International Journal of Advanced Education and Research
ISSN: 2455-5746
Impact Factor: RJIF 5.34
www.alleducationjournal.com
Volume 3; Issue 6; November 2018; Page No. 05-08

The research on infiltration of mathematical culture in high school mathematics teaching in China

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Abstract
With the development of the mathematics education and the advancement of the new curriculum standards, the demand for mathematics culture in mathematics teaching is higher and higher. There are a lot of researches on the infiltration of mathematics culture in high school mathematics teaching in China. These researches not only improve and enrich the theory, but also put it into practice, and have obtained good feedback in the actual classroom teaching. The research includes the status quo, meaning, and approach, but there are also some shortcomings. This paper sorts out the literature on the infiltration of mathematics culture in high school mathematics teaching, summarizes relevant viewpoints and conclusions, puts forward own views and prospects for further research in the future.

Keywords: high school mathematics, mathematical education, mathematical culture, mathematical learning

1. Introduction
The Mathematics Curriculum Standard for Senior High School (2017 edition)points out that the mathematics culture is one of the important contents throughout the mathematics curriculum of senior high school and infiltrates it into every module and topic, which realizes the integration of content and mathematics culture and reflects the times [1]. By the way, The Notification of the Revised Outline of the General Sat Exam in 2017 has increased mathematical cultural requirements for mathematics, which has permeated the mathematical culture into the test, which greatly increases the need for research to permeate math culture in high school math teaching [2]. In recent years, more and more college researchers and front-line educators from middle school have devoted themselves to the research in this field and achieved fruitful results in both theory and practice. In order to further enrich the research of permeating mathematics culture in high school mathematics teaching and fill in the blank of the research, this paper makes a literature review on the related research of permeating mathematics culture in high school mathematics teaching.

2. The Meaning of Mathematical Culture
In terms of the meaning of mathematical culture, some of the literature has given a reasonable explanation in a different way, most of which are explained by the broad and narrow perspectives. Zhu Changyou, Zhang Shilu, Liu Kaiming and others believe that the narrow sense of mathematics culture includes mathematical spirits, thoughts, insight, ideas, language and methods, and with the development of the times, narrow mathematical cultures are constantly changing. The generalized mathematical culture includes not only the narrow mathematical culture, but also the development and process of mathematical history, the spiritual and cultural fields such as mathematics education, and the relationship and interaction between mathematics and other disciplines. In short, mathematics itself is a culture (Liu, K. M., 2017; Zhang, S. L., 2017; Zhu, C. Y., 2017) [3-5]. Bu Yanbo digests the meaning of mathematics culture from the interpretation of the new curriculum standard: In the preparation of textbooks, the cultural value of mathematics should be infiltrated into various parts of the text by various forms. In teaching, the content of high school mathematics curriculum should be combined as much as possible. These papers introduce some historical events and figures that play an important role in the development of mathematics, reflecting the role of mathematics in the progress of human society and the construction of human civilization, as well as the promoting role of social development in the development of mathematics (Liu, K. M., 2017; Bu, Y. B., 2017) [1, 6]. Fang Lanying believes that the concept of mathematical culture is still uncertain. She temporarily gives the meaning of mathematics culture with a narrow definition. In fact, it is also recognition that mathematics culture is a dynamic process of continuous development and change. For the connotation of mathematics culture, Liang Lihua believes that the connotation of mathematics culture should reflect the historical and subjective nature of mathematics culture, including the material category or spiritual category embodied in a certain carrier or form, and it is a dynamic cultural system (Bu, Y. B., 2017) [6]. In short, mathematical culture is a diversified, open and dynamic system. With the in-depth development of research, its research field is not static.

3. The Roles of Infiltration of Mathematics Culture in High School Mathematics Teaching
From a macroscopic perspective, that is, the effect of infiltrating mathematical culture in high school mathematics teaching on the development of mathematics, Jiang Tao, Ping Ruihong, Li Shaomin, Fang Lanying *et al.* proposed the following functions of infiltrating mathematical culture in high school mathematics teaching: (1) Meeting the needs of

high school mathematics teaching reform. In the new curriculum standard, the mathematics culture has become the important content of the high school mathematics curriculum, under this reform situation, only by infiltrating mathematics culture in high school mathematics teaching can we meet the requirements of high school mathematics teaching reform. (2) Facilitating the realization of education objective in mathematics. Mathematical education is due to training students' mathematical thinking, helping them acquire practical knowledge of mathematics and improving students' mathematical literacy. In order to achieve the goal of improving students' literacy, it is necessary to make students understand mathematical culture and the value of learning mathematics. (3) Promoting the development of domestic mathematics education. Since the development of mathematics in the west has been ahead of that in China, the current domestic mathematics education has been imitating and learning from the west, which has caused great impact on the traditional planning and abacus in China. By attaching importance to mathematics culture, it is also conducive to the dissemination and development of traditional Chinese mathematics culture. (4) It is conducive to establishing links with other disciplines and cultures. For example, in the section on "the positional relationship between the line and the circle", we can use the ancient Chinese poetry "a plume of smoke rises up into the evening sky of the Great Desert, while the Yellow River dimmed as the setting sun goes down" to make an analogy of the image (Fang, L. Y., 2017; Jiang, T., 2016; Ping, R. H., 2014; Li, S. M., 2018) [7-10].

From a microscopic point of view, that is, from the perspective of individual student development, Guan Xiaoyan, Guo Zongyu, Zhang Zhenbing, Li Shaomin and others believe that they have the following effects: (1) it is conducive to exercise students' thinking ability. Although China is pursuing quality education nowadays, teachers are still forced to escape the test-oriented education in the teaching pressure, and they have no time to take into account the penetration of cultural knowledge. Therefore, if they are familiar with mathematics culture, they will certainly have a broad vision, and the effectiveness and comprehensiveness of their thinking will be enhanced. (2) Transforming the inherent thinking of students. On the one hand, teachers combine the teaching principles and spirit advocated by mathematics culture to guide and help students, encourage students to explore and innovate boldly. On the other hand, there are few examples of the innovation of mathematics in the history of mathematics. By telling these examples, students can be encouraged to break away from the original thinking pattern. (3) Inspiring students' interest in mathematics learning. Mathematical culture includes the anecdotes and inspirational stories of mathematicians, introductions in the classroom, and related video clips under the class, which is fun and entertaining. (4) Enhancing students' ability to innovate. Mathematics is also called the innovative art of thought. Teachers fully explore the innovative value contained in mathematics culture, encourage students to dare to question, be brave in innovation, and creatively solve various problems. (5) Cultivating students' spiritual character. Under the influence of mathematics culture, students can develop excellent quality, attitude and outlook on life and values (Li, S. M., 2018; Guan, X. Y., 2017; Guo, Z. Y., 2011; Zhang, Z. B., 2016; Hong, B., 2015; Li, C. S., 2014) [10-15]. In addition, Ping Ruihong and Fang Lanying pointed out that infiltrating mathematics culture in high school mathematics teaching is of great significance to help students establish a correct view of mathematics. The so-called mathematics view is a basic view of mathematics, including the understanding of mathematics content, methods, the knowledge of humanities and society in all aspects of mathematics, so as to achieve a comprehensive understanding of mathematics (Fang, L. Y., 2017; Jiang, T., 2016; Ping, R. H., 2014) [7, 9].

4. The Status Quo of Infiltration of Mathematics Culture in High School Mathematics Teaching

The current situation of infiltrating mathematics culture in high school mathematics teaching is the lack of mathematics culture education in high school mathematics teaching. (1) The position of mathematics culture education is vague. Some high school mathematics teachers only use mathematics as a tool to teach, and do not integrate mathematics culture into teaching well, which does not meet the requirements of quality education. (2) Education teaching methods are single and backward. The "instillation teaching" in which teachers are in a dominant position leads to a lower quality of mathematics teaching. (3) The teaching evaluation system is not perfect. Mathematical cultural investigations should be included in the quantitative assessment in a timely manner. (4) The purpose of teaching is single and the utilitarianism is too strong. Teachers usually aim at improving students' performance, but they often ignore the humanistic value of mathematics (Chen, R., 2017; Wang, F. C., 2016; Dong, Q., 2017) [16-18].

5. The Methods of Infiltration of Mathematics Culture in High School Mathematics Teaching

Tang Yaping, Wang Gengyin, Guan Xiaoyan, Zhu Changyou and others proposed the following methods and strategies for how to infiltrate mathematics culture in high school mathematics teaching. (1) Creating problem situations and make students recognize the mathematical culture contained in mathematics knowledge. For example, the introduction of a series of ratios through the context of cell division allows students to appreciate the value of mathematics in biology. (2) Infiltrating mathematical culture by introducing the history of mathematics. There are three ways to realize the aims as using the history of mathematics to introduce new lessons, interspersing the history of mathematics appropriately in the classroom teaching and assigning a math history problem or math history reading material after class. (3) Penetrating the mathematical culture in the textbook by introducing the concepts of subject culture and world outlook, values, etc. into mathematics textbooks, presenting the famous expert deeds in the textbooks while designing the content, and restoring the mathematician's thinking process. (4) Using the beauty of mathematics to penetrate the mathematics culture and cultivate students' sentiment. Mathematical beauty includes conceptual beauty, formula beauty, system beauty, symmetrical beauty, concise beauty and so on. (5) Using mathematics to infiltrate mathematics culture. Through the combination of number and form thinking, classification

discussion thinking, analogy and transformation thinking of the interpretation and use of mathematics culture infiltration to improve mathematics literacy. (6) Integrating with each other in a variety of disciplines. Bring the integration of mathematics and history, art, language, finance and other disciplines into the classroom, and infiltrate each other to form a knowledge network. (7) Applying inquiry and cooperative teaching, brainstorming, learning from each other, and inspiring each other (Zhang, S. L., 2017; Zhu, C. Y., 2017; Guo, Z. Y., 2011; Zhang, Z. B., 2016; Hong, B., 2015; Li, C. S., 2014; Chen, R., 2017; Wang, F. C., 2016; Tang, Y. P., 2017; Mao, F. C., 2015; Mao, X. Y., 2014; Liang, L. H., 2018) [4, 5, 12-17, 19-22].

Zhou Hongzhao, Jiang Tao, Wang Facheng and others believe that (1) Mathematics teachers should strengthen the study of mathematics history and culture, carry out training for teachers in school,, and hold academic exchanges to share their views. (2) Further improve the educational evaluation mechanism. As the college entrance examination reform incorporates the mathematics culture into the scope of the college entrance examination proposition, all kinds of high schools should also make corresponding countermeasures to improve the evaluation mechanism, incorporate the mathematical culture category into quantitative standards, and monitor and measure in real time. (3) Adjusting the structure of college courses, especially the Department of Mathematics. Courses such as “History of Mathematics” and “Mathematics Culture” will be added to start from the source of teacher training. (4) Strengthening the connection between mathematics teaching and life, and paying attention to the study of mathematical language. For example, in probabilistic knowledge, teachers can ask “Can you explain the life phenomenon of ‘dripping water wears through rock’ with probability knowledge?” (5) Positioning the teaching objectives to make the mathematics culture education have a definite aim. There are three aspects of teaching need to be cared: not to ignore science, be reasonable and be sure to be targeted. (6) Setting the teaching content, and let the math culture education have enabled examples to suggest (Jiang, T., 2016; Wang, F.C., 2016; Wang, G.Y., 2017; Huang, W., 2017; Zhou, Z. H., 2014; Jia, Y.P. &Yang, W. F., 2018) [8, 18, 23-26].

Funding

This research was financially supported by the Shandong provincial education department (Grant NO. SDYY17127) and the Shandong normal university (Grant NO. 2016JG29).

6. Conclusions and Prospects

6.1 Conclusions

The conclusion has the following six aspects:

1. Most of the sources of current research literature come from high school first-line teachers, who with rich practical experience. At the same time, the convincing cases are actually applied in practical teaching. The research keeps pace with the times. The literature before and after the new curriculum reform and the college entrance examination reform has different starting points and different focuses, reflecting the originality of the research and the teachers' ability to adapt to the new curriculum and college entrance examination reform.
2. At present, research on the infiltration of mathematics culture in high school mathematics teaching mostly stays in theory, and mainly focuses on the status quo, methods, and significance of the theory. There are few related practical researches, and in a few practical researches. Most of the articles are general studies of the high school teaching stage, and there are few sub-thematic studies.
3. In actual operation, it is less integrated with advanced teaching methods, such as multimedia technology and network information technology. It affects the teaching achievements and hinders the development of students. This is not only a problem in the penetration of mathematics culture, but also a problem in the overall high school mathematics teaching.
4. Literature class instance is very much, but most are for example in a blur, such as grain of rice on board and cell division, using the small example seepage mathematical culture lack great enlightening significance for students of concrete examples, not give in a knowledge or an example on the complete mathematical culture infiltration process.
5. Lack of measurement and statistics on student feedback. There is no detailed statistics and analysis of students' mastery 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.
6. Through the review, we can understand the necessity and feasibility of the infiltration of mathematics culture in high school mathematics teaching. Mathematical culture is not high and imaginary. It can be presented to students in real life and teachers have the necessary to also have the ability in each teaching link “moistens everything silently” penetration of mathematical culture.

6.2 Prospects

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

1. In terms of the theory research: it is not limited to the scope of mathematics teaching in high school. It is necessary to start more research with different topics, such as functions, vectors, series, geometry, etc. Sub-thematic research to form a complete theoretical system not only contributes to the formation of students' knowledge network of mathematical culture, but also can deal with the new requirements of mathematics culture in the new curriculum and college entrance examination reform, besides, it's more conducive to develop and improve students' mathematical ability.
2. In terms of the 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 high school mathematics and cultivate cultural awareness. On the other hand, it is necessary to produce a special quantitative assessment, make timely measurements, and obtain feedback so as to guide the next teaching activities in a targeted manner.

In addition, it is also necessary to absorb advanced foreign Research, select the essence and discard the dross, and apply them to teaching practice selectively, so as to better promote

the penetration of mathematics culture in Chinese high school mathematics teaching.

Funding
This research was financially supported by the Shandong provincial education department (Grant NO. SDYY17127) and the Shandong normal university (Grant NO. 2016JG29).

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