The Current Status and Practical Reflections on Mathematics Culture Teaching in Primary Schools

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Abstract: The content of mathematics culture is both rich and profound, with immense educational value. Currently, several sets of experimental textbooks for primary school mathematics curricula in China place significant emphasis on mathematics culture, integrating it into classrooms. However, through literature analysis, surveys, and case studies, it has been discovered that the integration of mathematics culture effectively stimulates students' interest in learning and promotes the development of mathematical thinking and innovation capabilities. At the same time, challenges such as uneven distribution of teaching resources and insufficient cultural teaching competence among teachers persist. In summary, the teaching of mathematics culture in primary schools is critical for enhancing students' overall qualities. In the future, it is essential to strengthen teacher training, optimize resource allocation, and deepen the practice of mathematics culture teaching.

Keywords: Culture; Value; Current Status; Practical Reflections

1. Introduction

The term "mathematics culture," as a specialized term in the field of mathematics, was incorporated into the Ordinary High School Mathematics Curriculum Standards (Experimental Draft) in 2003. Since then, teaching research on mathematics culture has become a topic of interest among education experts and frontline teachers. The renowned mathematics educator Zhang Dianzou believes: "Mathematics culture must enter the classroom. In actual mathematics teaching, students should truly experience cultural influence, resonate with cultural values, and appreciate the cultural taste and human warmth of mathematics during their learning process. This requires analysis from a micro perspective, integrating mathematics culture into curriculum standards and textbooks, and embedding it throughout the entire teaching process." [1] The curriculum standards also point out: "Mathematics culture, as a component of textbooks, should be integrated into the entire set of textbooks." [2] In recent years, the author has paid considerable attention to this topic and conducted practical explorations and reflections.

2. The Educational Value of Mathematics Culture

The content of mathematics culture is rich and profound, and its educational value is immense. Professor Gu Pei of Nankai University pointed out in his book *Mathematics Culture*: "Through mathematics culture, students can appreciate the scientific, applied, and humanistic value of mathematics; broaden their horizons; enhance their macro understanding and holistic grasp of mathematics; be influenced by outstanding cultural elements; and understand the rational spirit of mathematics, thereby improving their cultural literacy." [3]

2.1 It Develops Students' Rational Thinking

Mathematics is the gymnastics of thought, shining with the light of wisdom in every aspect. The presentation of opposing concepts such as abstraction and concreteness, the known and the unknown, numbers and shapes, and necessity and chance all contribute to the development of students' mathematical thinking abilities, enabling them to truly understand the essence of mathematics. [4]

2.2 It Inspires Students' Spirit of Inquiry and Fosters a Broad Scientific Perspective

Knowledge of the history of mathematics and the stories of mathematicians at home and abroad pursuing truth, wisdom, innovation, and rationality effectively stimulates students'

interest in learning. This, in turn, cultivates their perseverance and pursuit of truth

2.3 It Enhances Students' Aesthetic Abilities

Mathematics is inherently beautiful, characterized by its symmetry, orderliness, simplicity, and uniqueness. Strengthening mathematics culture teaching allows students to subtly appreciate, reveal, and create mathematical beauty during their learning process. It inspires them to engage in creative thinking guided by the principles of beauty, helping them shape a well-rounded personality and enhancing their ability to discover and appreciate beauty.

2.4 It Fosters Students' Awareness of Applications

Education in mathematics culture can showcase the practical nature of mathematics, making its application a conscious behavior. Examples of the golden ratio abound in daily life: the design of matchboxes and national flag proportions, or the optimal positioning of stage hosts, all ingeniously utilize the "golden number" 0.618. These mathematical models in life stimulate students to love life, view mathematics as magical and beautiful, and consciously apply dynamic mathematical knowledge in practical scenarios.

3. The Current Status of Teaching in the Field of Mathematics Culture

Currently, several experimental textbooks for primary school mathematics curricula in China place significant emphasis on mathematics culture, featuring rich and diverse content and materials. These textbooks introduce students to interesting mathematical facts, discoveries, famous mathematicians' stories, and more through explicit forms such as "Did You Know?", "Mathematics Kaleidoscope," "Mathematics Reading," "Mathematics Stories," "Mathematics Games," and "Mathematics Perspectives." Taking the Southwest Normal University version of the textbook as an example, the entire set includes 35 "Did You Know?" sections, mostly appearing at the end of chapters, evenly distributed across grades. [5] The materials cover several aspects, including the origins and development of knowledge, mathematicians' stories, mathematics stories, applications of mathematics, and mathematical ideas (see Table 1 for details).

Table 1. Distribution of the "Did You Know?" Section in Southwest Normal University Version Textbooks

Grade 1, Volume 1	The Story of Zero	P50	Grade 1, Volume 2	The 100s in Life	P20
	The Origin of Arabic Numerals	P68		The Fifth Edition of RMB	P58
				Changes in Timekeeping Tools	P63
Grade 2, Volume 1	The Multiplication Table	P49	Grade 2, Volume 2	The Abacus	P22
	The Origin of the Unit "Meter"	P64		Mathematical Patterns in Life	P61
	The Origins of Multiplication and Division Signs	P98		The Tangram Puzzle	P69
Grade 3, Volume 1	The Compass: One of China's Four Great Inventions	P39	Grade 3, Volume 2	Ancient Chinese Mathematician Yang Hui	P21
	The Origins of Leap Years	P73		Symmetry in Architecture	P76
	The Origin of Fraction Symbols	P94		The Origin of the Decimal Point	P87
Grade 4, Volume 1	Place Value Systems in Life	P26	Grade 4, Volume 2	The Origin and Function of Parentheses	P7
	The Clever Gauss	P39		The Famous Mathematician Hua Luogeng	P46
	Wonderful Multiplication	P61		The Evolution of Calculating Tools	P86
Grade 5, Volume 1	"Trouble" Caused by the Decimal Point	P22	Grade 5, Volume 2	Chen Jingrun and Goldbach's Conjecture	P17
	The Story of Tian Ji's Horse Racing	P77		Archimedes and the Crown	P59
	The Nine Chapters on the Mathematical Art	P98		Ancient Equations	P94
Grade 6, Volume 1	Ancient Chinese Mathematician Zu Chongzhi	P28	Grade 6, Volume 2	Ancient Geometry	P38
	Clever Borrowing "1" Method	P61		The Origin and Development of Statistics	P63
	The First Country to Use Negative Numbers	P92		The Chicken-and-Rabbit Problem	P83

Mathematics culture has entered classrooms as an independent column in the Southwest Normal University version of experimental textbooks. But how do frontline teachers and students perceive it? What is the current status of teaching? The author conducted a survey of

18 mathematics teachers and 200 students (grades 4, 5, and 6) from two schools familiar to the author.

3.1 Teachers' Understanding of Mathematics Culture and Teaching Practices

The survey included the following aspects: understanding of mathematics culture, the presentation of mathematics culture in textbooks, lesson scheduling, and teaching methods (Table 2).

3.1.1 Understanding of the concept and educational value of mathematics culture

The statistics show that only 60% of teachers have a relatively clear understanding of the concept of mathematics culture, recognizing it through aspects like mathematical history, mathematical ideas, and mathematical beauty. Optimistically, 100% of teachers selected all options in question 2, indicating unanimous agreement on the educational value of mathematics culture. They believe it promotes students' emotional attitudes and values, enhances aesthetic abilities, integrates mathematical ideas and methods, develops mathematical thinking, enriches mathematical knowledge, and broadens horizons. The educational value of mathematics culture has been fully recognized by frontline teachers

Table 2. Questionnaire on Teachers' Understanding of Mathematics Culture and Teaching Practices

1. Your understanding of the concept of "mathematics culture" is (): A. Very clear B. Relatively clear C. Somewhat clear D. Not clear
2. The educational value of "mathematics culture" is () (multiple choices allowed): A. Integrating mathematical ideas and methods to develop students' mathematical thinking B. Enhancing students' aesthetic abilities C. Promoting students' emotional attitudes and values D. Enriching students' mathematical knowledge and broadening their horizons
3. Your understanding of the presentation forms and content of "mathematics culture" in the entire set of textbooks is (): A. Very clear B. Relatively clear C. Somewhat clear D. Not clear
4. The primary time you allocate for teaching "mathematics culture" is (): A. Mathematics class B. School-based integrated practice class C. No specific class time; not covered
5. Your usual teaching methods for "mathematics culture" are () (multiple choices allowed): A. Teaching integrated with specific content B. Encouraging self-learning C. Briefly mentioning it when teaching mathematical knowledge, allowing students to read it themselves D. Not teaching it
6. You () actively collect other related mathematical culture knowledge to introduce to students.
A. Frequently B. Rarely C. Never

3.1.2 Current teaching practices of mathematics culture

Results indicate that only 50% of teachers are clear about the content of the "Did You Know?" sections in the entire set of mathematics textbooks, which can be attributed to multiple factors. Regarding teaching methods, 60% of teachers chose to let students read the content when appropriate, 20% encouraged self-learning due to a lack of teaching experience in this area, 15% did not teach it due to the absence of lesson plans in

teaching reference books, and only 5% combined it with specific content in their teaching. When asked whether they actively collect additional resources on mathematics culture, 90% of teachers admitted they do not prioritize this area and never collect additional materials.

3.2 Students' Understanding and Learning of Mathematics Culture

The survey covered the following aspects: familiarity with the "Did You Know?" sections in mathematics textbooks, interest in mathematics culture, and learning methods (Table 3).

Table 3. Questionnaire on Students' Understanding and Learning of Mathematics Culture

1. Your familiarity with the "Did You Know?" sections in the mathematics textbooks is (): A. Frequently read; very familiar B. Relatively familiar C. Only read when assigned by the teacher; somewhat familiar D. Not familiar
2. Your interest in the "Did You Know?" sections in the mathematics textbooks is (): A. Very interested B. Interested C. Not very interested D. Not interested
3. The "Did You Know?" sections in the mathematics textbooks help you in () (multiple choices allowed): A. Expanding mathematical knowledge B. Learning about mathematicians and mathematical history C. Appreciating the beauty of mathematics D. Understanding the applications of mathematics in life
4. Have you read books about mathematics culture outside of class? (): A. Frequently B. Occasionally C. Never

3.2.1 Students' interest in mathematics culture

60% of students reported frequently reading the "Did You Know?" sections and expressed great interest in them. Additionally, 30% of students showed moderate interest. This indicates that the mathematics culture content in textbooks effectively stimulates students' interest in reading and motivates them to learn and explore voluntarily, rather than being teacher-mandated.

3.2.2 Students' learning methods for mathematics culture

The survey indicates that textbooks are the primary source for students to access mathematics culture. Regarding the question, "Have you read any books related to mathematics culture outside of class?" 80% of students stated that they have never read such books. This could be related to the limited availability of mathematics culture books suitable for primary school students.

4. Practical Reflections

From the above analysis, it is evident that, over the past decade of curriculum reform, frontline mathematics teachers have deeply recognized the value of integrating mathematics culture into teaching and have gradually incorporated it into their lessons. However, their understanding of its essence remains incomplete, and their teaching methods are relatively simplistic. While students show strong interest in mathematics culture, the channels through which they access it are limited. How can mathematics culture teaching be conducted more effectively to internalize students' mathematical literacy? Based on my teaching practice, I have explored the following aspects:

4.1 Enhancing Teachers' Literacy and Fully Understanding the Cultural Essence

The kind of talents we cultivate largely depends on the educational philosophy and teaching behaviors of teachers. The renowned educator Sukhomlinsky stated in his book *The Art of Education*: "I am a thousand times convinced that without a poetic sense of emotion and beauty, there can be no comprehensive intellectual development for students." Therefore, frontline mathematics teachers must constantly draw from the "living water" of knowledge. As the saying goes, "To do a good job, one must first sharpen their tools." Teachers need to continually learn, improve their mathematical expertise and cultural literacy, and understand

the background, significance, systemic structure, ideas, humanistic perspectives, and aesthetic values inherent in primary school mathematics knowledge. Teachers should be aware that mathematics culture can be conveyed through a variety of rich historical materials, such as the lives and achievements of mathematicians, mathematical events and outcomes, classical historical problems, and anecdotes about mathematicians [6]. Additionally, it can be embedded in the generation, development, and application of mathematical knowledge, such as mathematical reasoning, ideas, and beauty. For example, when deriving the formula for the area of a circle, after hands-on activities, guide students to imagine "infinite subdivision" based on "finite segmentation." Help them realize, "The more segments there are, the smaller each segment becomes, and the closer they get to triangles, forming a shape that increasingly resembles a rectangle." Through infinite subdivision, students can see that "the reassembled circle truly becomes a rectangle," simultaneously exploring knowledge and understanding the concept of limits as a reflection of mathematics culture.

4.2 Strengthening the Role of the Classroom and Ensuring Effective Integration

The classroom is the primary avenue for students to learn mathematical knowledge, and the study of mathematics culture should be more prominently reflected in classroom teaching. Professor Zheng Yuxin pointed out: "Your teaching reflects mathematical thinking well, making you a ‘sage.’ You bring true wisdom to your students. Furthermore, if your mathematics teaching can provide students with intangible cultural immersion, then, even if you are only a primary school teacher working in a remote mountainous area, you are a true master, and your life is imbued with genuine value" [7]. Thus, every mathematics teacher should strive to improve the effectiveness of teaching mathematics culture. Here, I analyze my teaching practice with the "Did You Know?" section on the "Chicken-and-Rabbit Problem" as an example.

4.2.1 Creating contexts to spark interest and introduce the problem

a. "Class, about 1,500 years ago, an ancient Chinese mathematical classic *Sunzi Suanjing* recorded an interesting mathematical puzzle. Let’s take a look."

b. Understanding the Problem:

(1) Display the original problem on the slide: "There are chickens and rabbits in the same cage. There are 35 heads above and 94 feet below. How many chickens and rabbits are there?"

(2) Can you explain what is the meaning of this question?

Guide students to explain: "There are some chickens and rabbits in the cage. From above, there are 35 heads; from below, there are 94 feet. How many chickens and rabbits are there?"

c. Revealing the Topic:

"This is one of the most famous historical mathematical puzzles in China, the 'Chicken-and-Rabbit Problem.' Today, we will explore the 'Chicken-and-Rabbit Problem.'" (Write the topic on the board.)

4.2.2 Independent exploration and problem solving

a. Simplifying the Problem

The original problem involves large numbers, which are inconvenient for exploration. We can start with a simpler problem to seek a solution.

Modified problem: In a cage, there are several chickens and rabbits. From above, there are 8 heads, and from below, there are 26 feet. How many chickens and rabbits are there? (Note: Referencing a problem from the Renjiao edition textbook.)

b. Exploring the Solutions

(1) Requirements: First think independently, then discuss in groups to find solutions.

The teacher guides and participates in group discussions.

(2) Student feedback and sharing their ideas:

Method 1: Listing (see Table 4 for details)

Table 4. Tabulation

Name	Number								
Chicken	8	7	6	5	4	3	2	1	0
Rabbit	0	1	2	3	4	5	6	7	8
Feet	16	18	20	22	24	26	28	30	32

Conclusion: There are 3 chickens and 5 rabbits.

Method 2: Solving with an Equation

Solution: Let the number of rabbits be xxx, then the number of chickens is (8－x)

$4x+2(8-x)=26$

$x=5$

Chickens:$8-5=3$(chickens)

Follow-up question: What do 4x and $2(8-x)$ represent?

Method 3: Assumption Method

① Assume there are only chickens in the cage. Then there would be $8\times2=16$(feet). The actual count exceeds this by 26-16=10 feet. Since each rabbit accounts for 2 more feet than a chicken, the number of rabbits is $10\div2=5$.

② Assume there are only rabbits in the cage. Then there would be$8\times4=32$ feet. The actual count is 6 fewer, 32-26=6(feet). Since each chicken accounts for 2 fewer feet than a rabbit, the number of chickens is $6\div2=3$.

c. Summarizing the Methods

Teacher: "Class, what methods did we use to solve this interesting math problem?"

Student feedback: Listing, equation solving, assumption.

d. Solving the Chicken-and-Rabbit Problem in *Sunzi Suanjing*

Students choose their preferred method to solve the problem independently and report their solutions.

e. Introducing the Ancient Method for Solving the Chicken-and-Rabbit Problem

The ancient method: Assume each chicken lifts one foot, and each rabbit lifts two feet. Then there are $94\div2=47$ feet. Under this condition, each chicken contributes one foot, and each rabbit contributes two feet. Since the total number of feet exceeds the total number of heads by 1 for each rabbit, the number of rabbits is 47-35=12.

4.2.3 Extending applications

1. Boat problem

2. Greeting card problem

4.2.4 Summary

1. Today, we solved the Chicken-and-Rabbit Problem using listing, assumption, and equations. Think: Where else in math learning have we used listing or equations?

2. I hope you will observe life through the lens of mathematics and use it to solve real-world problems in the future.

Analysis and Reflections: At the beginning of the lesson, introducing the origin of the famous problem "Chicken-and-Rabbit" helped students appreciate the depth of ancient Chinese mathematics, broadening their horizons and stimulating their curiosity. During the analysis and problem-solving phase, methods such as independent thinking, group collaboration, and teacher guidance nurtured approaches like listing, equation solving, and assumption. These methods effectively incorporated mathematical concepts like the combination of numbers and shapes and modeling. Furthermore, presenting the ancient "lifting legs" method impressed students with the wisdom of ancient mathematicians. In the consolidation and summary phase, students tackled problems involving similar quantitative relationships to the Chicken-and-Rabbit Problem and explored instances of using listing or equations in mathematical studies. This process enabled students to observe, analyze, and solve problems mathematically, fostering an appreciation for the value of mathematical knowledge.

4.3 Using Applications as a Starting Point to Reflect in Multiple Forms

Due to the limitations of teaching time and space, only part of mathematics culture teaching can be completed in the classroom. Diverse activities are needed to achieve it. The *Curriculum Standards* state: "Mathematics teaching is the teaching of mathematical activities. Teachers should closely connect with students' living environments, starting from their experiences and prior knowledge, to create vivid mathematical scenarios…" Additionally, they emphasize: "It is important to learn and understand mathematics from students' life practice experiences and prior knowledge." [8] This highlights that teachers should guide students in combining life and mathematics learning, bringing familiar, relatable, real-life mathematics into their view, allowing them to perceive and discover the role and significance of mathematics. Students should learn to observe the world around them mathematically, enhancing their awareness of mathematics' applications.

4.3.1 Hands-on practice

Encourage students to engage in activities such as making, assembling, arranging, folding, cutting, measuring, and pasting, involving both their hands and minds. For example, after learning how to calculate the circumference of a circle, organize students to

draw a sports field. The width of track lines and the dimensions of lanes typically follow standard regulations. When the finish lines for 100m, 200m, 400m, and 800m races are determined, how can the starting points be calculated? How should the forward extension for each lane be determined? How should the angles for javelin, shot put, and discus fields be set? While the mathematical knowledge involved is simple, applying it in practice can be challenging. Through the teacher's guidance, students can realize the rich mathematics embedded in the track. [9] Another example is when second graders learn about various plane shapes in the second semester. They can explore the "Did You Know?" section about tangrams and use them to create various interesting patterns. Such activities help students feel that learning mathematics is enjoyable, which inspires interest and curiosity. This fosters a willingness to learn mathematics and teaches them basic methods of acquiring knowledge—such as observation—while cultivating their imagination and creative thinking.

4.3.2 Game activities

Incorporate appropriate games into mathematics lessons to deepen or expand students' mathematical knowledge, train and develop their thinking, and enhance problem-solving and analytical skills. Examples include "24 Points," matchstick puzzles, Tetris, domino magic, single-stroke drawings, and number grid challenges. [10]

4.3.3 Organizing storytelling competitions

Conduct storytelling competitions in the classroom involving mathematics-related stories. Students could share stories such as how Descartes created the coordinate system by determining the position of a fly or how Chen Jingrun dedicated over ten years of intense research to solving the famous "Goldbach Conjecture," regardless of extreme heat or cold. These activities help students gain an initial understanding of the origins and development of mathematics, appreciate its contribution to human civilization, foster an interest in learning mathematics, deepen their understanding of mathematical knowledge, and illuminate the humanistic value of mathematics.

4.3.4 Practical applications

Use after-class time or holidays to organize social practices such as statistical surveys, practical applications, and experiential activities. For instance, after learning about symmetry, students can collect pictures of real-world examples of axial symmetry and share their insights.

Such practices help further students' understanding of symmetry in reality, allowing them to see its applications in daily life, appreciate its unparalleled beauty, and learn to analyze and explore the mysteries of the world mathematically. Assigning real-life contexts to mathematical problems deepens students' understanding of mathematical knowledge and enhances their awareness of society and human development. This fosters an understanding that mathematics is useful, applicable, and powerful. As a result, students will be motivated to use mathematics, appreciate its practical value, and achieve the goals of multicultural mathematics education.

5. Conclusion

In summary, mathematics is fascinating. As frontline primary school mathematics teachers, we must use our wisdom to fully explore the boundless cultural charm within textbooks. By creating an environment conducive to lively and proactive learning, we can build a mathematics classroom culture that enables children to enjoy mathematics and use mathematics. Let us strive to make our mathematics classrooms vibrant and full of life.

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