The Development and Exchange of Mathematical Culture Between France and China

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Abstract:
Mathematical culture refers to the history of mathematics, mathematical spirit, mathematical ideas, mathematical methods, mathematical language, and mathematical education. Below, I will categorize mathematical history and the mathematical education to focus on discussing their development in China and France, as well as their differences and connections.

Keywords:
Mathematical culture, development, connections

1. Introduction

1.1 Research object

My research focuses on the specific content of mathematical culture between China and France, as well as the differences between them, and the academic or cultural exchanges in mathematics between China and France in history.

Mathematical culture refers to the history of mathematics, mathematical spirit, mathematical ideas, mathematical methods, mathematical language, and mathematical education. Below, I will provide a detailed explanation of the specific meanings of the remaining six issues.

The history of mathematics refers to how mathematics was generated and developed in these two countries; The spirit of mathematics, mathematical ideas, mathematical methods, and mathematical language can be grouped together, all of which belong to the academic aspect of mathematics. Mathematics education belongs to the third aspect of mathematical culture and is also the main way for mathematical culture to penetrate into human society. Mathematics education mainly includes primary mathematics education, corresponding to primary education; Secondary mathematics education, corresponding to secondary school mathematics education; Higher mathematics education corresponds to mathematics education for undergraduate students and above.

1.2 Research purpose

As two countries with a long history, China and France have both accumulated profound mathematical knowledge and formed unique mathematical cultures. I am curious about the general content and differences in mathematical culture between these two countries. This is also more conducive to the exchange of mathematical culture and academic aspects between the two countries.

1.3 Research significance

Studying the mathematical culture of China and France is of great significance for understanding the characteristics, advantages, and cultural factors behind their mathematical education. Through such research, we can gain a deeper understanding of the differences and characteristics in mathematics education between the two countries, thereby promoting mutual learning and communication, and improving the quality of each country's education. Meanwhile, this research also helps to reveal the manifestations and development trends of mathematical culture in different countries and ethnic groups, further promoting the development of global mathematics education.

Specifically, studying the mathematical culture of China and France can be carried out from the following aspects:

1.4 Objectives and concepts of mathematics education

Exploring the objectives and concepts of mathematics education in China and France, as well as their implementation in practice. This helps us understand the core values and guiding principles of mathematics education in both countries.

1.5 Curriculum and teaching methods of mathematics education

Analyze the curriculum, teaching methods, and evaluation systems of mathematics education in China and France. This helps us understand the implementation methods and effects of mathematics education in both countries.

1.6 Cultural connotation of mathematics education

Explore cultural elements in mathematics education in China and France, such as mathematics history, mathematics and real life, mathematics and science and technology, mathematics and humanities and arts. This helps us to understand the cultural heritage and characteristics of mathematics education in both countries.

1.7 International cooperation and exchange in mathematics education

Explore the cooperation and exchange between China and France in the field of international mathematics education, and share each other's successful experiences and lessons. This helps us understand the international perspective and influence of mathematics education in both countries.

In short, studying the mathematical culture of China and France is a topic of profound significance. It not only helps us better understand and grasp the characteristics and advantages of mathematical education in both countries, but also promotes the development and progress of global mathematical education.

2. The History and the Academic Development of Mathematics in France and China

2.1 The history and the academic development of mathematics in France

From a historical and traditional perspective, France is a country that highly values mathematics, and its mathematical traditions are excellent. It is truly a mathematical powerhouse and powerhouse Indeed, throughout French history, we will find that many famous mathematicians in the West originated from France: from Pascal, the founder of modern probability theory, to Fourier and Lagrange, from Descartes, the father of analytic geometry, to Simon Laplace, the discoverer of the Laplace equation, from Monge, the founder of descriptive geometry, to De Montmartre, a renowned figure in the field of probability theory, and so on. During the 17th to 19th centuries, France was definitely a leader in the field of mathematics worldwide.

Therefore, the famous German mathematician Gauss recorded an interesting

conversation in one of his biographies. A stranger in Paris asked the locals, "Why have so many great mathematicians emerged in your country's history?" The Parisian replied, "Our best people learn mathematics." The stranger then asked the French mathematician, "Why has your country's mathematics always been famous around the world?" The mathematician replied, "Mathematics is the best part of our traditional culture."

2.2 The history and the academic development of mathematics in China

Chinese mathematics originated from ancient times to the Western Han Dynasty, flourished from the mid Sui Dynasty to the late Yuan Dynasty, and declined from the late Yuan Dynasty to the mid Qing Dynasty. It can be seen that the development history of ancient Chinese mathematics has not been smooth sailing. Although China is currently in a backward position in the world mathematics competition, as long as we uphold the spirit of perseverance and courage of our Chinese ancestors, we can stand firm in the forest of world mathematics for a long time.

The Hundred Schools of Thought during the Warring States period promoted the development of mathematics, with some schools summarizing and generalizing abstract concepts related to mathematics. The definition and proposition of certain geometric terms appear in the Mojing, and the Mohist school also provides definitions of finite and infinite; Zhuangzi emphasizes abstract mathematical ideas. However, this new idea that emphasizes abstraction and logical rigor has not been well inherited and developed.

The Qin and Han dynasties were the period of formation of the ancient Chinese mathematical system. With the rise of private education, the Han Dynasty formed libraries and scriptures. The first stage of library education mainly involves literacy education and imparting some mathematical knowledge; Although the second stage involves reading and writing training, the focus shifts to cultivating students' ideological concepts and ethical morals. The Zhou Bi Suan Jing, compiled in the late Western Han Dynasty, had two mathematical achievements: firstly, it proposed special cases and universal forms of the Pythagorean theorem; The second is to provide the Chenzi method for measuring the height and distance of the sun. During the Wei and Jin dynasties, Chinese mathematics had significant theoretical development. Zhao Shuang, a native of Wu during the Three Kingdoms period, was one of the earliest mathematicians in ancient China to prove mathematical theorems and formulas. He not only provided detailed annotations to the Zhou Bi Suan Jing, but also rigorously proved the Pythagorean theorem using geometric methods in the Annotations to the Pythagorean Circle and Square Diagram, reflecting the idea of the cut complement principle; Liu Hui, a person from the Three Kingdoms, annotated "Nine Chapters on Arithmetic", and their work is considered to be the beginning of the theoretical system of ancient Chinese mathematics. The computational mathematics of the Song and Yuan dynasties entered its heyday, and a group of famous mathematicians and mathematical works emerged. Examples include Jia Xian's "Nine Chapters of the Algorithm for the Emperor", Qin Jiushao's "Nine Chapters of the Book of Numbers", Li Ye's "Measuring the Round Sea Mirror", Yang Hui's "Detailed Explanation of the Nine Chapters Algorithm", Zhu Shijie's "Four Yuan Jade Mirror", and so on. `

The greatest achievement of the Ming Dynasty was the popularization of abacus calculation, and the publication of Cheng Dawei's "Zhi Zhi Suan Fa Tong Zong" became a symbol of the transition from abacus calculation to abacus calculation. But this also led to the gradual loss of ancient mathematics based on calculation, and the stagnation of mathematical development.

3. The Mathematical Academic Achievement and Communication in France and China

3.1 The mathematical academic achievement in France

The mathematical community in modern France has achieved significant academic achievements in multiple fields. Here are some important achievements:

1) ***Mathematical analysis***
   French mathematician Henri Poincar é had a profound influence in the field of mathematical analysis. He is a pioneer in multiple fields such as differential equations, topology, and number theory, and has proposed many important concepts and methods in these fields.
2) ***Algebraic geometry***
   Algebraic geometry is an important branch of mathematics, and French mathematician Jacques Tits has made outstanding contributions in this field. His work promoted the development of algebraic geometry and had a profound impact on modern mathematics.
3) ***Probability theory***
   French mathematician Pierre Simon Laplace made significant contributions in the field of probability theory. His work laid the foundation for the development of statistical physics and quantum mechanics, and had a profound impact on modern statistics and data analysis.
4) ***Differential equation***
   French mathematician Jean Gustave Monge made significant contributions in the field of differential equations. His work promoted the theoretical development of differential equations and had a profound impact on modern mathematics.

The above are just some of the achievements of modern mathematics in France, and in fact, the contributions of French mathematicians go far beyond these. Their work not only promoted the development of mathematics, but also had a profound impact on other scientific fields.

3.2 The mathematical academic achievement in China

The academic achievements of modern and contemporary Chinese mathematics are very significant, especially in the following areas where significant breakthroughs have been made:

1) ***Differential geometry***

Academician Qiu Chengtong has had a profound influence in this field, and his work has been widely recognized and highly praised internationally.

2) ***Algebraic geometry***
Academician Wu Wenjun has made outstanding contributions in this field, and his work has not only had a profound impact domestically, but also received high praise internationally.

3) ***Algebraic topology***
Academician Liao Shantao has also made outstanding contributions in this field, and his work has also been widely recognized and highly praised internationally.

4) ***Partial differential equations***
Academician Gu Chaohao has made significant contributions in this field, and his work has not only had a profound impact domestically, but also received high praise internationally.

5) ***Dynamic system***
Academician Chen Shengshen has had a profound influence in this field, and his work has been widely recognized and highly praised internationally

6) ***Analytical Number Theory***
Academician Chen Jingrun has made outstanding contributions in this field, and his work has not only had a profound impact domestically, but also received high praise internationally.

The above listed achievements are only partial. In fact, Chinese mathematicians have made tremendous contributions in various fields of mathematics and have achieved many world-class results. These achievements not only enhance the international status of Chinese mathematics, but also make important contributions to the development of global mathematics.

3.3 The academic and cultural exchanges in mathematics between France and China

The academic and cultural exchanges in mathematics between France and China have a long history and diverse forms. Here are some specific examples:

1) ***Mathematics exchange activities between Chinese and French high school students***
The mathematics exchange activity between Chinese and French high school students is a good example, which aims to strengthen the teaching and research exchanges in mathematics between the two countries. The first Sino French High School Mathematics Exchange Event was held in 2014 to celebrate the 50th anniversary of the establishment of diplomatic relations between China and France, and achieved great success.
In addition, the second Sino French High School Mathematics Exchange Activity "Calculating with Him/Her" was held in Beijing in May 2017. The activity received support from the Chinese Ministry of Education and the French Ministry of National Education, Higher Education, and Research, and was jointly organized by the China France Education International Exchange Association and the French Embassy in China.

2) ***Youth Scholar Exchange Team of the School of Mathematical Sciences at Peking***

University

Another example is the Young Scholar Exchange Team from the School of Mathematical Sciences at Peking University, which visited France in June 2023. The delegation was led by Professor Zhang Zhifei, Vice Dean of the School, and the members of the team included young scholars such as Zhou Bin, Deputy Director of the Department of Mathematics, and Liu Baoping. During their stay in France, the exchange team had in-depth discussions with Professor Frederick Russelt, the head of the Mathematics Department at the University of Thackeray in France. The two sides focused on cutting-edge mathematical issues and sought opportunities for cooperation.

Overall, the academic and cultural exchange in mathematics between France and China not only promotes common progress in the field of mathematics, but also provides opportunities for the younger generation of both countries to learn and grow.

4. The Mathematical Education in China and France

4.1 The mathematical education in France

1) ***The current situation of mathematics education in France***

France's mathematics education has always been known for its high quality, and its level of mathematical research is internationally renowned. According to statistics, since the 1950s, 13 French people have won the Fields Prize, which is commonly referred to as the "Nobel Prize in Mathematics".

However, in recent years, mathematics education in France has faced some challenges. For example, during his first term, French President Macron attempted to reform high school education by abolishing compulsory mathematics courses for the first year of French high school from 2020, with the aim of reducing students' fear of mathematics and allowing them to enjoy high school learning more easily. This reform has led to a large number of students abandoning mathematics, resulting in a shortage of students in the French higher education system. Therefore, the French Ministry of Education has had to adjust its policy, starting from 2022, all first-year high school students in France are required to take one hour of compulsory mathematics classes per week.

2) ***The development Direction of mathematics education in France***

In response to the current challenges, French Minister of Education, Pap Ndiaye, has proposed a strategy to designate 2023 as the "Year of Mathematics Promotion". This strategy aims to enhance the mathematical abilities of all students and promote gender equality in the field of mathematics. Specific measures include providing math training to primary school teachers, including kindergarten teachers, encouraging junior high schools to establish math learning societies starting from the 2023 academic year, and establishing small math learning groups in the first grade of junior high school.

In addition, the French government is also considering integrating artificial intelligence into the education system. Faced with the sweeping fourth industrial revolution and the

wave of artificial intelligence, the French education sector has responded quickly and acted effectively in the global wave of artificial intelligence development. At the same time, it emphasizes the need to ensure that students form information ethics and media literacy that are good at distinguishing right from wrong, in order to resist the negative impact of the era of rapid technological advancement.

Overall, mathematics education in France is undergoing a series of changes aimed at adapting to new educational needs and social changes, while also striving to maintain its leading position in the global field of mathematics education.

4.2 The current situation and future development direction of mathematics education in China

1) The current situation of mathematics education in China

The current situation of mathematics education in China can be summarized from the following aspects:

(1) Educational philosophy: China's mathematics education emphasizes the holistic nature of mathematics, emphasizing the connections between various branches of mathematics. In addition, China's mathematics education is also attempting to combine receptive learning with self-directed inquiry learning to achieve better teaching results.

(2) Teaching methods: China's mathematics education adopts various teaching methods, including traditional teaching methods, discussion methods, experimental methods, etc. At the same time, students are also encouraged to learn through independent exploration.

(3) Curriculum Setting: China's mathematics education curriculum is relatively comprehensive, covering various fields of mathematics, aiming to cultivate students' comprehensive mathematical literacy.

(4) Existing problems: Although China has made certain achievements in mathematics education, there are also some problems, such as excessive emphasis on exam oriented education and neglect of the cultivation of students' practical application and innovation abilities.

2) The development direction of mathematics education in China

The future of mathematics education in China may develop in the following directions:

(1) Deepening curriculum reform: In the future, mathematics education in China will continue to deepen curriculum reform to adapt to new educational needs and changes in the social environment

(2) Strengthen quality education: In the future, mathematics education in China will pay more attention to quality education to cultivate students' practical and innovative abilities

(3) Promoting internationalization: In the future, China's mathematics education will actively promote internationalization to enhance the international influence of China's mathematics education

(4) Using scientific and technological means: In the future, China's mathematics

education will make full use of scientific and technological means, such as the Internet, big data, artificial intelligence, etc., to improve teaching efficiency and quality.

Overall, the current situation and development direction of mathematics education in China demonstrate that China is striving to improve the quality and efficiency of its mathematics education to better meet the needs of social and personal development.

4.3 Comparison and exchange of mathematics education between France and China

French mathematics education and Chinese mathematics education each have their unique characteristics and advantages. French mathematics education is renowned for its strict curriculum and high-level teaching quality, while Chinese mathematics education is recognized for its solid foundation and good exam results.

The following is a comparison of mathematics education between the two countries:

1) Educational objectives

French mathematics education places more emphasis on cultivating thinking abilities and practical applications, while Chinese mathematics education places more emphasis on laying a solid foundation and training logical abilities.

2) Teaching content

French mathematics education focuses more on modern higher mathematics ideas, while Chinese mathematics education focuses more on basic knowledge and exam skills.

3) Teaching methods

French mathematics education focuses more on restart and inquiry based learning, while Chinese mathematics education focuses more on lecture based and problem-solving skills.

4) Curriculum design

Mathematics education in France is spiraling upwards, with progressive learning, while mathematics education in China is systematized and gradually deepened.

5) International evaluation

French students have performed outstandingly in certain international competitions, while Chinese students have achieved excellent results in international mathematics competitions.

6) Recent changes

Mathematics education in France is facing challenges and needs to be reformed to cope with declining grades. Mathematics education in China is improving, increasing student participation and innovation.

From the above comparison, it can be seen that French mathematics education places more emphasis on students' thinking ability and practical application, while Chinese mathematics education has obvious advantages in basic knowledge and exam skills. Both countries are seeking improvement and innovation to adapt to constantly changing educational needs and challenges.

5. Conclusion

China and France have a profound foundation and unique contributions in the mathmatical culture, which is categorized in the history of mathematics, mathematics academia, and mathematics education. The following is a summary of these two countries in these areas:

5.1 History of mathematics

Chinese mathematics has a long history, with classic works such as the Zhou Bi Suan Jing and the Nine Chapters on Arithmetic dating back to ancient times. These works not only laid the foundation of ancient Chinese mathematics, but also had a significant impact on the development of world mathematics. For example, the circle cutting technique and the proof of Pythagorean theorem in "Nine Chapters on Arithmetic" are outstanding achievements in ancient Chinese mathematics.

The history of French mathematics also has a long and rich history. Since ancient Greece, France has had a tradition of studying mathematics. In the Middle Ages, France became one of the centers of European mathematics, and many outstanding mathematicians emerged, such as Descartes and Fermat. Their work laid the foundation for the development of modern mathematics.

5.2 Academic mathematics

Both China and France have achieved outstanding achievements in mathematical academia. Chinese mathematicians have made significant breakthroughs in fields such as algebra, geometry, and number theory, such as Chen Jingrun's proof of the "1+2" conjecture and Qiu Chengtong's K ä hler Einstein metric. These achievements not only enhance the international status of Chinese mathematics, but also contribute to the development of world mathematics.

French mathematicians have made significant achievements in fields such as topology, differential geometry, and number theory. For example, Grothendieck's theory of homology algebra and Alan Kone's work on differential geometry are outstanding representatives of French mathematics. In addition, France actively promotes the cross integration of mathematics with other disciplines, such as mathematical physics and mathematical biology.

5.3 Mathematics education

In terms of mathematics education, both China and France focus on cultivating students' mathematical literacy and innovation ability. Chinese mathematics education emphasizes the mastery of basic knowledge and the training of basic skills, improving students' mathematical level through extensive practice and exams. At the same time, China is also continuously promoting mathematics education reform, focusing on cultivating students' innovative thinking and problem-solving abilities.

French mathematics education places greater emphasis on students' self-directed learning and exploratory abilities. The mathematics curriculum in France is flexible and

diverse, encouraging students to freely choose the direction they are interested in for in-depth learning. In addition, France also attaches great importance to the combination of mathematics education and practical applications, cultivating students' practical abilities and innovative spirit through project-based learning and other methods.

In short, China and France have made unique contributions and profound foundations in the history of mathematics, mathematics academia, and mathematics education. The two countries have continuously promoted the development and progress of mathematics through mutual learning and exchange, making important contributions to the world mathematics cause.

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