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Analysis of the feasibility of integrating innovative education into higher mathematics education

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Abstract: This paper takes the establishment of coordinate system, the establishment of calculus system and the discovery of t-distribution in advanced mathematics as a case to introduce what is innovation and entrepreneurship education in higher mathematics, further lists the Bertrand theory and other cases to illustrate the diversity of mathematical conclusions, discusses the basis of the integration of higher mathematics education and innovative education, and then expounds the necessity of integrating higher mathematics education with innovative education at the level of Maslow's psychological needs, and finally discusses the strategy of integrating innovative education in higher mathematics education.

1. Introduction

In the context of the new era, cultivating students' innovative thinking ability is an important goal of higher education education. The purpose of innovative education is not simply to enable students to acquire new ideas and methods, but to cultivate how to use new thinking and new methods to apply professional knowledge to social practice. With the rapid development of the economy, the role of advanced mathematics is expected to become more and more important, in the disciplines of society, whether it is traditional finance, economics, statistics and other majors, or the new big data, artificial intelligence, deep learning, etc. need relatively strong mathematical knowledge. It is particularly important to reflect the ability of innovative thinking in advanced mathematics, or how to organically combine higher mathematics education with innovative education. Many scholars have also made some analysis and exploration on this.

Sun Linpo[1] discusses the teaching situation and teaching mode of higher mathematics in the context of innovation and entrepreneurship education in this article, and gives some new methods of higher mathematics teaching. Yu Dajin[2] analyzed why higher mathematics innovation education should urgently highlight entrepreneurship education and the integration of mathematics and innovation education in the context of innovation and entrepreneurship education. Qu Yang[3] analyzes the current situation of higher mathematics teaching in the context of innovation and entrepreneurship education in the discussion on the reform of higher mathematics teaching in the context of innovation and entrepreneurship education, and explores the reform path and method of higher mathematics teaching. Hao Xiaoying[4] analyzes the teaching methods and strategies of higher

vocational higher education based on mathematics in higher vocational education in the context of innovation and entrepreneurship education. Duan Hongling[5] in the article Exploring the Training Model of Graduate Mathematical Innovation Talents Driven by Big Data, starting from the aspects of innovative thinking and innovative practice, and using mathematical modeling as the carrier, a talent training model suitable for postgraduate mathematical innovation practice platform was constructed. Shen Huihui[6] proposed in the analysis of the impact of university mathematics education on innovation and entrepreneurship education, in addition to teaching basic theoretical mathematical knowledge, university mathematics courses should combine the practical application of relevant mathematics textbook knowledge and research problems to extract appropriate mathematical knowledge and problems, so that students can think and grow in practice. Sun Yuefang[7] proposed a series of methods to enhance the integration of mathematics courses and innovation and entrepreneurship courses in the teaching reform of college mathematics courses and innovation and entrepreneurship education. Mei Zhengyang [8] started from the MCM/ICM special prize papers, analyzed the innovation points and thinking characteristics of the Chinese and American special prize papers, obtained some enlightenments of university mathematics innovation education, and put forward the direction of university mathematics innovation education. Li Hongxia[9] started from the strategies and methods of cultivating students' innovative thinking in mathematics, and gave some mathematical suggestions for the integration of innovative thinking and mathematics courses. Huang Ping[10] takes the new engineering as the background and creates an innovative practice base featuring mathematicalization and computational thinking, and explores the importance of the practice base to cultivate students' innovative thinking and innovation ability. Zhou Rongwei[11-12] took the School of Mathematics and Computer Science of Guangdong Ocean University as an example to discuss the role of the construction of innovation and entrepreneurship practice base on the cultivation of innovative talents in the context of the Guangdong-Hong Kong-Macao Greater Bay Area.

Based on previous research, combined with mathematical cases, this paper discusses what is innovative education in mathematics, the basis of the integration of mathematics education and innovative education, the necessity of integration of mathematics education and innovation, and the integration of innovative education strategies in mathematics education.

2. What is innovative education in mathematics

Mathematics has always felt rigorous, even rigid. From elementary school mathematics education to high school mathematics education, mathematics teachers are always emphasizing the rigor of mathematics and the similarity of mathematical answers. In the eyes of the world, it seems that mathematics is a discipline that has remained unchanged for a thousand years, and the mathematical content learned in different eras is exactly the same, and it is only used as the basis for further learning in many disciplines in application. Learning mathematics is impossible or difficult to innovate. Is mathematics really a constant subject? The answer is clearly no. In the development of mathematics, it is precisely because of the generation of new knowledge that it will constitute the rich mathematical knowledge we learn today.

When Newton studied the problem of variable speed linear motion, he found that the mathematical knowledge at that time could not solve this problem, and after unremitting efforts, he finally developed calculus and became the founder of calculus together with Leibniz. If Newton, who conformisted only of using the mathematical knowledge of the time to solve the problem of variable speed linear motion, then this question would not have been answered. Mathematics in the long river of history, for a long time mathematics was divided into algebra and geometry, especially geometry because of its abstraction, often has great difficulty, until the pioneer of modern analytic geometry, Descartes, established the concept of coordinate system, the number and shape organic combination,

so that the solution of geometric problems has a concise and effective solution, creating a new era of analytical geometry. These are examples of innovation. There are many such cases, and it is impossible to list them all.

Of course, some people may think that these are masters of mathematics, and it is normal to innovate in mathematics. What innovation can the average math learner have? This is a cognitive misunderstanding. When it comes to mathematical innovation, people always think that mathematical innovation is the creation of mathematicians, is the quality that only mathematical masters can have, and ordinary people's learning of mathematics is only a simple application of mathematics. It is the constraint of this view that makes many mathematics teachers lack their own cognition of innovation and entrepreneurship education, and it is difficult to pay attention to students' innovation ability and potential, and long-term adherence to the old mathematics teaching methods will affect the cultivation of students' innovative thinking ability. In fact, in the history of mathematics, there are many cases of ordinary people making great mathematical achievements,For example, Gesett found that the t-distribution is a good illustration.

The normal distribution, also known as the Gaussian distribution, is a distribution proposed by the prince of mathematics Gauss in error analysis, and is the most commonly used and important distribution in life. Because of theories such as the law of large numbers and the central limit theorem, in social or mathematical statistics, people always think that data will come down to a normal distribution. Until the quality inspector of a small brewery, Gesett, discovered the t-distribution when studying the quality inspection of small samples, creating a new era of statistical inference of small samples. Gesett was just an ordinary person, an ordinary math learner, an ordinary quality inspector job, but his careful observation of life led him to discover the t-distribution that caused statistical shocks. So innovation is not just a matter for math masters, ordinary math learners can also have innovation.

When it comes to mathematical innovation, many people always think that it is the invention and creation of mathematicians. It is the constraint of this concept that ignores the innovative potential of mathematics students and hinders the cultivation of students' innovation and entrepreneurship ability.

Innovative education in mathematics does not just refer to the innovation of knowledge. The core of innovative education in mathematics should be an educational concept that cultivates the innovative spirit and innovative ability of mathematics learners. Moreover, the integration of mathematics and innovative education is a basic and necessary work

3. The foundation for the integration of mathematics education and innovative education

Mathematics is inherently rigorous, but it is by no means a rigid subject. The results of mathematics can also have non-uniqueness, and here is an example of Bertrand theory. The charm of mathematics can be seen through this example.

The question is to take any string in a circle, and ask what is the probability that its length exceeds the side length of the bilateral triangle in the circle?

If a string in a specified direction is made with a diameter perpendicular to this direction, only the string that intersects the part of the diameter between one-quarter and three-quarters can exceed the side length of the regular triangle, and the answer to this question is one-half.

If one endpoint on the string is used as a tangent and the other end of the string moves randomly on the circumference, then the chord between 60 and 120 degrees to this tangent can exceed the side length of the regular triangle, and the probability is one-third.

If the position of the inner chord of the circle is uniquely determined by the middle point, and a concentric circle with a radius of only half of the original radius is made in the circle, then the midpoint of the inner chord of the major circle falls in the small circle, and the chord length can

exceed the side length of the regular triangle, and the probability is one-quarter. The three results are shown in Figure 1.

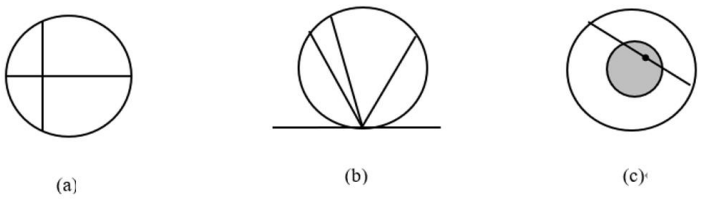

Figure 1: Bertrand Theory

There are three different answers to the same question, and because they just look at the sample space differently, all three answers are correct.

And mathematics is not only the result of theoretical arguments to be applied, such as there are many conjectures, Goldbach conjectures, four-color principles and so on, even if they are not demonstrated, it still does not affect its use. For example, the four-color principle says that no matter how complex the map, different areas of the map can be clearly represented in different colors with four different colors. The theoretical demonstration of this problem has not been proved so far, but the use of computer simulation technology, the theory is simulated, and finally it is possible to distinguish different map areas with only four colors, and this theory has also been widely used in cartography. Through this example, we can further see that mathematics also has a bold imagination, not a dazzle.

Mathematics is a discipline that makes bold assumptions and is carefully verified. Innovative education refers to developing innovative thinking, cultivating innovative spirit and having innovative ability on the basis of the original teaching. Mathematics education is an important educational module in modern higher education, mathematics education teaches students abstract thinking and logical reasoning ability, can improve students' ability to simplify and concretize some problems, innovative thinking training can enable students to think in a unique way to solve problems.

4. The need to integrate mathematics education with innovative education

Mathematics education in the course content and teaching mode are relatively perfect, relative to many emerging majors, mathematics is a historical discipline, in the modern education system, agriculture and forestry, arts and sciences, art and sports and other majors are generally opened university mathematics courses, for students' systematic training or scientific logical thinking cultivation. However, the teaching of mathematics courses in many universities is mainly the introduction of mathematical theories and the cultivation of the ability to use formulas to calculate, and lacks the presentation of cutting-edge content in mathematics. Students only achieve the cultivation of scientific thinking, and fail to learn new things from knowledge, and this talent training mode will hinder the progress of teaching to a certain extent. Therefore, it is necessary to integrate innovative education into mathematics education, cultivate students' ability to think innovatively, let students apply the knowledge of mathematics, and integrate the logical thinking of mathematics into the education of various subjects.

The famous psychologist Maslow has a Maslow's hierarchy of psychological needs, he divides people's needs into physiological needs, security needs, belonging needs, respect needs, and self-realization needs, as shown in Figure 2.

Figure 2: Maslow's psychological needs

Of course, everyone's positioning is different. Some people will say that not everyone who studies mathematics needs to embark on the road of innovation and entrepreneurship, right? It is true that not everyone needs entrepreneurship, but the spirit of innovation and entrepreneurship is necessary for everyone. The rigor of mathematics is by no means an excuse for conformism, and the multidimensional results of mathematics mentioned above are by no means blindly aggressive capital. Only by having an innovative heart that is constantly pursuing, cherishing dreams, only with the determination to start a business and putting courage into the blue strands of the road, can we achieve success, and only higher mathematics education integrated with innovative thinking can realize the self-worth needs of mathematicians.

5. Strategies for integrating innovative education in mathematics education

5.1 Infiltrate innovative ideas into the teaching of advanced mathematics

Innovative ideas are the prerequisite for scientific and social progress, and the teaching of methods is often more important than the transmission of knowledge. The knowledge content of mathematics is boring, many knowledge points students learn in class, and after a year or two, due to less use, they will also forget. But the way of thinking taught by teachers often benefits for life. Therefore, in the teaching of advanced mathematics, how to organically integrate thinking methods and knowledge points, and integrate innovative thinking into teaching, it is particularly necessary. Innovative thinking in mathematics is hidden, how to explore innovative thinking methods from the definition theorem example problems, and integrate these methods into the teaching, so that students not only learn the knowledge of mathematics, but also harvest mathematical innovative thinking methods.

Interest is the best teacher, and cultivating students' strong interest in mathematics is an effective means to pass on mathematical innovative ideas to students. In teaching, teachers should cultivate students' ability to question and criticize the existing achievements, and students' skepticism of corresponding knowledge and solutions will explore new methods, so that it is easier to infiltrate innovative thinking in teaching.

5.2. Reconstruct the teaching content of advanced mathematics

The traditional textbooks of advanced mathematics pay more attention to the inheritance of advanced mathematics knowledge points, and the source of knowledge points and the future development direction are often less involved, mathematical knowledge is more difficult to understand, if it is only a blind knowledge explanation, students often do not learn thoroughly. In order for more people to understand advanced mathematics, it is necessary to reconstruct the teaching content of advanced mathematics.

Teaching materials are the basis of teaching, but the teaching of courses can not only rely on

teaching materials, integrate innovative ideas into higher mathematics courses, form lectures and teaching plans with innovative thinking, and rely on good teaching resources to teach both good mathematical knowledge and innovative thinking. Of course, this is very demanding for teachers, and it puts forward high requirements for what kind of innovative thinking method of knowledge points is combined with and how to effectively combine them. However, as long as we can do a good job in reconstructing the teaching content of higher mathematics that integrates innovative thinking, we can complete the teaching of higher mathematics courses with half the effort.

5.3. Pay attention to the organic integration of theory and practice

Practice is the only criterion for testing truth, and so is empty talk and misleading the country, practical work prospering the country, and the teaching of advanced mathematical knowledge. Mathematics is not only theory, but also mathematics for practice. Mathematics is a discipline that goes from practice to theory and then from theory to practice.

The reason why many people find mathematics difficult to learn and understand is because of the lack of organic combination of mathematical theory and practice, and mathematics that cannot be practically applied by theory is empty, and students will find it difficult to grasp the key points when learning. Relying on mathematical modeling, with the help of MATLAB, SPSS, MATHEMATICA, integrate innovative thinking, combine different practical content in different advanced mathematics modules, for example, when teaching the knowledge of calculus, you can start from the solution of leaf meshed area, with the help of MATLAB software to visually show students the division and solution of area, which cannot be presented by traditional teaching methods, can only rely on computer software and innovative ways of thinking. In order to vividly explain to students the solution of the definite integral area. Students learn in this way to have a longer memory. Only by combining theory and practice can we avoid the separation of theory from practice and do a good job in inheriting advanced mathematical knowledge with innovative thinking.

When it comes to the practice of mathematics, many people think about running tutoring classes, educational institutions and so on. This is indeed one of the practical applications of mathematics, but by no means the only one. We can use the statistical knowledge we have learned to establish a data investigation and analysis agency, complete the collection, collation and analysis of data, and provide data feedback for the commissioning unit. More broadly, mathematical modeling in mathematics can be used to complete the connection between mathematics and practice, and apply mathematics to solve real-life problems, such as optimal planning problems, the establishment of product classification standards, data prediction and decision-making and other issues.

5.4. Establish an innovative management system for advanced mathematics assessment

One of the effective strategies for integrating innovative thinking into advanced mathematics is to improve the assessment management system. Colleges and universities must be aware of the shortcomings of traditional teaching evaluation in the evaluation system of advanced mathematics. In the new teaching management system, attention should be paid to innovating the content, methods and modes of assessment, reasonably adjusting the composition ratio of students' scores, and strengthening the assessment of students' innovative thinking ability. For example, short essays, practical teaching, experimental teaching and other links in the subject preface can be placed in the assessment of higher mathematics courses, and students can be encouraged to participate in mathematics competitions, mathematical modeling competitions, teacher training skills competitions and other competitions, and scores can be encouraged in the assessment of corresponding subjects. Such a multi-measure and perfect assessment system is not only conducive to assessing the professional knowledge of advanced mathematics, but also enables the effective development and

improvement of students' entire innovative consciousness and thinking.

6. Conclusions

This paper presents papers from four aspects: innovation and entrepreneurship education in mathematics, the foundation of integration of mathematics education and innovative education, the necessity of integration of mathematics education and innovative education, and the strategy of integrating innovative education in mathematics education, and analyzes innovative education in mathematics education based on actual cases of mathematics. The study of mathematics is rigorous and developmental, and a lot can be done in mathematics education by combining innovative thinking. Only by continuing to do a good job in the organic integration of mathematics education and innovative education can we do a good job in higher education.

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