

Reform and Development of Compulsory Junior Secondary Mathematics Curriculum in International Perspective

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Abstract: The purpose of this paper is to discuss the compulsory junior high school mathematics curriculum in terms of reform and development from an international perspective. First, the mathematics curriculum systems of different countries in the international arena and their advantages and disadvantages are introduced. Secondly, the current situation of the domestic compulsory junior secondary mathematics curriculum is analyzed, including the curriculum and students' academic level. Subsequently, drawing on the mathematics education reform practices in three countries, namely Singapore, Finland and the United States, the development trend of compulsory junior secondary mathematics curriculum in international perspective is proposed, such as the integration of technology and mathematics education and the focus on heterogeneous learners. Finally, it is suggested to strengthen teacher training and the introduction of multiple assessment systems for China's mathematics curriculum reform. Through this study, it is expected to provide useful reference and inspiration for the reform and development of compulsory junior high school mathematics curriculum in China.

1. Introduction

Compulsory junior middle school mathematics curriculum, as the foundation for cultivating students' mathematical literacy and scientific thinking, has been receiving widespread attention. In recent years, globalization and the rapid development of information technology have brought unprecedented challenges and opportunities to education in different countries. Under such a background, different countries have actively explored the reform and development of mathematics curriculum, seeking new education models and teaching strategies to meet the needs of the times. China, as one of the most populous countries in the world, has paid much attention to the reform of its compulsory junior high school mathematics curriculum. Therefore, this paper examines the mathematics education practices of three typical countries from an international perspective, with a view to providing useful reference for the reform and development of China's compulsory junior high school mathematics curriculum.

2. Overview of the Internationally Compulsory Lower Secondary Mathematics Curriculum

2.1 Comparison of mathematics curriculum systems in different countries

There are significant differences in the content, structure and teaching methods of the mathematics curriculum systems of different countries. Take the United States as an example, its mathematics curriculum focuses on cultivating students' mathematical thinking ability and problem solving ability, emphasizing the combination of theory and practice. Its mathematics curriculum system is divided into basic mathematics, algebra, geometry, probability and statistics and other subject areas to meet students' individual needs with diversified curricula [1].

In contrast, Singapore's mathematics curriculum is highly regarded internationally. Mathematics education in Singapore focuses on building a deep foundation of mathematical concepts in students and pursues a high level of development in mathematical thinking and logical reasoning. Its curriculum system emphasizes tiered teaching to ensure that each student learns according to his or her own learning abilities and interests.

And in Europe, Finland is regarded as one of the models of education. The Finnish mathematics curriculum focuses on developing students' creative thinking and problem-solving skills, and fostering students' interest and motivation in mathematics through inspirational teaching methods. The Finnish mathematics curriculum focuses on the holistic nature of education, combines mathematical knowledge with real life, and allows students to experience the joy of mathematics in practical applications.

2.2 Strengths and weaknesses of mathematics education in different countries

Mathematics education in different countries has its own strengths and weaknesses. The mathematics curriculum in the United States emphasizes the cultivation of students' innovative thinking and practical ability, and encourages students to conduct in-depth research and exploration in the field of mathematics. However, due to the relatively decentralized education system in the United States, there are large differences in curriculum standards and teaching contents among states and school districts, resulting in the problem of inequality in education still exists.

Mathematics education in Singapore has achieved remarkable success in international competitions and its mathematics standards have been consistently ranked among the top. This is attributed to Singapore's stringent teaching quality standards and teacher training system in mathematics teaching. However, the overly competition-oriented teaching model has resulted in a heavier learning burden for students, which may lead to learning anxiety and boredom.

Finnish mathematics education has attracted global attention with its unique teaching methods and educational philosophy. The Finnish mathematics curriculum focuses on the personalized development of students, fully respects their interests and needs, and fosters their ability to learn on their own initiative. However, the Finnish education system is more centralized, and this integrated education model is not easy to replicate in other countries and faces the challenge of adapting to a diverse student population.

Taken together, the mathematics education of different countries has its own strengths, which are worth learning from and studying. When reforming the compulsory junior middle school mathematics curriculum, we can learn from the experiences of different countries, combine them with China's national conditions and educational needs, and form a new model of mathematics education suitable for the development of our country, so as to promote the comprehensive improvement of students' mathematical literacy and innovation ability.

3. The current situation of the domestic compulsory junior high school mathematics curriculum

3.1 Curriculum and teaching content

In the curriculum of domestic compulsory junior middle school mathematics, it is usually divided into three grades: the first, second and third grades. The first stage mainly includes number and equation, graph and position, real numbers and algebra, focusing on cultivating students' basic mathematical concepts and calculation ability. The Elementary 2 stage further extends to functions and images, geometric transformations, etc., emphasizing the cultivation of students' mathematical thinking and problem-solving skills. The junior stage focuses on the comprehensive application of mathematics, including probability and statistics, trigonometry and other contents, laying a solid foundation for students' high school studies [2].

However, there are some problems in the current domestic mathematics curriculum. First of all, the content of the curriculum is relatively complicated, and students need to master a large number of knowledge points, which easily leads to excessive pressure on students' learning. Secondly, some teaching materials and teaching methods are still traditional, focusing on mechanical memorization and test-taking skills, and lacking effective ways to cultivate students' interest in mathematics and innovation ability. In addition, there are insufficient resources for teaching mathematics in some areas, resulting in uneven quality of teaching and a gradual widening of the gap between students.

3.2 Current status of students' academic level and learning attitudes

The overall academic level of mathematics of domestic compulsory education junior high school students has shown a trend of improvement year by year. According to statistics from the Ministry of National Education, in recent years, the average achievement in mathematics of junior middle school students in compulsory education nationwide has gradually and steadily risen, and the number of awards won by students in mathematics subject competitions has been increasing. This improvement has been made possible by the education department's attention to and reform efforts in mathematics education, as well as the hard work of teachers and the diligent study of students.

However, despite the increase in overall standards, some students still perform poorly in mathematics. Some students are anxious and bored with mathematics, believing that it is difficult to understand and of a strong test-taking nature. The formation of such learning attitudes is to a certain extent related to the setting of the teaching content and the teaching methods, and some schools focus on test-taking training to the neglect of students' actual interests and needs, resulting in a gradual decline in students' interest in mathematics. In addition, the lack of educational resources in some areas and the limited teacher strength and teaching facilities in schools have affected the quality of students' mathematics learning.

4. Compulsory Junior Secondary Mathematics Curriculum Reform Practices in International Perspective

4.1 Singapore's Mathematics Curriculum Reform Experience

Singapore has been regarded as a model of mathematics education, and its mathematics curriculum reform experience is worth learning from. The Singapore mathematics curriculum emphasizes in-depth understanding of mathematical concepts and the cultivation of mathematical thinking. In Singapore's mathematics curriculum, teachers focus on heuristic teaching, cultivating students' active learning and problem-solving abilities by posing questions and guiding them to

explore [3]. At the same time, Singapore's mathematics teaching attaches importance to the application of mathematics, emphasizing the practical use of mathematics in real life, so that students feel the charm of mathematics from life.

Mathematics education in Singapore also focuses on the need for students to personalize their learning. Mathematics courses of different levels of difficulty and content are offered according to students' learning levels and interests. Students can choose a mathematics curriculum that suits their learning situation so that they can better develop their mathematical abilities. In terms of teacher training, Singapore's mathematics teachers undergo rigorous selection and training, and they not only need to possess solid mathematical knowledge, but also need to have excellent teaching ability and educational philosophy. This lays a solid foundation for ensuring that students receive quality mathematics education.

4.2 The Case of Finland's Mathematics Education Reform

Finland is recognized as one of the countries with the highest level of education in the world, and its mathematics education reform case also provides useful reference for other countries. Mathematics education in Finland pays attention to the cultivation of students' creative thinking and problem-solving ability. In Finnish mathematics classrooms, teachers focus on guiding students to ask questions and conduct discussions to stimulate students' interest in mathematics and let them experience the joy of mathematics in their learning.

Mathematics education in Finland emphasizes the individual development of students. Teachers focus on understanding students' learning characteristics and interests, and tailor their teaching plans according to students' needs and abilities. This teaching mode that focuses on students' individual differences helps to stimulate students' motivation to learn and promotes their motivation to learn mathematics [4]. In addition, Finnish mathematics education emphasizes the combination of mathematics and real life. Through rich teaching cases and practical applications, teachers allow students to use their mathematical knowledge in real problems, so as to cultivate students' ability to apply mathematics.

4.3 Attempts to Reform the Mathematics Curriculum in the United States

The United States, as a major player in global education, has also made a series of reform attempts in mathematics education in recent years to adapt to the ever-changing social needs and educational concepts. These attempts aim to improve students' mathematical literacy, cultivate creativity, and strengthen the connection between mathematics and real life.

On the one hand, the reform of the United States mathematics curriculum focuses on emphasizing the cultivation of mathematical thinking and problem-solving skills. The traditional mathematics curriculum focuses mainly on algorithms and computation, but with the advent of the information age, pure computational ability is no longer sufficient. American education advocates the cultivation of students' mathematical thinking, including critical thinking, creative thinking and collaborative problem-solving ability. The new mathematics curriculum emphasizes students' active thinking, posing problems and exploring solutions through a variety of methods, thus stimulating students' interest and motivation to learn.

On the other hand, the United States mathematics curriculum reform emphasizes the connection between mathematics and real life. Educators recognize that mathematics should play a greater role in real-world problems, and the new mathematics curriculum focuses not only on theoretical knowledge, but also on the application of mathematics in science, technology, engineering and daily life. Through real-life examples, project studies and mathematical modeling, students can better understand the value of mathematics in solving practical problems and develop the ability to apply

mathematical knowledge to real-life situations.

However, the reform of the U.S. mathematics curriculum also faces some challenges. Due to the decentralized and localized nature of the U.S. education system, each state and school district has a certain degree of autonomy, leading to differences in the reform of the mathematics curriculum in different regions. At the same time, new teaching methods and concepts require adaptation and training for teachers, which takes some time and resources.

On the whole, the mathematics education reform experiences of Singapore, Finland and the United States provide useful reference and inspiration for the reform of the compulsory junior secondary mathematics curriculum in an international perspective. The mathematics education reforms in these countries all emphasize the cultivation of students' active learning and problem-solving abilities, the integration of mathematics education with real life, as well as the attention to students' individual development needs. Drawing on these experiences can help us optimize and improve the domestic mathematics education system and promote the overall enhancement of students' mathematical literacy and innovation ability.

5. The development trend of compulsory junior high school mathematics curriculum in international perspective

5.1 Integration of technology and mathematics education

In today's era of digitalization and informatization, the integration of technology and mathematics education has become an important trend in the development of compulsory junior middle school mathematics curriculum in international perspective. As a science and a tool, mathematics is inseparable from the development of modern technology. By integrating technology with mathematics education, it can better stimulate students' interest and motivation in learning mathematics and promote the application of students' mathematical knowledge in practical problems.

Modern technologies, such as computers, the Internet, and mobile devices, provide rich and diverse resources and tools for learning mathematics [5]. Mathematics education can use these technological tools to present students with vivid mathematical images, simulation experiments, and interactive learning. For example, using mathematical software and applications, students can explore mathematical concepts, solve real-world problems, and increase motivation through interactive learning games.

In addition, the integration of technology provides teachers with better pedagogical support and resources. Teachers can better organize the teaching process and assess student learning outcomes with the help of tools such as teaching management systems and online classrooms. At the same time, teachers are able to participate in online education communities and teacher training programs to continuously improve their teaching abilities and educational and pedagogical concepts.

5.2 Focus on Heterogeneous Learners

Another important development trend of compulsory junior high school mathematics curriculum in international perspective is to pay attention to heterogeneous learners. Heterogeneous learners refer to the group of students who show different learning characteristics and needs due to individual differences in the process of mathematics learning. Reasonable adjustment and optimization of mathematics curriculum and teaching methods for heterogeneous learners is the key to improving teaching effectiveness and students' academic performance.

Educationalists recognize that each student is unique and has different learning styles and learning rhythms. Therefore, it is an important trend in the development of mathematics education

to focus on focusing on heterogeneous learners and respecting students' individual differences. Teachers should understand the learning characteristics and needs of students and adopt diverse teaching methods to help each student develop his or her full potential. Tiered teaching is an effective method to divide students into different learning groups and provide math courses of different levels of difficulty and content according to their learning levels and interests.

6. Suggestions For Reforming The Compulsory Junior High School Mathematics Curriculum In China

6.1 The Necessity of Drawing on International Experience

Under the current background of globalization and informatization, drawing on international experience is crucial for the reform of the compulsory junior secondary mathematics curriculum in China. Many countries in the world have made remarkable achievements in mathematics education, and their experiences in mathematics curriculum reform provide valuable lessons and references for China. Through in-depth study of the mathematics education practices in Singapore, Finland, the United States and other countries, we can find the advantages and innovations and apply them to China's mathematics curriculum reform. Drawing on international experience can help us better solve the current problems facing mathematics education, optimize curriculum and teaching content, improve teachers' teaching level, stimulate students' interest and motivation to learn, and promote the development of China's compulsory junior high school mathematics curriculum.

6.2 Strengthening Teacher Cultivation and Development

In China's compulsory junior high school mathematics curriculum reform, teachers are crucial key factors. Therefore, strengthening teacher training and development is an important reform proposal. Teacher training should focus on the improvement of teachers' professional knowledge of mathematics and teaching ability, so that teachers can better understand the content of mathematics teaching and master advanced teaching methods and educational concepts [6]. Teacher training should also focus on the improvement of teachers' educational and teaching literacy, cultivate teachers' enthusiasm for teaching and sense of responsibility, and inspire teachers' love and commitment to the cause of education.

6.3 Introducing a diversified assessment system

Currently, China's compulsory junior high school mathematics education mainly relies on the traditional examination and evaluation system, which leads to an overly test-oriented teaching process and neglects students' actual learning outcomes and the overall development of their disciplinary literacy. Therefore, it is recommended that a multiple assessment system be introduced to evaluate students' mathematics learning outcomes in a more comprehensive, objective and integrated way. The multi-dimensional assessment system can include multiple aspects of assessment such as daily teaching performance, academic level tests, project research results, mathematical modeling competitions, classroom performance, and so on. Through comprehensive assessment, it can better reflect students' mathematics learning level and ability, encourage students' all-round development, and cultivate their comprehensive literacy and innovation ability. At the same time, the multiple assessment system can also promote teachers' teaching reform and innovation, and promote the improvement of teaching quality.

7. Conclusion

Under the background of globalization and technological progress, the reform and development of compulsory junior middle school mathematics curriculum in international perspective show diversified trends and innovative ideas. By comparing the mathematics curriculum systems of different countries, we learn the advantages and challenges of different countries in mathematics education. In this process, the integration of technology and mathematics education brings new possibilities for teaching and learning, prompting students to understand mathematical knowledge more deeply and apply it to practical situations. At the same time, focusing on heterogeneous learners can better meet the needs of different students and promote more personalized and diverse education. International experiences provide valuable insights for China's compulsory junior high school mathematics curriculum reform, especially the mathematics education practices in Singapore, Finland and the United States. In addition, China should strengthen teacher training and development, cultivate an excellent teaching force, and improve the quality of education and teaching. The introduction of a multiple assessment system can measure students' learning outcomes more comprehensively, reduce the pressure of test-oriented education, and encourage students to participate in learning more actively.

In summary, the reform and development of compulsory junior secondary mathematics curriculum in international perspective is a field full of challenges and opportunities. By drawing on international experience, integrating technology and mathematics education, and paying attention to individual student differences, we can cultivate new-age talents with more innovative abilities and international competitiveness, and make positive contributions to the development of global education.

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