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THE NEW *CURRICULUM STANDARD* AND THE NEW MATHEMATICS

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ABSTRACT

On the background of the history of mathematics with mathematics education, this paper explains the history of mathematics and mathematical cultural that was increased in the new "Curriculum Standard". It also discusses the way for the integration of the history of mathematics and mathematics education. It also points the integration can be regarded from mathematics cultural perspective and mathematics quality education. As the Pythagorean theorem in the East-West formulation and application of mathematics for example, this paper elaborates the related teaching mentality. We should change the traditional mathematics values while hand down a tradition culture essence, so that we can effectively merges the history of mathematics and mathematics education into one organic whole. For this, we can achieve the purpose of understanding mathematics the long and short of the story, the widespread application as well as the prospects for development.

Keywords: mathematics curriculum standards; history of mathematics; mathematics education; teaching reform

At the beginning of the new century, Chinese Ministry of Education has promulgated two new "Math Curriculum Standards": "full-time compulsory education in mathematics curriculum standards (trial version)" and "high school mathematics curriculum standards (trial version)" (this paper referred to as "Curriculum Standards"). One of the significant changes is to update new teaching thought and teaching content, especially the history of mathematics and mathematics education will be closely integrated to form a new model of mathematical education. This is a landmark in the history of mathematics education in China.

1 The history of HPM in China

HPM is a shorter form of "International Study Group on the Relations between the History and Pedagogy of Mathematics". [Ou Shifu, 2003]HPM has its corresponding organizations, conferences and journals.April 1998 by the International Commission on Mathematics Education (ICMI) was launched, HPM hosted "The Role of History of Mathematics in Mathematics Education" International Symposium in Marseilles, France. The delegates from China Mainland, Hong Kong and Taiwan attended the meeting. [Zhang Dianzhou, 2009]Hong Wansheng, Taiwan Normal University Professor founded the Chinese-language publications "HPM Newsletter" in October 1998, published with the

history of mathematics and mathematics education-related news and papers, 2010, 13 volumes have been published more than 100 period.

The history of the HPM in Chinese mainland can be traced back in 1996. "The 3rd International Symposium On the History of Mathematics and Mathematical Education Using Chinese Characters" held in Hohhot, Inner Mongolia Normal University. This is the first academic conference for the history of mathematics and mathematics education opened together. However, it is the only form of connection, the contents of the vast majority papers presented at the meeting were pure history of mathematics. In 2002 "The 5th International Symposium on the History of Mathematics and Mathematics Education Using Chinese Characters" held in Tianjin Normal University. Although most of the papers' content in this conference were the history of mathematics, but more than 10 articles involved combination of history of mathematics and mathematics education. In May 2005 "The 1st National Conference on History and Pedagogy of Mathematics" held in Xi'an, Northwestern University. It opened officially the curtain of HPM professional meetings. This conference theme is to explore how to combine the history of mathematics and mathematics education, and how to use the history of mathematics in mathematics teaching. Many papers presented at the meeting is to explore the combination and application for history of mathematics and mathematics education, which involving higher mathematics, secondary mathematics, and elementary mathematics education. This conference has produced a great response in the history of mathematics and mathematics education community.

In April 2007, "The 2nd National Conference on History and Pedagogy of Mathematics" was held in Hebei Normal University. It shows a clear sign of the HPM. 180 delegates attended the meeting were continue to build a friendship bridge between the history of mathematics and mathematics education. They created a mutual benefit and win-win favorable situation. In May 2009, "The 3rd International Conference on History and Pedagogy of Mathematics" held in Beijing Normal University, it extended conference to the international scope. The total number of participants and the papers has increased. The important part of the papers is to study history of mathematics effective use in mathematics education, and interpretation of HPM in the actual case in the theory and methods. The integration of history of mathematics and mathematics education has been recognized by mathematicians and mathematics educators. It becomes as a new development model.

In May 2011, "The 4th National Conference on History & Pedagogy of Mathematics" held in Shanghai East China Normal University, participants include representatives from Canada, Germany, Korea, Japan, India and other international experts in history of mathematics and mathematics education. A total of 224 domestic experts and scholars and more than 130 articles in Chinese and English was presented in the meeting. The meeting focused on the theory and practice of HPM, colleges curriculum for history of mathematics and mathematical cultural topics. It shows the fruitful results and future prospects of HPM.

2 Improvements of new "curriculum standards"

In 2001, the China Ministry of Education issued "full-time compulsory education in mathematics curriculum standards (trial version)". Then they made a revision by the opinions during practice in 2007. By the year of 2003, a new " high school mathematics curriculum standards (trial version)" [The people's Republic of China Ministry of Education, 2003] was promulgated, the basic philosophy em-

phasizes: offers a variety of courses to meet individual choice; advocate actively for the exploration of learning styles; focus on improving students' mathematical thinking; to develop students awareness of the mathematics application; keeping pace with the times to understand the "double base"; stressed nature, attention to appropriate formal; reflect the cultural values of mathematics; focus on the integration of information technology and mathematics curriculum.

This corresponds with the new "curriculum standards" of course a significant adjustment: to reduce the required courses, a significant increase in elective courses. Some of the traditional elementary math content, such as "conic and equation", "number system expansion and the introduction of plural" are included in the elective course. The hyighlighted parts in a required course are "preliminary algorithms, statistics, probability", It put "counting principles, statistics cases, probability" in elective courses again, embodies the concept of advanced mathematics course times.

New "curriculum standards" arranged "the history of mathematics election lecture" in the "Elective Series 3". In fact, after the required courses and elective Series 1 and Series 2 is basically the knowledge of the original schools. From the series 3 is the new part. Series 3 and Series 4 contain 16 topics, the history of mathematics ranked first. In the the third part of "curriculum standards" also arranged the "mathematical culture" (do not teach separately). "Curriculum standards" stressed the need to "reflect the knowledge of the occurrence and development process, promote student self-exploration" (The people's Republic of China Ministry of Education, 2003, p117) and the "penetration of mathematical culture, embody the human spirit" (The people's Republic of China Ministry of Education, 2003, p119) in the "materials for the proposal".

Compared to the previous "teaching program" the course objectives (the purpose of teaching) have been greatly changed: add "the development of mathematical application consciousness and sense of innovation, and strive for the real world contains some of the mathematical model of thinking and making judgments"; "has a certain mathematical perspective, the gradual understanding of the scientific value of mathematics, applications and cultural values, to form the habit of thinking critically, the rational spirit of respect for mathematics, experience the aesthetic significance of mathematics," and so on.

In fact, the new "curriculum standards" of the purpose of teaching can be attributed to three sentences:

To know how mathematics came out, that requires students to understand the causes of mathematics, to know the development of mathematical context.

To know how mathematics is used, that is, to understand mathematics in the production life of the application, know the value of mathematics.

To know how mathematics is changing, that is, to understand the background of developments in mathematics and its development prospects.

In mathematics teaching, to achieve these three goals, knowledge of history of mathematics into mathematics teaching is not an option, but essential.

3   The ways of integrating history of mathematics and mathematics education

In the international scope, the history of mathematics into mathematics teaching has been a long time exploration of practice and successful models, such as two-cycle mode of hermeneutics, patterns of

resources integration contact, history-psychology of epistemological mode, the model of integration logic-history-cognition, "why-how to" mix mode, and so on. [Zhu Fengqin, Xu Bohua, 2010] Now the problem need to be explored is how to localized.

In recent years, at domestic-related meetings, various artists discuss freely, lays out the current trends in mathematics education. Their opinions for practicing of HPM in China had a very good inspiration. It can be concluded as the following points:

First, China and the West have differences in cultural traditions of the fundamental starting point and the basic way of thinking. The result not only affect the science and technology, but even affect culture, correct understanding and development of innovation. Thus it has an impact on the general quality of the whole nation. As a result, we should let mathematics into Chinese fine cultural traditions, then we can get lessons from the development of mathematics in comparison with the West.

Second, we need to create an artistic conception of the cultural for history of mathematics, and to emphasize the role of education of mathematics culture. For example, Zhuang Zi's famous quote "the wood stick of a length, get rid of half every day, eternally inexhaustible". It was used as an example of infinitesimal in ancient Chinese.(Liang Zongju, 1981) In fact, Zhuang Zi's intention is to "eternally inexhaustible", not to say that "this is the limit of the process tends to 0." It is its artistic conception can helps to understand the limit. Through the process of taking half of all, people felt the state of "a wood stick close to zero but not zero". As a result, mathematicians use this sentence as mathematics historical datas application. We will strive to reveal the cultural connotation of the history of mathematics knowledge, and further make the history of mathematics into mathematics education.

Third, combination with the demands of current new "curriculum standards" for mathematics competence education, we must not only insist on the history of mathematics based on mathematics education should put the history form into an education form, but also insist on mathematics education based on the history of mathematics should to find new the growing point in history of mathematics. American famous mathematician, mathematics historians and mathematics educators M.Klein (Morris Kline, 1908 $\sim$ 1992) showed us in the "Mathematics in Western Culture" preface:"The historcal order happens to be most convenient for the logical presentation of the subject and is the natural way of examining how the ideas arose, what the motivations for investigating these ideas were, and how these ideas influenced the course of other activities."[M. Klein, Zhang Zugui translation, 2005] Klein believes that the history of mathematics can provides an overview of the whole curriculum, so that course content with each other, and connect with the main part of mathematical thoughts; The history of mathematics allows students to see how real mathematicians create history-how to fall down, how to find their way in the fog, to muster the courage to study; To tell them about mathematics from a historical perspective, is one of the best ways to make students understand mathematics content and mathematics attractive appreciation(M. Klein, Zhang Zugui translation, 2005, xv pages). History of mathematics is an effective way to achieve the objectives of the new mathematics curriculum.

4   Train of thoughts on teaching

We can see from the ancient Chinese classic "Jiu Zhang Suan Shu(Nine Chapters on Arithmetic)" that, the Chinese mathematical culture originated in the actual needs, such as measurement of land, mea-

suring volume and so on. Chinese mathematics made the actual production of civil life for object of study, and solved practical problems for the target. It start around of establishing and improving computing technology and algorithms, emphasising on the results should be in the analysis and induce based on observation and experimentation. It made the mathematical truth in calculation, putting mathematics in a few self-evident, on the principles of the visual image. However, at present, the content and methods of Chinese mathematics education has been westernized. Chinese mathematics education's form using the Western model, but in cultural psychology it also use unconsciously the Chinese traditional mathematics and culture. It lead to many confused problems in mathematics education in realistic. They are, how to deal with the relationship between training thinking and guidance practice, emphasizing the pursuit of mathematical visual effect and its practical effect, or its rational debate and logical deduction. We will take the cultural background of the birth and development of Gou Gu Ding Li (Pythagorean theorem) in China and the West as an example, by use of history of mathematics to explor the relationship between cultural traditional and modernization of mathematics education.

Gou Gu Ding Li is the root of Chinese geometry, and the essence of Chinese mathematics. The birth and development of Chinese mathematics metheds, such as Kai Fang Shu(square root methed), Fang Cheng Shu(equation methed), Tian Yuan Shu(establish eqution methed) and other techniques, have a close relationship with Gou Gu Ding Li. [Qian Baocong, 1964]Combining Gou Gu Xing(Right triangle) and ratio algorithm has been constituted various measurements (such as Liu Hui's "Chong Cha Shu"). Ancient mathematicians often used Gou Gu Xing triangle instead of general triangle, which can avoid to discuss the nature of angle. By this way, Chinese ancient mathematicians did not touch the complex theory of parallel, making geometric system is concise, problem solution more practical. Investigating the birth and development of Chinese Gou Gu Ding Li, we can see that ancient Chinese cultural tradition of mathematics obvious emphasis had obvious characteristics, such as pay attention to application, focusing on linking theory with practice, combinating with number and shape, using calculate mainly, being good at establishing a set of algorithms system. However, China's traditional culture pay attention to "pragmatism", the way of thinking which believed in speaking instead of doing. This research methods makes Gou Gu Ding Li has not been beyond the visual experience and the specific operations from the beginning of its born. It is always as an art in the dissemination and application instead of a complete set of deductive reasoning. Its mode of development is to solve the practical problems. This value orientation of the technique application influence our understanding of mathematics, and our mathematics teaching. In our secondary school textbooks, we directly express that Gou Gu Ding Li in the form of number. This is a reflection of this value orientation. [Wang Qingjian, 2004]

In the West, from began with Pythagoreans discovered "irrational number with the rational incommensurable", the Pythagorean theorem as a metric benchmarking of Euclidean space, through deductive reasoning, giving the new chapter for the improvement and development of geometric axiom systems. While proofing the Pythagorean theorem, Euclidean combined with graphical analysis, deductive reasoning to obtain a series of theorems and corollaries. Since then, Western mathematicians extended the Pythagorean theorem to seek a positive integer of indefinite equation from its number meaning, leading to the famous Fermat's conjecture and Mordell conjecture. They extended the Pythagorean theorem from its graphics meaning, leading to the relationships for the area of plane figure, and the surface area of three-dimensional graphics. By this way continue, through the process of

pursuit of rigorous logic and mathematical beauty, modern mathematics access to development. This mathematics tradition for advocates rational and emphasize deductive reasoning contained western religious and philosophical values, which for we learn mathematics and understand the formation of the architecture of modern mathematics has important implications.

The Pythagorean theorem that was born in the different cultures of China and the West and its development path gives us the inspiration, which is that we must inherit the essence of traditional culture as the same times to change the traditional view of mathematics value, in order to learn the western mathematical axiomatic system, embarked on mathematics education modernization. For this purpose, we should be designed to meet our own cultural traditions and customs of classroom teaching. The Pythagorean theorem teaching, for example, can be use the following links to instructional design.

First, we start from the cultural traditions, by using of modern teaching methods for math test. Such as students draw a right triangle calculations themselves, or use the Geometer's Sketchpad software to automatically measure the length of three sides for verify. Second, we can use the comparison of China Liu Hui's proof of the Pythagorean theorem and the Euclidean method in "Element", to tap the cultural connotations.

Liu Hui's proof is based on a self-evident, intuitive image "Chu Ru Xiang Bu" principle, that process can be operated with in-kind.[Wu Wenjun, 1998] So that practical problem can be into mathematics, and ultimately achieve the construction of meaning for mathematical theorems. The proof of Euclid's method is completely divorced from material object. It shows the pursuit of beauty of mathematics and mathematical rational. In this way, students' think can be trained.The presentation of latter method can be used math "re-creation" theory. Throught analysis its exploration process, making the proof idea is gradually revealed. So students can finish the deep understanding for the deductive system structure of the axiomatic.

In summary, we can start from the cultural traditions, using modern means of education to inherit and carry forward the traditional culture, mining the meaning of traditional culture, to achieve the modernization of mathematics education.

From the current situation in the world, the further integration for the history of mathematics and mathematics education is the general trend. The cultural of mathematics education becomes priorities. During the years of research and exploration about the new "Curriculum Standards", history of mathematics teaching practice in China has become possible. The integration of history of mathematics and mathematics education will have a more promising future.

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