

Analysis and Integration of Mathematics Culture in Mathematics Education

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Abstract – The education of mathematics should be integrated into the education of culture. By analyzing the cultural characteristics of mathematics and the educational function of mathematics culture, this paper explores the way of integrating mathematics culture. Through the integration of mathematics history, students can understand the process of the generation and development of mathematical knowledge, and carry out cultural accumulation; Introducing inquiry learning to cultivate students' cooperative ability and innovative spirit; The use of multimedia assisted teaching to show the beauty of mathematics to enhance students' cultural perception; Use mind map and mathematics composition skillfully to integrate mathematics culture education to improve learning interest.

Keywords – Mathematics Culture, Mathematics Education, Mathematical Quality, History of Mathematics, Inquiry Learning.

I. INTRODUCTION

The concept of mathematical culture was put forward by western scholars. The development of western philosophy of mathematics and human culture has promoted the formation and development of the concept of mathematical culture, and the concept of mathematical culture has provided a new concept for mathematics education [1]. Dianzhou Zhang believed that “today's mathematics education still lacks ‘mathematical culture’”. Many people who have studied mathematics for many years can neither observe mathematics from a cultural perspective nor examine culture from a mathematical perspective” [2].

Based on the related research materials of mathematics education and mathematics culture, this paper expounds the connotation, characteristics and educational functions of mathematics culture. Aiming at the functions of mathematics culture, such as developing rational thinking, cultivating application consciousness and improving comprehensive quality, combining with the current situation of mathematics education, this paper explores the forms and methods of the infiltration and integration of mathematics culture in mathematics education.

II. THE RELATED THEORETICAL ANALYSIS OF MATHEMATICAL CULTURE AND THE RESEARCH OF INTEGRATING METHODS

2.1. Research Status and Background

Mathematics is a kind of culture, and mathematics education should also be cultural education.

M. Klein, the famous American historian of mathematics, in his three books: *Mathematics in Western Culture*, *Mathematical thought Ancient and Modern*, and *Mathematics-The Loss of Certainty*. He made a systematic and profound exposition of mathematical culture from the perspective of the development of human culture [3].

Professor Xiaoli Sun of Beijing University made a systematic study and introduction of mathematical culture. She and Donggao Deng co-edited *Mathematics and Culture*, which collected the relevant treatises of some

mathematical masters, and also recorded the thinking on mathematical culture from the perspective of natural dialectics. Another book *Mathematics and Culture*, written by Minyou Qi, mainly expounds the cultural value of mathematics from the history of non-Euclidean geometry, especially points out the cultural significance of mathematical thinking [4].

According to the relevant literature, there are basically two kinds of research groups on mathematics culture and mathematics education: theoretical researchers, front-line teachers or researchers. The research results are basically divided into the following categories:

- (1) The research of mathematics culture includes the analysis and discussion of the connotation of mathematics culture, the research value of mathematics culture, research methods and so on.
- (2) Analysis of the educational value of mathematical culture. It mainly analyzes the aspects of cultivating rational thinking, humanistic spirit, innovation consciousness and moral education in mathematics culture education.
- (3) Some articles about teaching view, teaching strategy and teaching content. From the perspective of culture, the papers analyze the inadequacies in the existing teaching and the reasons, and tries to put forward some opinions on the teaching of infiltration of mathematics culture.
- (4) Research on the Current Mathematics Curriculum Standards and Textbooks. This kind of article mainly studies the requirement of the mathematics culture content in the curriculum standard, and puts forward the viewpoint that the mathematics teaching material should have the characteristics of the Times and be suitable for the students' learning law.

2.2. The Connotation of Mathematics Culture and its Cultural Characteristics

Mathematics is a scientific language, tool and technology that permeates every aspect of modern technology. Mathematics describes the abstraction of many material forms, which embodies the knowledge, experience and consciousness of human beings, and is an unnatural product created by human.

The thought and rules of mathematics form a relatively stable behavior system, which makes mathematics become an independent cultural form, which interacts and permeates with other cultural forms in the cultural system, and becomes a relatively independent and open subsystem of human culture and beings, which conforms to the broad definition of culture. Along with the course of history, mathematics spreads in different ways, and develops in the process of spreading, influencing and merging. Mathematics has the basic characteristics of culture and should be regarded as a culture [5].

According to the research of modern mathematics, in a broad sense, mathematical culture is a system with specific functions that takes mathematical scientific knowledge as the core and the related cultural fields radiated by the content, method, thought and spirit of mathematics as an organic part. Its basic elements are mathematics and various cultural objects related to mathematics.

Mathematics uses its unique symbolic language to describe various quantities, their relations and changes in the real world. This convenient, concise and normative symbolic language is accurate and profound. Mathematics describes the world by means of symbolization and abstraction. Mathematical thinking and methods are abstract, profound and unique. Mathematics is simple, harmonious and unified.

Mathematics has abstract nature, mathematics is an abstract subject. In the abstract world, a point has no size, a line has no width, and a surface has no thickness. Abstraction is eternal and does not change with matter.

The language expression, conclusion method and logic structure of mathematics are concise. Mathematical language is the carrier of mathematical thinking, with unique symbols, grammar and expression, accurate and rigorous. Every mathematical definition theorem is after repeated elaboration, mathematicians use the most concise language to express the most accurate and full meaning, with concise and clear symbols to describe complex relations. The simplicity of mathematics is also reflected in the way it is solved. For example, recursion method, modeling method, substitution method, elimination method, image method etc., all reflect the simplicity of mathematical methods and the wisdom of problem solving. Mathematics expresses the most complex theory in the simplest form.

Mathematical knowledge itself is deterministic, and the pursuit of completely certain and reliable knowledge. Mathematics needs to accurately describe concepts, definitions and theorems, and to draw accurate conclusions through rigorous logical reasoning and deduction [6].

Mathematics has inheritance, there is no inheritance, there is no accumulation, mathematical knowledge is formed in the long-term historical development process, its process shows that knowledge has inheritance.

2.3. *The Educational Function of Mathematics Culture*

Mathematics culture contains rich educational significance, which can improve the overall quality of students. Through the study of mathematics courses, students can master the main mathematical tools and cultivate students' logical thinking and rational thinking. Mathematics has an imperceptible influence on the formation of people's ideas, spirit and mode of thinking, and is of great significance to the formation and development of human rational spirit. The educational function of mathematics culture is mainly reflected in the following aspects [7].

- (1) Mathematical culture education can develop students' rational thinking. Rational thinking is an objective and rational attitude, a precise and quantitative method, an open mind and a critical spirit. It is an abstract, super-experiential thinking orientation. Students must have rational thinking in their mathematical accomplishment, so that they can receive good thinking training and develop the habit of dealing with problems rigorously and accurately, that is, rational spirit. The mathematics culture education can let the student learn this kind of rational, the effective thinking, establishes the mathematics science rational cultural belief [8].
- (2) Mathematical culture education can cultivate students' application consciousness. The object of mathematics is not only the object of objective reality, more is the product of abstract thinking, mathematics is rarely restricted by a specific situation, but the application of mathematics extends to all areas of society. In the education of mathematics culture, through the display of various application materials, let the students intuitively feel the application value of mathematics, can make the students establish and strengthen the application consciousness of mathematics.
- (3) Mathematics culture can enhance students' ability to appreciate beauty. Mathematical beauty has all the characteristics of scientific beauty such as logic beauty, content beauty, form beauty, thought beauty and method beauty. Its symmetry, conciseness and harmony can be seen everywhere. Strengthening

mathematics culture education can make students feel various mathematical methods and profound mathematical thoughts, appreciate the variety of mathematics in the development process, comprehend the rich and beautiful side of mathematics, and improve the ability of appreciation of beauty.

- (4) The mathematics culture education helps the student form the correct mathematics view. The concept of mathematics includes the understanding of the content and method of mathematics, as well as the application value, scientific value and humanistic value of mathematics. Mathematical culture enables students to realize that major discoveries in mathematics are often accompanied by breakthroughs in scientific cognition. Let students understand the relationship between mathematics and other subjects, understand the role of mathematics in promoting social development and progress [9].

In a word, the educational function of mathematics culture is three-dimensional and pluralistic, which can promote the all-round development of students and improve their overall cultural accomplishment.

2.4. Exploration on the Integration of Mathematics Culture in Mathematics Education

East China Normal University Professor Dianzhou Zhang pointed out, “Mathematical culture must enter the classroom”, “micro-mathematical culture research should be carried out from multiple aspects” [10]. Then, how to make mathematical culture into the classroom, give play to the value, role and function of mathematical culture, and how to make mathematical culture adapt to the classroom in an appropriate form?

Through literature review, investigation and interview, we can strengthen the education of mathematical culture from the following aspects.

- (1) Integrating into the history of mathematics, revealing the process of mathematical knowledge production and development.

The history of mathematics describes the development of the entire course of mathematics, is the context of mathematics, mathematics history is also one of the best ways to inspire mathematics teaching, history can play an important role in teaching. To the introduction of the history of mathematics classroom, such as introduce the history of the symbol form about mathematicians celebrity anecdotes, shows a difficult process of mathematical problem solving, tell students crisis three times in the history of mathematics and so on, through these, students understand the mathematical development and formation, hardships and exploration, rich and magical, stimulates the student to study and explore more mysteries, can stimulate students' thirst for knowledge.

- (2) Strengthen the connection between mathematics and real life and other subjects.

Mathematics is a tool subject, which not only serves for science, engineering, agriculture and medicine, but also permeates in archaeology, history, biology and other fields.

Mathematics should be a part of popular culture, and everyone should have a selective and differentiated grasp of valuable mathematics. Mathematics is all around us, such as deposits and loans, housing mortgages, stock market charts, price analysis tables, and so on. These things we encounter in our daily life are closely related to mathematics. To strengthen the practical connection between mathematics and production and life can make students intuitively understand mathematics and experience the application value of mathematics.

- (3) Enrich classroom teaching content and teaching method, introduce inquiry learning.

In terms of teaching content, researchers have been enthusiastic about the design of classroom teaching cases,

reflecting on previous teaching, trying to reveal the cultural connotation of mathematics through mathematical historical materials, revealing mathematical thinking and methods through algorithm comparison, and setting up the power of example through the deeds of mathematical celebrities [11].

In terms of teaching strategies, most researchers put forward that mathematics should return to life, strengthen the connection between mathematics and production and life reality, reduce the formal requirements of mathematics, focus on understanding and application, and let the educated understand the process of cultural creation to benefit from mathematics through observation and experiment.

Inquiry-based learning is a process in which students are encouraged to construct mathematical knowledge with their own knowledge and experience under the guidance of teachers. The process of construction is the process of inquiry. Students do not simply inherit learning, but carry out inquiry learning through “independent exploration, cooperative communication” on the basis of inheritance. Independent inquiry learning has the characteristics of autonomy, question, inquiry, activity, cooperation and multidimensional.

Inquiry-based learning can be carried out in groups, which is beneficial to cultivate students' cooperative spirit and enhance collectivism. Can enhance the students' language generalization, expression and communication ability and the ability to summarize and organize; To enable students to prove and guess and make reasonable deductive inferences. Through observation, summary, induction, conjecture and verification, cultivate students' rigorous scientific attitude and positive enterprising spirit, stimulate the interest and enthusiasm of learning mathematics.

(4) The use of multimedia assisted teaching can show the beauty of mathematics.

The content of mathematical culture is extensive and profound, rich and long history of mathematics, mathematical games that inspire wisdom, ever-changing mathematical methods, mathematical experts who dare to challenge, rigorous and scientific quality of mathematics. In the limited time and space, it is not enough to only rely on the teacher's blackboard, language, textbooks, wall charts and other presentation methods to show mathematics, intuitive, vivid, interesting multimedia assisted teaching plays an important role.

Multimedia combines sound, picture, animation, video, can mobilize students' hearing, vision, touch and other sensory organs. The use of information technology can vividly show mathematical knowledge, improve teaching methods, build mathematical culture atmosphere, enrich the connotation of mathematical culture, and achieve the purpose of improving students' sense and understanding of mathematical culture.

(5) Introducing mind mapping and mathematics composition to improve the interest of mathematics learning and integrate mathematics culture education.

Mind mapping is a kind of thinking visualization tool. It can connect the contents related to the core theme and show the connections and hierarchical relations between them. It can help students to understand things from a global concept, which is a key to the development of the brain. Using mind map to guide students to solve problems can show students' thinking process, train students' logical thinking ability, better organize and master knowledge, train their divergent thinking, and increase students' interest in mathematics learning [12].

Mathematics composition is a new teaching method, which provides a new situation for mathematics teaching. Math composition is a way for teachers to ask students to write according to what they have learned, so that they

can further deepen their understanding of mathematical knowledge [13]. Mathematics as a way to ask students to express their mathematical ideas in writing, reflect the process and experience of mathematical thinking, and show the results of students' mathematical inquiry and the existing problems. Appropriately adopting the form of mathematics composition to enrich the teaching methods of mathematics can help students to experience the fun of mathematics learning and improve the efficiency of classroom learning [14].

III. CONCLUSION

Through the integration of mathematics culture in mathematics education, students' rigorous and realistic scientific attitude and enterprising spirit of continuous pursuit can be cultivated. It can better cultivate students' mathematical thinking and improve their innovation ability. It can stimulate students' interest in learning, obtain positive emotional experience, cultivate students' excellent qualities, and finally achieve the goal of promoting students' all-round development and lifelong development.

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