ability [3] refers to the subject's ability to apply mathematical knowledge and methods into practical problems and solve the practical problems. The application ability of mathematics is always associated with the completion of specific activities. Without concrete activities, the subject's application ability can not be performed and developed.

The mathematical application ability mainly has the following characteristics:

The first characteristic of mathematical application ability is the proficient in extracting problems and providing solution approach. The subject is able to extract the core problem form numerous complex practical problems, and then combine mathematical knowledge, ideas, and methods to construct the approach solving practical problems with the utilization of various tools and technical supports.

The second one is the innovation ability. The subject is capable of applying mathematical knowledge, ideas, and methods to propose novel approaches for solving problems. Moreover, the subject can address practical problems creatively.

The third characteristic is the interdisciplinary comprehensive ability. The subject is able to address practical problems by combing mathematical knowledge with knowledge from other subjects.

The fourth characteristic is the team collaboration ability. The subject can collaborate with others to address practical problems together.

The fifth characteristic is concise and scientific expression ability. The subject is capable of describing the solution concisely and providing scientific suggestions.

2.3 Relationship between Mathematics Application Consciousness and Application Ability

The mathematics application consciousness serves as the driver for application ability of mathematics. The application consciousness decides the mathematical thoughts and knowledge, which further influences application ability of mathematics. Some mathematical ideas in our subconscious may be correct, uncertain, or even incorrect. Therefore, we need to judge all these mathematical ideas. When we consider some mathematical ideas correct, our application consciousness will push us to implement it with our application ability.

The Mathematical application ability serves as the practitioner of application consciousness of mathematics. The strength and weakness of application ability directly influences the direction and correctness of application consciousness. The proactive practical process enhances the application ability of mathematics, and then the good application ability of mathematics stimulates to improving application consciousness of mathematics.

3. The Current Situation of Mathematics Application Consciousness and Application Ability

Based on the current practical research, scholars have promoted the cultivation methods and measures for application consciousness and application ability in the higher education [4]. They made practical works from various aspects, such as curriculum design and teaching method, teacher role and education environment, student participation and evaluation method. The following are several attempts in cultivating application consciousness and application ability.

During the teaching process, teachers start from current hot topics, and encourage students to think about how to address problems, thereby introduce new course. The homework is better to be assigned with practical application as much as possible to enhance the key concepts covered in the course. This helps to cultivate the intuitive and proactive application consciousness of mathematics and improve application ability of mathematics through concrete mathematical knowledge. However, some drawbacks exist in this approach. During the process of teaching knowledge points, the introduction of problem needs to be closely aligned with knowledge points, which is too specific and fragmented. As a result, the cultivation of application consciousness and application ability is lack of comprehensiveness and holistic understanding. Additionally, it also lacks the training of scientific paper writing skills.

Encouraging students to participate in mathematical modeling training and competitions is another attempt. By providing comprehensive and systematic training, starting from practical problems, conducting preliminary research with a task-oriented approach in mathematical modelling [5], it strengthens the application consciousness and application ability of mathematics. This approach sparks ideas for mathematical modeling, applying mathematical knowledge to address problems, and ultimately enhances mathematical application skills. But it has the drawback of fewer participants and limited overall popularity.

Encouraging students to engage in scientific research is also an attempt. The scientific research requires to put strong emphasis on innovation, which is suitable for few senior students who have high level of application consciousness and ability.

Based on the above analysis, adopting curriculum literature review method in college mathematics can address the above drawbacks existing in above approaches.

4. Curriculum Literature Review Method

4.1 Literature Review

With the rapid development of media and information, the contents and forms of literature are becoming increasingly diverse. From the source of literature production, literature includes primary literature and secondary literature. In terms of the literature form, there are textual, visual, and video formats, and so on [6]. Normally, the literature specifically refers to masterpiece and journal paper.

Literature review [7] is a very common study method. The first step of literature review is to gather a substantial amount of relevant words and journal papers on a specific field, discipline, or aspect of a subject, issue, or research topic. And then it can provide a comprehensive overview and explanation of the latest developments, academic perspectives, or suggestions related to the current topic or issue through processes such as reading, analysis, extraction and organization. The literature review provides an overview of the current research state in this field, and outlines the basic viewpoints including issues and limitations, and gives the future trends of research.

The literature review has significant advantages [8]. First, it can enhance the application consciousness of proposing problems and solving problems. The literature review is able to provide the theoretical basis for the ongoing research, and help researchers avoid the situation of repeating previous researches. Second, the literature review can help researcher find new frontiers, allowing them formulate new research problems which can effectively contribute to the comprehensiveness of this field based on the existing research and basic knowledge. It also can help researchers to explain the importance of research works. Third, the literature review is able to enhance the application ability and provide some suggestions and guides for the problems met during the research process.

4.2 Mathematical Curriculum Literature Review Method

Based on the foundation of mathematical source knowledge, integration of professional training objectives, and student interests, the combination of "knowledge, specialization, and interest" is used to determine the mathematical curriculum literature review analysis suitable for the learning situation of the class. During the lesson preparation stage, teachers need to have a thorough understanding and master of the cultivation objectives and knowledge framework structure of the mathematics course offered in the current semester. And then, teachers need to organize the key points of this course that can address which kind of problems to clarify the direction of application consciousness of mathematics. Knowing the characteristics and cultivation requirements for the students in the teaching class, and combining them with the current hot interests and hobbies of students, to determine the self-perceived points of interest in application consciousness of mathematics. For instance, during the COVID-19 pandemic prevention and control period [9-10], teachers can provide the Bayesian inverse probability formula [11] from the probability theory course, and analyze the necessity of universal nucleic acid testing; To address the large amounts of parcels at the beginning of semester, the matrix theory can be utilized to allocate parcel pickup points reasonably. Broadening the condition formed by application consciousness of mathematics, and utilizing the concrete mathematical knowledge to solve problems, is beneficial to build up the ability of mathematical application.

Adopting different treatments according to different study situations. Students can search for two or three papers published within the last five years according the directions of the mathematical curriculum literature review. The easiest way to access these materials is through the China National Knowledge Infrastructure (CNKI). The basic requirements are as follows: First, answering the question raised by literatures, researching the background, investigating the current status of domestic and international research, and fostering the ability of application consciousness of mathematics. Second, making it clear about the approaches addressing problems, and have a full master of the mathematical knowledge. The primary mathematical application consciousness has been possessed after implementing this requirement. Third, by comparing with the literature, considering if improvements can be done to further develop methods and if there are other problems can be studied with the methods in the literatures. It's important to cultivate students to integrate knowledge points, methods, thoughts, and problems in the mathematical application, and to develop their ability to establish mathematical models and provide solutions. Fourth, cultivating students to collect information from papers and the ability of summarization. Students have strong application consciousness of mathematics if implementing all the above steps. The extended requirements are based on implementing the basic requirements, including writing a paper individually or cooperatively, which indicates that students satisfy the primary mathematics application ability.

Students are also encouraged in the evaluation system to achieve multi-evaluation. By employing the teaching platform, a system containing student peer evaluation, self-evaluation, and teacher evaluation is utilized to provide comprehensive assessments. It's an important part for students joining the evaluation, because it can cultivate the application consciousness of mathematics and application ability of mathematics. Through the student peer evaluation, students can learn from each other. Through the self-evaluation, students can consider and improve their cognition and thoughts about problems. Student evaluations promote students' learning motivation and innovation spirit, and improve their interest and enthusiasm in study. Teacher evaluation can help teachers to timely know about students' learning status, and find problems for improving teaching methods and quality.

The topic of mathematical curriculum literature review analysis should be expressed at the first class in a new semester. The review report and paper should be submitted two weeks before course end. The evaluation should be done at the last class.

Through the statistics of quantitative quality analysis of literature review homework and class questioning, we took the matrix application in the Linear Algebra course as an example. The class major in material has 28 students who didn't perform the mathematics literature review homework, within whom 4 students has the primary application consciousness (14.29%) and no one has the

strong application consciousness and primary application ability. For the class with 31 students belongs to the major of metal material, after the first literature review training, 27 students have the primary application consciousness (87.10%), and 15 students have the strong application consciousness (48.39%), and 7 students have the primary application ability (22.58%). After the second literature review training learning about Bayesian formula, 31 students have the primary application consciousness (100%), and 25 students have the strong application consciousness (80.64%), and 16 students have the primary application ability (51.61%). It can be observed that beneficial from the mathematics literature review training, most students improved a lot in the application consciousness and application ability as shown in following table:

Table 1. Practical contrast table

Homework times /students number	Ratio of students with primary application consciousness (%)	Ratio of students with strong application consciousness (%)	Ratio of students with primary application ability (%)
0/28	14.29	0	0
1/31	87.10	48.39	22.58
2/31	100	80.64	51.61

4.3 Advantages of Curriculum Literature Review Method

The curriculum literature review method has the following characteristics in cultivating application consciousness and application ability of mathematics: putting study into practice, all students involved, consciousness enhancement, ability improvement.

First, the "three combination" based on curriculum literature review method has very clear direction, which can closely relate knowledge with application, and attract students participate in this process. This process is also incorporated into the assessment process, ensuring every student complete it conscientiously. Assessments are done by multi approaches, which involve all students.

Second, through the literature review, students can learn about how to build up application consciousness of mathematics and how to solve practical problems with concrete mathematical knowledge. The literature review can also help students to improve application ability in modelling process. The application consciousness has the opportunity to be informed, and the application ability has the opportunity to be improved.

Third, students can learn about the extensive application of mathematics, the sophistication of mathematical technique, the mathematical spirit of some scientists when solving problems in the concrete literature review process. Students can master the mathematical knowledge as well as the mathematical culture.

5. Summary

The cultivation of application consciousness and application ability of mathematics is a long-term process. By adopting the mathematical curriculum literature review method, it mobilizes the enthusiasm and proactiveness of students in participating in mathematical application. This closely combines theory and application, making the application consciousness has the origin and the application ability has the practical platform. Due to the time constraints in each teaching period, it is only possible to apply literature review method once per semester, which may result in a less deep cultivation of application consciousness and application ability. There is also another issue that teachers lack continuity in cultivating the application consciousness and application ability because of the changed classes. Therefore, the whole teaching team should cooperate together to improve the performance.

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