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The Research on the Strategy of Integrating the History of Mathematics into the Teaching of College Mathematics

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Abstract

The integration of mathematics history into college mathematics teaching is helpful to restore the original appearance of mathematics, stimulate students' interest and deepen students' understanding of concepts, therefore, many scholars have studied the strategy of integrating the history of mathematics into the university mathematics teaching. In order to better integrate the history of mathematics into the mathematics teaching, this paper reviews and combs the research on the strategy of integrating the history of mathematics into the university mathematics teaching in the past 20 years, and finds that the previous research mainly put forward the strategies of integrating the history of mathematics into the university mathematics teaching from five aspects: choosing the appropriate materials of mathematical history, adding the materials of the mathematical history in teaching materials, improving the teachers' literacy of mathematics history, the concrete methods of integrating the mathematics history into the university mathematics teaching and the requirements of integrating mathematics history into university mathematics teaching. Secondly, there are still blank points in the past research, mainly the secondary processing strategy of mathematical history materials and the teaching mode of integrating mathematical history into mathematics teaching, and it is necessary to further study the above two issues in the future.

Keywords

History of Mathematics, Mathematics Teaching, University

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1. Introduction

As an important part of mathematical culture, the history of mathematics helps to restore the original appearance of mathematics, reveal the background knowledge, stimulate students' interest, deepen students' understanding of concepts and cultivate students' mathematical thinking, and receives more and more attention in mathematics teaching [1-2]. College mathematics has more abstract concepts and obscure theorems, so it is very important to integrate the history of mathematics into college mathematics teaching [3, 5]. In order to promote the better integration of the history of mathematics into college mathematics teaching, in the past 20 years, a series of academic studies on the strategy of integrating history of mathematics into college mathematics teaching have emerged [1-9]. These academic studies have greatly promoted the integration of history of mathematics into college mathematics teaching. In order to learn from the past research and better integrate the history of mathematics into mathematics teaching, this paper intends to review and sort out the relevant research in the past 20 years, and summarize the strategies of integrating the history of mathematics into university mathematics teaching.

Through reviewing and combing, it is found that the previous studies mainly put forward the strategies of integrating the history of mathematics into the university mathematics teaching from five aspects: choosing the appropriate materials of mathematical history, adding the materials of the

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mathematical history in teaching materials, improving the teachers' literacy of mathematics history, the concrete methods of integrating the mathematics history into the university mathematics teaching and the requirements of integrating mathematics history into university mathematics teaching.

2. Choosing the Appropriate Materials of Mathematical History

The choice of materials is the primary problem of integrating the history of mathematics into the teaching of Mathematics University. Li Chunli and Mu Ke point out that in the selection of mathematical history materials, the principles of scientificity, practicality and interest should be followed, that is, the content of mathematical history materials should be correct, vivid and interesting, and it is helpful for students' mathematical learning and ability improvement. The history materials of mathematics include the formation and development process of mathematical concepts, the contribution and brief introduction of mathematicians, the promotion and influence of mathematics on the development of other fields, and the formation, development and improvement process of mathematical ideas and methods [3]. However, not all the materials of mathematical history can be well integrated into the teaching. Yuan Qianqian, Qin Chuanliang and others believe that the materials of mathematical history should be closely connected with the course content and teaching objectives, selected according to the actual teaching, and the teacher should process the materials of mathematical history twice to find the main factors that can help students [4].

3. Adding Materials of Mathematical History in Teaching Materials

As the core resource of teaching activities, mathematics textbook is an important carrier of knowledge teaching. Xu Dongfang believes that at present, the content of Higher Mathematics Textbooks in China focuses too much on theoretical knowledge, and the intake of relevant process background knowledge is less, which is not conducive to the construction of a complete knowledge framework for students, so the proportion of mathematical history knowledge in higher mathematics textbooks should be increased appropriately [5]. Similar to this, Yu Hongyu proposes that we can imitate the new mathematics textbook of basic education, insert some mathematics stories and biographies into the teaching materials of higher mathematics without changing the arrangement system of the existing teaching materials, and write some reference books or papers on how to integrate the history of mathematics into the teaching of higher mathematics in order to make the teachers of higher mathematics have rules to follow [6]. Students are bound to encounter the difficulties that big mathematicians encounter when they make some creations. Therefore, Duan Luling proposes that the compilation of teaching materials should be more systematic and humanized, close to the students' knowledge, integrate some knowledge of mathematical history, and appropriately adjust the content of teaching materials [7].

4. Improving the literacy of Teachers' Mathematics History

As the saying goes, "to give students a glass of water, teachers should have a bucket of water". Therefore, in order to make the history of mathematics better integrated into the teaching of college mathematics, we should pay attention to improve the mathematical history literacy of mathematics teachers. Zeng Qingmao, Guo Zhengguang, Zhou Yuzhong, etc. point out the current situation of teachers' application of the knowledge of history of mathematics in higher mathematics teaching, that is, some teachers think that the knowledge of history of mathematics is dispensable and wastes teaching time in higher mathematics teaching; some teachers realize the important role of history of mathematics in higher mathematics, but they don't know how to apply the knowledge of history of mathematics to higher education, which leads to the separation of history of mathematics education and knowledge of mathematics education; some teachers don't have enough knowledge of history of mathematics [8].

Based on the above situation, the above-mentioned authors and Liu Jiangrong, Lin Yingju and Zhang Yongzhen think that the university teachers should treat the history of mathematics correctly, strengthen the understanding of the history of mathematics, and master the systematic and comprehensive knowledge of the history of mathematics. Secondly, the teachers of higher mathematics should change their thinking of mathematics from the simple knowledge imparter to the designer, organizer and guide of higher mathematics teaching. They should reintegrate and redevelop the learning materials and learning resources in higher mathematics, and perfect and supplement the mathematics content. In addition, it puts forward specific suggestions to improve the mathematical history cultivation of mathematics teachers. One is to invite the experts of mathematical history to teach the knowledge of mathematical history to the teachers of higher mathematics, or

to send the front-line teachers to participate in the professional seminars and training courses on mathematical history; the other is to organize the relevant teachers of the teaching and research section to compile some teaching materials about the history of mathematics teaching, and develop the relevant teaching resource base to provide teachers with more abundant knowledge materials about the history of mathematics; The third is that the university should subscribe to the newspapers and magazines of the history of mathematics as much as possible, provide the cases of successful application of the knowledge of history of mathematics to the teaching of higher mathematics, and make a CD for the relevant teachers to learn from [9-11].

5. The Concrete Method of Integrating Mathematics History into University Mathematics Teaching

5.1. Direct and Indirect Use

According to the way that teachers use the materials of history of mathematics when they integrate the history of mathematics into mathematics teaching, Du Wanjuan divides the methods of integration into direct application and indirect application. Direct application refers to the direct integration of historical facts and biographies of mathematicians in mathematics teaching to sort out the historical context of knowledge. Indirect use refers to the combination of historical materials to reconstruct the teaching design of the occurrence and development of knowledge, and to design teaching cases that are consistent with the order of historical occurrence and development, so that students are not passively receiving knowledge but participating in the dynamic process of mathematical research [12]. This kind of teaching design that indirectly uses the data of mathematical history is also called "designing teaching cases from the perspective of HPM" [13].

5.2. Integrating Mathematics History into Teaching links

The teaching includes five basic links: preparing lessons, taking classes, doing homework, tutoring after class, checking and evaluating students' academic achievements. Mao Qili proposes that the first class should be prepared for students from the perspective of historical development. Before the lecture, a general introduction should be made. Combined with the preface, the generation and development process, key figures, or the future should be summarized, so that students can have a comprehensive understanding of the history of mathematics to a certain extent, and view mathematics from the perspective of development [14]. Xia Yanqing proposes that when writing the teaching plan and preparing lessons, teachers should consciously integrate relevant historical data and flexibly choose the form of historical data [15]. Jia Lidong, Wang Hui and Li Quan propose that in the introduction of the new course, the biography or mathematical development history of mathematicians should be used to introduce the new course; in the teaching process, according to the state of students, the deeds or stories of mathematicians should be interspersed appropriately; the history of mathematics should be presented in the teaching content, and the "context" of knowledge should be explained clearly; the history of mathematics should be supplemented after the teaching [16]. Liu Mei and Wang Zhi propose that a part of the history of mathematics be added to the homework and assessment links, that is, to arrange part of the history review of mathematics in the homework links, and to calculate some of the results in the year-end assessment [17].

5.3. Integrating Mathematics History into Teaching Process

Li Ting, Dong Dan, Li Xin and Yang Haoju put forward that, first, in the teaching activities, the biographies of mathematicians and other vivid and narrative contents of mathematical history are explained to improve students' interest in classroom learning; second, in the teaching of concepts or theorems, the knowledge of mathematical history is introduced, and the historical origin and context of the formation of concepts or theorems are briefly introduced to experience the occurrence of mathematics; third, we should inform the students of the obstacles in the actual process of mathematics development, understand the history of mathematicians, and enhance the courage of students to overcome difficulties [18-20]. Wang Yongliang points out that every specific mathematics subject has its own interesting questions or classic proofs and solutions. Students will be impressed by the introduction of these interesting historical proofs in the teaching process [21]. Song Linfeng proposes that teachers should skillfully use multimedia technology, carefully prepare courseware, take full and accurate historical materials and physical photos as the main materials, and present intuitive pictures such as manuscripts and works [22].

Liu Kaijun and Cheng Keling put forward that mathematical thinking method is an introduction and cognitive process of the essence of mathematical knowledge in the history of mathematics, and a high generalization of mathematical thinking and practice methods. In the process of mathematical history penetrating into mathematical teaching, teachers should focus on analyzing the mathematical thinking methods in the content of mathematical history for students. Secondly,

in the teaching process, teachers should guide students to better understand the evolution process of various mathematical symbols in the history of mathematics. The comparison between the past and the present mathematical symbols helps students better understand the characteristics of the use and expression of mathematical symbols, which is conducive to deepen students' understanding and impression of these mathematical symbols [23-24].

Zhu Xiaoning proposes that the teaching method of "problem solving" should be integrated into the higher mathematics classroom with the history of mathematics as the background knowledge, that is, through the presentation of some classic problems in the process of mathematics development, to guide students to analyze and solve problems, and to show the mathematical thinking and methods involved in the process of problem solving [25]. According to Yang FA, Zhu Fengqin and Xu Bohua, teaching materials should be used as the main line to create teaching situations and activate the classroom atmosphere [26-27]. Zhang Jinjiang put forward the method of "summary" to integrate into the history of mathematics, that is, to summarize the occurrence and development process of stage knowledge [28].

5.4. Diversified Penetration Strategies

Mao Qili proposes that teachers should organize and carry out research-based learning with mathematical history as the content, including the development of mathematical concepts, the story of mathematicians, etc. Tao Chaohai believes that in order to promote the integration of mathematics history and mathematics, we should set up elective courses of mathematics history, hold lectures on mathematics history, set up interest groups, and run blackboard newspapers about mathematics history knowledge [29].

6. The Requirement of Integrating the Mathematics History into College Mathematics Teaching

Li Xiaosha points out that to integrate the history of mathematics into the teaching of higher mathematics, we should take the appropriate example of history as the carrier, closely integrate with the course content, process the history of mathematics twice, adapt to the knowledge level of students, so as to make the history of mathematics better transition to the course content. In addition, the teacher should not give a long lecture on the history of mathematics in the teaching process, that is, mathematics knowledge is the main part, and mathematics history knowledge is the auxiliary part [30].

7. Review of Existing Studies

To sum up, we can see that the current research on the strategy of integrating the history of mathematics into the university mathematics teaching mainly focuses on five aspects: choosing the appropriate materials of mathematical history, adding the materials of the mathematical history in teaching materials, improving the teachers' literacy of mathematics history, the concrete methods of integrating the mathematics history into the university mathematics teaching and the requirements of integrating mathematics history into university mathematics teaching.

For the selection of mathematical history materials, previous studies put forward the principles and requirements for the selection of mathematical history materials, list the materials that can be integrated into the history of mathematics, and propose that teachers process the materials of mathematics history twice. In terms of the increase of knowledge about the history of mathematics in teaching materials, predecessors have come to the conclusion that the arrangement of teaching materials should be humanized, and some mathematical reasons and biographies should be inserted properly on the basis of not changing the original arrangement system of teaching materials. As for the improvement of teachers' mathematical history literacy, predecessors have studied the current situation of university mathematics teachers' teaching integrating into the mathematics history, and put forward some suggestions to improve the university mathematics teachers' mathematical history literacy. As for the concrete methods of integrating mathematics history into the university mathematics teaching, they include the methods of directly and indirectly using the materials of the history of mathematics, the methods of integrating the history of mathematics knowledge into the teaching links, the methods of integrating the history of mathematics knowledge into the teaching process and the diversified integration strategies. In terms of the requirements of integrating the history of mathematics into mathematics teaching, The predecessors propose that we should select the appropriate historical materials to integrate into the mathematics teaching, and the history of mathematics as a supplement, with mathematics knowledge as the main requirement. All these strategies are reasonable.

However, from the above analysis, we can see that some researches are not deep enough, and there are blank points in the research. There are two outstanding problems. One is how to prepare the materials of mathematical history for classroom teaching, especially how to process the materials of mathematical history twice. In the research of selecting mathematical history materials, predecessors have put forward that not all mathematical history materials can be well

integrated into mathematics teaching, which should be adapted to the teaching content and students' actual knowledge level, not directly quoted, and should be processed twice. However, there is no explanation on how to process the mathematics history twice, so as to prepare the materials of mathematics history for classroom teaching. This will lead to that when teachers integrate the history of mathematics materials into mathematics teaching, they often directly quote the mathematics history, which will affect students' understanding of the knowledge.

The second is that there is no academic research on the teaching mode of integrating the history of mathematics into mathematics teaching. When the mathematics history is integrated into mathematics teaching, it is necessary to consider the influence of many factors. Therefore, the construction of the model of integrating the history of mathematics into mathematics teaching will be conducive to mathematics teachers' teaching. Secondly, if there is no good teaching mode, college mathematics teachers may only talk about the history of mathematics in class to improve students' interest. Then the students will feel that the history of mathematics is an addition to what they have learned, and they think that it happened a long time ago and has no practical use or significance.

Therefore, in the future, it is necessary to study the secondary processing strategy of mathematics history materials and the teaching mode of integrating mathematics history into mathematics teaching, so as to better integrate the history of mathematics into mathematics teaching.

8. Conclusion

This paper reviews and combs the research on the strategy of integrating the history of mathematics into the teaching of college mathematics in the past 20 years, and finds that the past research mainly focuses on five aspects: choosing the appropriate materials of mathematical history, adding the materials of the mathematical history in teaching materials, improving the teachers' literacy of mathematics history, the concrete methods of integrating the mathematics history into the university mathematics teaching and the requirements of integrating mathematics history into university mathematics teaching. However, there are still gaps in the current research, that is, the secondary processing strategy of mathematical history materials and the research on the teaching mode of integrating mathematical history into mathematics teaching. Therefore, it is necessary to study the secondary processing strategy of mathematical history materials and the teaching mode of integrating mathematical history into mathematics teaching in the future.

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