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Current Situation and Development of Chinese High School Mathematics Textbooks from the Perspective of HPM Theory--Taking Function as an Example

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ABSTRACT. *To cater to the trend of the integration of mathematics history into mathematics education from the perspective of HPM theory, this paper starts from Chinese high school mathematics textbooks (Human version, Jiangsu version and Hunan version), analyzes the current situation of the mathematics history knowledge existing in the function part and its integration forms, and puts forward suggestions for future development.*

KEYWORDS: *HPM theory; mathematics history; mathematicstextbook; function*

1. Introduction to HPM theory

HPM theory originated from *International Study Group on the Relations between History and Pedagogy of Mathematics*established at the second international mathematics education conference held in Exeter, UK in 1972. Since its establishment, HPM has specifically referred to the study on the relationship between mathematics history and mathematics education and is an important part of mathematics education research. [1]

The purpose of HPM theory is to promote the comprehensive improvement of mathematics education level through the perfect integration of mathematics history and mathematics education.It not only improves teachers' mathematical literacy, but also enables students to understand the generation and formation of mathematics while mastering mathematical knowledge and thoughts, enhance their enthusiasm in learning mathematics, and realize the cultural value and scientific value of mathematics as well as its great role in promoting the development of social civilization.

The French mathematician Poincare once said: “If we want to predict the future of mathematics, then the appropriate way is to study the history and current situation of the subject.”[2]Since the advent of HPM theory in 1972, the integrated development of mathematics history and mathematics teaching has become an

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important topic of research around the world. However, it was not until the beginning of this century that China emphasized the significance and value of mathematics history in *the Curriculum Standards for Ordinary High School Mathematics (Experiment)* [3].

At present, there are four forms in which mathematics history is integrated into mathematics teaching, which are additive, replication, adaptation and reconstruction[1].The four methods will produce different effects according to the degree of integration and the application conditions, and the specific use is determined by teachers to make the corresponding curriculum design arrangement for the corresponding students. However, at present, the supplementary form is more frequently used, and teachers use the form of telling a short story to popularize the knowledge related to mathematics history, while the adaptive form and the reconstructed form are less, which can promote the self-construction of students by reshaping the historical scene and other forms.

2. The present situation and development direction of HPM theory in mathematics textbooks

2.1 Current situation and analysis

The functional knowledge in the compulsory textbooks of Human version, Jiangsu version and Hunan version is all based on collection, but the degree of correlation is different. Jiangsu version is more concise and clear, and puts all the knowledge of function into a single chapter. Human version and Hunan version choose cantor's definition of correspondence relation in set theory and put together the concept and basic properties of function and set. For other knowledge of function, Human version is divided into two chapters: basic elementary function and application of function, while Hunan version is put together uniformly.

By comparing the three versions of textbooks, this paper makes the following statistics on the emergence and elaboration forms of mathematics history in functional knowledge:

Table 1 Analysis of mathematics history in the three versions of textbooks

Version	Chapter that appears	Related content	Form of exposition
Human version [4]	1.2.1 Concept of function	"The function symbol y=f(x) was introduced by the German mathematician Leibniz in the 18th century."	Annotation
	1.2 Function and its representation	"The development of function concept"	Reading material
	Chapter 1 Concepts of set and function (end)	Practice assignment (understanding the formation and development history of function)	Practice assignment

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	2.2.1 Logarithmic function	“Invention of logarithm”	Reading material
	3.1 Function and Equation	“Solving equations in Chinese and foreign history”	Reading material
	3.2 Function model and its application(end)	Practice assignment (verify Newton's cooling model and explore practical problems)	Practice assignment
Jiangsu version [5]	2.3 Logarithmic function	“Logarithmic discovery”	Reading material
	2.6 Function model and its application	Practical application of Newton's cooling law	Word problem stem
	Chapter 2 Function concept and basic elementary function (end)	Practice assignment (independently explore major events in the development of mathematics, etc.)	Practice assignment
Hunan version [6]	2.2 Logarithm function	“Log history”	Reading material
	Mathematical culture	“A little history of function concepts”	Reading material

As can be seen from the above table, the statistics of the occurrence times of mathematics history in functional knowledge show that Human version appears 6 times, Jiangsu version appears 3 times, and Hunan version appears 2 times. In general, Human version covers the most extensive and complete knowledge of mathematics history, and is good at integrating the knowledge of mathematics history into practice assignment to promote students' independent exploration. While Jiangsu version is relatively simple and clear. It only provides the most prominent knowledge of mathematics history with relatively long reading materials, and it is good at applying the knowledge of mathematics history in practice to strengthen understanding and absorption. Hunan version is focused on providing a large amount of knowledge to read and the content is detailed and substantial.

In general, the integration of mathematical history knowledge into textbooks can be divided into explicit integration and implicit integration, which can be divided into the following types according to the actual situation:

(1) Annotation

Through the analysis of the three versions, it can be found that textbooks all prefer to present mathematics history in a systematic and long form rather than to integrate it into the understanding and analysis of knowledge points. The annotation in Human version just explains the origin of a symbol in the knowledge point easily, without further emphasis. This leaves open questions like who Leibniz is, how the function was represented in the first place, and why it was changed. This is not a good interpretation of the knowledge of mathematical history, so it is only an additional type of explicit integration.

(2) Reading material

All three versions of the textbooks tend to give a long overall account of mathematics history. Apart from the fact that Hunan version tends to popularize

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mathematics culture, Human version attaches more importance to the knowledge of mathematics history than Jiangsu version. As can be seen from the above table, mathematics history in Human version is provided along with students' regular knowledge points. The knowledge is elaborated in a slightly appropriate way and connected with the ancient and modern times, which is more suitable for students to read and understand simply and stimulate their curiosity. Jiangsu version pays more attention to the study of knowledge points. In terms of the quality of relevant reading materials, it is relatively simple and clear, aiming to understand.

(3) Practice assignment

In addition to Hunan version, both Human version and Jiangsu version use the method of assigning practice assignments to promote students' understanding of mathematics history. Jiangsu version provides relevant reference materials and directly allows students to understand independently. In this way, the effect achieved depends on students' autonomy and teachers' supervision, with strong uncertainty. Human version has two practice assignments: one is to let students choose their own topics to understand and research related knowledge of mathematics history; the second is to select a situation of mathematics history for students to verify and explore practical problems .In the initial stage of contact with function, there is not only the understanding of relevant knowledge, but also the setting of mathematics history context for independent exploration, so that students can better contact with the knowledge of mathematics history of function, and improve the understanding and application ability of function.

(4)Word problem stem

Compared with Human version which regards Newton cooling law as a practice assignment, Jiangsu version which integrates it into word problems can make students perceive and accept it more. Moreover, different from the integration of reading materials, integrating the knowledge of mathematics history into actual problems can not only enrich students' reading comprehension of mathematics history knowledge, but also promote the absorption and application of knowledge points, which is a good way of implicit integration of mathematics history.

2.2 Development direction and suggestions

(1)Promote the situational knowledge of mathematics history

The concept of function has evolved over the centuries. From the analysis of the introduction of functions in the three versions of textbooks, it can be concluded that Hunan version connects with the definition of function in junior middle school, while Human version and Jiangsu version give three examples. These three examples are respectively taken from physical knowledge, life knowledge and social problems, while examples of other functions are mostly taken from other subject knowledge and life and social problems. It can be seen that the knowledge of mathematics history has a great shortage in the introduction of contextualization. Contextualization of mathematics history knowledge can not only stimulate students'

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interest in learning, but also promote students' mutual absorption and understanding of mathematics history knowledge and conventional knowledge.

(2) Promote the fragmentation of knowledge of mathematics history

Most of the history of mathematics knowledge in today's textbooks is presented to students in the form of a large number of reading materials, so that although it can be elaborated in detail, it is difficult to leave a deep impression on students .If a large number of reading materials can be selected and integrated into the topic that students are interested in or examples in life, and teachers guided students to carry out practical operation and application, it will have a better effect.

(3) Promote the two-way promotion of teaching materials and teachers

Teachers are the main promoters and implementers of teaching activities [7], and the compilation of teaching materials also serves teachers .However, current textbooks are not complete in compiling mathematics history, and there are not many cases in which mathematics history is integrated into teaching. Therefore, it is necessary for researchers of mathematics history, authors of mathematical textbooks and practitioners of mathematical teaching activities to cooperate with each other in compiling textbooks and designing teaching courses, so as to promote the integration of mathematics history into mathematical teaching and give play to its due value.

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