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Research on permeation of mathematics culture in primary school mathematics teaching in China

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Abstract
In the process of mathematics teaching in elementary school, in addition to cultivating students' good mathematics habits and teaching students mathematics theory knowledge, teachers should also let students understand mathematics culture. Through infiltrating mathematics culture in the primary school mathematics teaching, the efficiency of the primary school mathematics teaching is improved, and the comprehensive quality of the students is improved. There are a lot of researches on the infiltration of mathematics culture in the primary school mathematics teaching in China. These researches have not only improved and enriched the theory, but also get practically applied and made good feedback in the actual classroom teaching. The research includes aspects such as meaning, method, and status, and there are also some shortcomings. This paper sorts out literature on the infiltration of mathematics culture in primary school mathematics teaching, summarizes relevant viewpoints and conclusions, puts forward our own views and forecasts the future research.

Keywords: primary school mathematics teaching, mathematical culture, primary school mathematics, mathematical learning

1. Introduction
"Compulsory Education Mathematics Curriculum Standard (2011 Edition)" states that "mathematics is a culture of human beings, and its content, ideas, methods and languages are important components of modern civilization" (Ministry of Education of the People's Republic of China, 2011) [1]. For primary school mathematics teaching, the study of infiltrating mathematics culture in primary school mathematics teaching, exploring its understanding and practice, can not only greatly enrich the theoretical connotation of primary school mathematics education, but also has more profound practical significance (Tian, Y., 2017) [2]. Therefore, in recent years, more and more university researchers and primary school educators have devoted themselves to research in this area, and have achieved fruitful results in both theory and practice. In order to further enrich the study of infiltrating mathematics culture in mathematics teaching in elementary school, and to fill in the blank aspects of research, this paper reviews literature on the infiltration of mathematics culture in elementary school mathematics teaching.

2. The connotation of mathematical culture
The connotation of mathematics culture is very rich, so far there is no unified definition. Some scholars believe that mathematics culture is the position and role of mathematics in science; some believe that it is to cultivate rigorous quality and innovative spirit through rational thinking; others think it is a unique idea and method of mathematics. From the perspective of mathematics, Huang Qin'an believes that mathematics culture is the sum of mathematical concepts, consciousness, psychology, historical events, characters and mathematics that transcend (enlarge and contain) the scope of mathematical science. From a cultural point of view, Gu Pei believes that the narrow sense of mathematics culture is the exponential thoughts, viewpoints, spirits, methods and their formation and development; the definition of the broad sense also includes the history of mathematics, the beauty of mathematics, the education of mathematics, the intersection of mathematics and humanities, mathematics and the relationship between various cultures, etc. From a systemic point of view, Wilder was first proposed in 1981. He believes that mathematics culture is a dynamic system with powerful spiritual and material functions based on the mathematical science system and the related cultural fields radiated by mathematical thoughts, spirits, knowledge, methods, techniques and theories (Shi, Y. P. & Shang, X. Z. & Yang, Q. S., 2016; Zhang, F. & Jin, Y. P., 2017) [3, 4].
In addition, the meaning of mathematical culture is frequently misunderstood in the process of practice and exploration. Qiu Xinggang believes that the main manifestations are in two aspects. On the one hand, the concept is narrowed, means that the mathematical culture is simply equated with the history of mathematics, on the other hand, the concept is generalized, means that the mathematical culture is confused with the classroom culture (Qiu, X. G., 2007) [5].

3. The principle of infiltrating mathematics culture in mathematics teaching in primary schools
1. Historic principles: Let students understand the history of mathematics culture and its impact on human development. From the perspective of mathematics history, we will explore the mathematical and cultural materials related to the teaching content, so that students can understand the origin and development process of mathematics as much as possible to inspire students to actively think about problems and improve their thinking ability.
2. Applied principles: Mathematical culture stems from life

and is developed to solve practical problems around us. Let mathematics culture be close to life, pay attention to the application of mathematics culture in life, and do not let theory and reality out of touch.

3. Ideological principles: Mathematical culture is ideological, which is reflected in some mathematical formulas, theorems and algorithms that are usually learned. In the process of teaching the development of mathematics knowledge, the teacher reveals the thinking process of acquiring knowledge and allows students to establish a correct mathematical view in the process of infiltration of mathematics culture.
4. Aesthetic principles: the beauty of mathematics, that is, a state of mind when getting mathematics knowledge or solving mathematics problems. Through infiltrating the mathematical beauty in mathematics culture, students can develop the interest and motivation to learn mathematics, improve the ability of mathematics appreciation and aesthetic taste (Zhang, W. & Yang, T., 2017) [6].

4. The significance of infiltrating mathematics culture in mathematics teaching in primary schools

From the perspective of needs, Li Shiyong and Zhang Yan believe that infiltrating mathematics culture in primary school mathematics teaching has the following meanings. (1) The penetration of mathematical culture is the need to create situations. By creating knowledge-related or similar situations, students can explore learning, discover learning, and enjoy learning in a specific environment. In the teaching of "Wide Angle of Mathematics -- Collection" in the second volume in the third grade of the People's Education Press, the "Mobius Belt" was introduced in the link leading before class. (2) The penetration of mathematical culture is the need to impart new knowledge. Teachers should pay attention to students' life experiences and let students feel the practice in vivid and specific situations. For example, in the second volume of the third grade of the People's Education Press, the content "Year, Month, and Day" allows students to combine their own life experiences and observe the number of days in February of different years, which leads to the knowledge of ordinary and leap years. (3) The penetration of mathematics culture is the need of teachers to improve them. Teachers should raise their quality of culture from both theoretical and practical aspects. Mathematics teaching in primary school involves the Fibonacci sequence, Cyclotomic Method, and mathematics culture of the chicken and rabbit cage in Sun Zi Suan Jing. This requires teachers themselves to have sufficient reserves of mathematical culture knowledge first (Li, S. Y., 2016; Zhang, Y., 2018) [7, 8].

From the perspective of personal development of students, Cao Jianling, Tian Yang and others have the following insights. (1) Feel the beauty of mathematics through the penetration of mathematical culture. For example, align the digits; add from the ones digit, and every tenth into one, these simple words include all the contents of integer addition, reflecting the simple beauty of mathematics. When studying the axis-symmetric figure in the fourth grade of the People's Education Press, students can feel the symmetry of mathematics through various examples in life. Additionally, mathematics also has the characteristics of singular beauty, form beauty, and logic beauty. (2) Stimulate students' interest in learning and cultivating students' ideological and moral qualities. The elementary school stage is a crucial period for the formation of students' ideological and moral character. By telling interesting mathematical stories, not only can attract students' attention, but also stimulate students' interest in learning, and cultivate the formation of the will of the students. (3) Help students better understand the nature of mathematics. Putting the study of mathematics knowledge into the whole human humanistic system can help students to understand mathematics in more dimensions and deeper understanding of the essence of mathematics. (4) It can better promote the development of students' rational thinking. Carrying out mathematics culture teaching in elementary school mathematics teaching, guiding students to establish rational thinking styles and habits can better get the comprehensive development of students. (5) It can effectively improve students' practical application ability. Solving practical problems such as "chicken and rabbit cage" is able to help students understand that mathematics culture, mathematics knowledge and real life are closely related. Learning mental abacus calculation as to passing on the traditional abacus calculation can help students to establish the conception that mathematics both comes from life and serves life (Tian, Y., 2017; Zhang, F. & Jin, Y. P., 2017; Li, S. Y., 2016; Zhang, Y., 2018; Cao, J. L., 2015; Cao, Y. P., 2016; Li, L., 2018; Cui, J. H., 2016) [2, 4, 7-12].

5. The status quo of infiltrating mathematics culture in mathematics teaching in primary schools

Shi Yanping, Zhang Feng, Dai Yaoliang and others believe that the current situation of mathematics culture in primary school mathematics has the following situations and deviations. (1) From the source, students' basic knowledge of mathematics in primary education majors in colleges and universities is not rich enough, mathematics ability is not strong, the understanding of mathematics thoughts and methodology is relatively shallow, the necessary knowledge of mathematics is lacking, and the ins and outs of mathematics development are not understood. (2) Some teachers did not completely escape the embarrassment of exam-oriented education. They were afraid of delaying class time. Even if they had guided in the classroom, they only stayed in the understanding and introduction of the explicit content of mathematics culture, ignoring the excavation and inspiration of invisible content. (3) The examination method is rigid, the teacher's teaching lacks innovation, and the teacher's emotional input is insufficient. (4) The teaching materials are unreasonable, the materials are lengthy and too mathematical, what's else, the interest and attraction are insufficient. The material is too old, and it is separated from the facts, which makes it difficult for the current primary school students to get a personal understanding. Some materials are scarcely linked with mathematics, making it impossible for teachers to achieve perfection in the classroom.(5) The evaluation system is thin, at the same time, the evaluation criteria are based on test scores, ignoring the exertion of mathematical human values (Shi, Y. P. & Shang, X. Z. & Yang, Q. S., 2016; Qiu, X. G., 2007; Yuan, Y., 2011; Liu, X. M., 2016; Sun, L. L., 2010; Han, C. P., 2017) [3-5, 13-16].

6. The strategy of infiltrating mathematics culture in mathematics teaching in primary schools

Han Cuiping, Jiang Hao, Huang Yiqing and others believe that in primary school mathematics teaching, the penetration of mathematical culture has the following strategies. (1) Take the teacher as the leading factor and use various methods to strengthen the penetration of mathematics culture. In the process of lesson preparation, teachers and students collect mathematics materials and cultivate the spirit of exploration. In the course of the class, they will realize the true meaning of mathematics in the exploration and make the classroom full of vitality. After the class, teachers and students will use mathematics observation and mathematics handwritten newspapers to improve the mathematical culture. (2) Build a learning mathematical culture environment and carry out rich mathematical activities to help students form mathematical habits. Students can be allowed to set up a report on mathematics culture, set up a wide angle of mathematics culture, solve a Sudoku as a competition project. (3) Cooperate between home and school to build a family mathematics and cultural environment, with the help of the family to cultivate students' interest in mathematics. Parents should cooperate with the teacher to help the children access mathematics information online, and do mathematics and cultural handwritten newspapers with the children. They can also read mathematics books such as "Li Yupei Mathematical Fairy Tales" and "Charlie IX" with the children to increase the knowledge. (4) Realize the traits of mathematics culture through the integration of mathematical resources. Teachers should break through the limitations of mathematics in teaching and actively communicate with other disciplines to achieve a multi-faceted and multi-angle impact on students' minds. For example, in the learning process of multiplication, teachers can supplement the culture related to numbers in the teaching process. The culture related to "7" has seven puzzles, seven rhymes and so on. (5) Inspire humanistic emotions and achieve the improvement of the vitality of mathematics culture. In the process of the new curriculum reform, more and more attention is paid to the implementation of emotional goals, so that students can pay attention to the development and progress of self-survival, society, nature, and human civilization in the process of learning knowledge so long as improving their abilities (Tian, Y., 2017; Li, L., 2018; Cui, J. H., 2016; Han, C. P., 2017; Feng, L. Q., 2015; Yan, W. H., 2014; Huang, Y. Q., 2012; Jiang, H., 2014) [2, 11, 12, 16, 17-20].

Yuan Ying, Zhang Wei, Cao Peng and others also propose methods of infiltrating mathematics culture in primary school mathematics teaching. (1) Start from the source of teacher training, consolidate the knowledge of mathematics and culture, and effectively improve the teaching quality of normal students. Strengthening the teaching of higher mathematics content that is highly correlated with mathematics teaching in primary schools. It combines the content of mathematics teaching in primary schools to enable teachers to learn related mathematics education problems. In addition, pay attention to the cultivation of language skills and write ability of normal students. (2) Infiltrate mathematics culture in the classroom through group cooperation. Compared with individual learning and competitive learning, group cooperative learning highlights mutual promotion and group function, which is conducive to the improvement of classroom efficiency. (3) Make infiltration in accordance with the psychological characteristics of primary school students in different sections. The low-level students are not focused and unstable, and the perceptual characteristics are general and confusing. Therefore, it is necessary to use a more intuitive way to perceive permeation. The middle-level students have increased their attention and purpose, and their desire for knowledge is strong. Therefore, we choose to infiltrate mathematics culture according to their characteristics of attention and thinking. The high-level students have independent and critical thinking characteristics, and the way of thinking begins to change from concrete image thinking to abstract logical thinking. Therefore, it is necessary to infiltrate mathematics culture according to students' memory and thinking characteristics. (4) In the process of teaching, students should be trained to think independently and have the courage to criticize and explore and pursue the rational spirit of truth. This is also the highest level of mathematics education, which needs to be cultivated subtly from the primary school stage. (5) Teach materials through the excavation of mathematics to achieve the penetration of mathematics culture. The position of mathematics culture thought in primary mathematics textbooks is not obvious. However, modules such as "mathematical wide angle" and "do you know?" imply a large amount of mathematical culture, which requires teachers to fully excavate the teaching material, carries on the penetration in the teaching (Shi, Y. P. & Shang, X. Z. & Yang, Q. S., 2016; Zhang, W. & Yang, T., 2017; Cao, J. L., 2015; Cao, Y. P., 2016; Yuan, Y., 2011; Song, H., 2016; Cao, P., 2013; Dai, Y. L., 2017; Liu, L. & Xu, W. B., 2008) [3, 6, 9, 10, 13, 21-24].

7. Research Review

7.1 Conclusion

1. Most of the current research literature comes from the first-line teachers in primary schools. The practical experience is rich, and the cases are actually applied in practical teaching and are convincing. In the process of literature retrieval, a large number of papers with different regions and nationalities as the background are also found which shows the difference of mathematical culture in primary school mathematics teaching in different regions and the necessity of research.
2. At present, most of the researches on the infiltration of mathematics culture in primary school mathematics teaching are in the theoretical aspect, and mainly focus on the status quo, methods, and significance of the theory. There are few related practical researches. Most of the articles are general studies of the primary school teaching stage, and there are few sub-thematic studies.
3. The primary school stage is the beginning of basic education, which has a fundamental role in the personal growth of students. Mathematical culture is no exception. It is necessary for students to develop a mathematical and cultural concept from an early age. The existing research lacks special research based on the physical and mental characteristics of primary school students. The methods and significance of most researches still infiltrate mathematics culture in the general teaching of

mathematics teaching, and have not been implemented in the background of specific research of primary school.

4. There is no measurement and statistics on student feedback. There are few detailed statistics and analyses on the mastery of students after the infiltration of mathematics culture. Only by grasping the degree of acceptance of students can we judge the feasibility of teachers infiltrating mathematics culture methods in teaching.

7.2 Recommendations

I think the follow-up study should include two aspects:

1. In terms of theoretical research: on the one hand, we cannot generalize the theory in the whole mathematics teaching of primary schools, and we must start more research in different modules and correspond one-to-one with the content of the curriculum to form a complete theoretical system. It not only contributes to the formation of the mathematical culture knowledge network of students, but also can be targeted to meet the new requirements of the "Standards" on mathematical culture. On the other hand, paying attention to the status and role of the infiltration of mathematics culture in primary school in the future education and exploring the research methods of strong cohesiveness can help to fully demonstrate the meaning of infiltrating mathematics culture in primary school mathematics. Moreover, it is conducive to the formation and development of students' mathematical ability.
2. In terms of practical research: on the one hand, it should be implemented in knowledge points and examples, so that students can truly feel the application and role of mathematics culture in primary mathematics and cultivate cultural awareness. On the other hand, the practical ability and self-discipline ability of primary school students are at the stage of development and formation. There are teachers' help and guidance in the school. Parents also need to provide assistance outside the school. Teachers should change the concept that some parents think that teachers should be responsible for the children's learning, let them be happy and good at mathematics learning in home-school cooperation. In addition, special quantitative assessments should be produced to make timely measurements and obtain feedback so as to guide the next teaching activities in a targeted manner.

Finally, we must also absorb the advanced research results from abroad, take the essence, go to its dross, and apply it to teaching practice in order to promote the penetration of mathematics culture in mathematics teaching in primary schools in China.

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