### Research on High School Mathematics Teaching Design from the Perspective of HPM

Hongwei Ji<sup>1</sup>, Zhengmei Lu<sup>2,\*</sup>

<sup>1</sup>Nantong Normal College, Nantong, Jiangsu, China <sup>2</sup>Rudong County No.1 Senior High School, Nantong, Jiangsu, China \*Corresponding Author.

Abstract: With the deepening of basic education curriculum reform, there is an increasing emphasis on mathematical cultural education, requiring teachers to integrate mathematical history into daily teaching and guide students to experience the historical development and humanistic spirit behind mathematical knowledge. The embodiment of mathematical thinking methods and the formation and generation of mathematical conclusions require the integration and combination of mathematical history. HPM (History and Pedagogy of Mathematics) mainly studies the relationship between the history of mathematics and mathematics education. Since its establishment, the relationship between the history of mathematics and mathematics education has been highly concerned. Integrating the history of mathematics into mathematics teaching can not only enhance students' interest in learning mathematics, but also help them understand the essential characteristics of the mathematical knowledge they have learned. Mathematics is a relatively abstract and diverse subject, often seen as a pile of dry knowledge in the eyes of students. Therefore, this article proposes the HPM perspective, integrating historical, philosophical, and socio-cultural factors into it, which can not only strengthen students' mathematical understanding and application abilities, but also develop critical thinking and innovation abilities, bringing new ways of thinking to teachers and students. This article will discuss high school mathematics teaching strategies and their educational significance and potential effects on students from the perspective of HPM.

Keywords: HPM Perspective; High School

### Mathematics Teaching; Comprehension Ability; Critical Thinking; Innovation Ability

### 1. Introduction

Mathematics has always been an important component of human thinking development. It is not only a natural science, but also carries rich historical and philosophical connotations. As the foundational stage of mathematics, high school mathematics plays a crucial role in cultivating students' mathematical literacy and thinking abilities. In the past, high school mathematics teaching often emphasized the imparting of knowledge and the cultivation of test taking skills, lacking in-depth thinking on the essence, history, and philosophy of mathematics. However, in recent years, a new perspective on mathematics teaching - HPM (History and Pedagogy of Mathematics) - has gradually emerged, which focuses on the connections within the discipline and the application of mathematical knowledge, providing a more comprehensive and creative teaching strategy.

### 2. Characteristics of High School Mathematics Teaching from the Perspective of HPM

### 2.1 Humanistic Nature

As one of the important educational concepts in the field of education, humanism emphasizes the importance of valuing students' comprehensive development and individual differences in the educational process, and emphasizing the cultivation of students' humanistic literacy and personality qualities in teaching. In high school mathematics teaching, from the perspective of HPM (Human Mathematical Thinking), humanistic teaching has become an important feature. Firstly, the humanistic aspect of high school mathematics teaching is manifested in the formulation of educational goals. From the perspective of HPM, the purpose of education is not only to impart knowledge and skills, but also to develop students' mathematical thinking ability humanistic literacy. High and school mathematics education aims to develop students' mathematical thinking abilities. them apply mathematical enabling to knowledge to solve real-world problems and possess critical thinking and innovative thinking [1]. The formulation of this goal emphasizes the training of students' logical thinking, reasoning ability, and problemsolving ability in the teaching process, making mathematics education closer to students' needs. Secondly, the humanistic aspect of high school mathematics teaching is reflected in the selection of teaching methods. Humanistic teaching emphasizes the student-centered position, respects individual differences and learning methods, and values the cultivation of self-directed learning ability and cooperative spirit. Teachers can use heuristic teaching methods in high school mathematics teaching to stimulate students' interest in learning and desire for knowledge, enabling them to actively explore and learn mathematical knowledge. At the same time, teachers can also use group discussions and cooperative learning to promote collaboration and communication among students, thereby cultivating team spirit and communication skills. Thirdly, the humanistic nature of high school mathematics teaching is reflected in the selection of teaching content. Humanistic teaching emphasizes the quality and depth of knowledge, and attaches importance to the cultivation of students' mathematical understanding and application abilities. In high school mathematics teaching, teachers can choose mathematical problems related to students' actual life and social practice, allowing students to learn mathematical knowledge through solving practical problems, cultivating students' mathematical thinking ability and innovative consciousness. By combining mathematical knowledge with practical problems, teachers can stimulate students' interest in learning, enhance their sense of identification and practical application mathematics. Fourthly, ability in the humanistic nature of high school mathematics teaching is reflected in the selection of evaluation methods. Humanistic teaching emphasizes diverse and comprehensive evaluations, focusing on cultivating students' comprehensive qualities and abilities. In high school mathematics teaching, teachers can adopt evaluation methods that are not only based on exam scores, but also combine various forms of evaluation such as oral expression, practical operation, and project to comprehensively research understand learning situation and ability students' development. This evaluation method makes education more focused on individual differences and potential development of students, putting people first and emphasizing the cultivation of students' self-learning ability and lifelong learning ability [2].

### 2.2 Richness

High school mathematics education is an important stage in cultivating students' mathematical literacy and thinking ability, and in this stage, the richness of teaching plays a crucial role. HP The teaching of high school mathematics from the perspective of M "problems" focuses on as the core. emphasizing the cultivation of students' problem-solving abilities and innovative spirit. The following will explore the characteristics of richness in high school mathematics teaching from three aspects: problem setting, teaching methods, and resource utilization. Firstly, in terms of problem setting, teachers can design diverse and multi-level questions based on actual situations. These questions can revolve around textbook knowledge and be integrated with students' daily lives and social practices. By flexibly setting questions, teachers can stimulate students' interest in learning, stimulate their thinking and exploration desires. For example, when teaching the concept of functions, teachers can pose a practical problem: the price of a certain product decreases with the increase of sales volume, and the profit increases with the increase of sales volume. Please analyze the relationship between the profit function and the sales volume function, and derive the maximum value of sales volume and profit. Such problems not only arouse students' interest, but also cultivate their ability to use the properties of functions to solve practical problems. Secondly, in terms of teaching methods, HP The high school mathematics

teaching from the perspective of M emphasizes the subjectivity of student participation. Teachers can use various teaching methods. such as classroom discussions, case analysis, group cooperation, etc., to stimulate students' initiative and self-learning ability. Through interaction and collaboration with students, they can inspire each other and continuously expand their thinking boundaries in the process of problem-solving. At the same time, teachers also guide students in modeling can mathematics. enabling them to extract real-world mathematical models from problems and apply them to solve real-world problems. This method can bring students closer to mathematical application scenarios and enhance their problem-solving abilities. Thirdly, in terms of resource utilization, richness is manifested in teachers fully utilizing various teaching resources [3]. Teachers can use multimedia technology in teaching to import various forms of resources such as charts, animations, and videos, making abstract mathematical concepts more vivid and intuitive. Teachers can also guide students to utilize online resources, such as online learning platforms, math problem forums, etc., to broaden their learning channels and enable them to acquire rich mathematical knowledge from multiple perspectives. By integrating and utilizing these resources, we can provide students with a more open and diverse learning environment, enhancing their mathematical learning experience.

### 2.3 Inheritance Oriented

Inheritance is an important feature of high school mathematics teaching. In the highly developed modern society of information technology, the inheritance based teaching model still holds an irreplaceable and important position. Inheritance based teaching advocates passing on mathematical knowledge and skills from generation to generation, allowing students to receive the influence of excellent mathematical traditions and ways of thinking through interaction and teaching between teachers and students, and further cultivate students' various abilities on this basis. Firstly, traditional teaching focuses on imparting knowledge. Teachers serve as guides and enlighteners in high school mathematics teaching. Teachers impart basic concepts, theorems, and methods of mathematics to

students through explanations, demonstrations, and example analysis. Teachers, with their rich knowledge reserves and unique teaching experience, provide students with comprehensive and systematic mathematical knowledge, which helps them build a solid mathematical foundation. Secondly, traditional teaching emphasizes the inheritance of classic problems. There are many classic questions in high school mathematics, and these questions carry the essence of many mathematical thinking modes and problem-solving skills. The so-called inheritance teaching is to guide students to dissect the problem-solving ideas and methods of classic problems, help them understand the essence of the problem and the key to solving it, and cultivate mathematical thinking and innovation ability. At the same time, traditional teaching also promotes students' creativity and imagination in the process of answering questions, enabling them to flexibly apply the knowledge they have learned to solve practical problems. Traditional teaching emphasizes the continuation of traditional knowledge structures and methodologies. Thirdly, mathematics is a rigorous discipline with its own system and laws. Inheritance based teaching advocates that students start from the basics and gradually learn mathematical knowledge, gradually establishing their own knowledge system. At the same time, traditional teaching also emphasizes the training of students' problemsolving methods and thinking patterns. Through repeated training and practice, students gradually master problem-solving skills and methods, thereby improving the accuracy and efficiency of problem-solving. Fourthly, traditional teaching emphasizes the interaction between students and teachers and students. From the perspective of traditional teaching, teachers are no longer just "lecturers" in the traditional sense, but should become guides and partners for students' learning. Teachers can understand students' learning situation and confusion through interactive communication, provide timely assistance and guidance to students, and stimulate their interest and initiative in learning. At the same time, students can also raise questions, express their opinions, participate in the teaching process, discuss problems together, and solve problems in communication with teachers [4].

### **3.** Methods of High School Mathematics Teaching from the Perspective of HPM

### **3.1 Penetrating the History of Mathematics**

Penetrating the history of mathematics is a unique perspective for exploring the development of mathematics. It not only stays on the surface of mathematical knowledge, but attempts to explore in depth the thinking patterns, conceptual changes, and historical evolution of mathematical ideas behind perspective mathematics. From the of permeating the history of mathematics, we can also see the conceptual changes of mathematics in different historical periods. In ancient times, people associated mathematics with the universe, nature, and believed that mathematics was a tool for revealing the truth of the world. In modern times, mathematics has gradually been established on a rigorous axiomatic system and has become a rigorous discipline of logic. This shift in mindset is not only a change in the way mathematics thinks, but also reflects a change in human cognition of the real world. In addition to the evolution of mathematical thinking and the transformation of concepts, the infiltration of mathematical history also focuses on the historical background of mathematical development. The progress of mathematics is often closely related to the development of society, culture, and science. For example, during the Industrial Revolution, the rapid development of mathematics was closely related to the rapid development of fields such as mechanical manufacturing, navigation, and aviation. In the modern information age, the application of mathematics is not limited to traditional scientific fields, but also involves emerging fields such as data analysis and artificial intelligence. These changes in historical background not only spurred innovation in mathematics, but also provided a stage for the development broad of mathematics. The study of permeating the history of mathematics not only helps students better understand the development process of mathematics, but also provides reference for modern mathematics education. Teaching high school mathematics from the perspective of permeating the history of mathematics can enable students to have a deeper understanding of the meaning and value of mathematics.

In the classroom, teachers can guide students

to stimulate their interest in learning by studying the historical background and evolution of mathematical thinking behind mathematical problems. At the same time, the infiltration of mathematical history can also help students establish connections between mathematics and other disciplines, promoting interdisciplinary learning and thinking. HP The infiltration of mathematical history into high school mathematics teaching methods from the perspective of M is undoubtedly a creative and inspiring approach. By developing students' unique mathematical perspectives and profound mathematical understanding, it can not only enhance the effectiveness of mathematics learning, but also develop their creativity and critical thinking abilities. At the same time, students can also experience the beauty of mathematics and the joy of philosophical speculation. In the teaching method of infiltrating the history of mathematics, teachers can choose several famous mathematical problems or theorems as the starting point for teaching. Problems such as Euclid's algorithm, Fermat's Last Theorem, and the Golden Ratio, which occupy an important position in the history of mathematics, can arouse students' deep thinking and curiosity. Afterwards, teachers can provide detailed descriptions of the background, problem-solving historical process, and mathematical ideas of the test questions, and guide students to think about their mathematical principles and methods. At the same time, teachers can also use quotes from mathematicians, provide photos and materials related to mathematicians, and narrate the life stories of mathematicians to help students develop a sense of identification and interest in mathematicians. In this way, students can not only learn knowledge, but also understand the struggle process of the mathematical mathematicians and achievements created by students, which can resonate emotionally with mathematics and generate more motivation to learn and explore mathematics [5,6]. In addition, teachers can demonstrate certain mathematical models or practical applications in the history of mathematics to help students experience the value of mathematics in practical applications. By demonstrating the application of the golden ratio in fields such as architecture, art, and nature, students can deeply understand the

importance of mathematics in real life, thereby stimulating their interest and motivation to learn mathematics.

# 3.2 Exploring the Philosophy of Mathematics

Mathematics not only contains a set of special symbols and rules, but also a way of thinking and problem-solving art. However, high school mathematics teaching often regards mathematics as a tool, emphasizing its practicality while ignoring the philosophical connotations it contains. From the perspective of HPM, we can more deeply explore the philosophical significance contained in mathematics. HP M emphasizes the close integration of humanities and mathematics, aiming to develop students' mathematical intuition and thinking abilities, making mathematics teaching more meaningful and creative. By exploring the philosophy of mathematics, students can gain a deeper understanding of the essence of mathematics and organically integrate it with daily life. Firstly, exploring mathematical philosophy can help students establish correct mathematical concepts. Traditional mathematics teaching on formulas usually only focuses and calculation methods. making students accustomed to using mechanized methods to solve problems [7]. But the essence of mathematics is one of the ways of thinking, which is to develop logical thinking and creativity in the process of solving problems. By guiding students to think about the essence and meaning of mathematical problems, and exploring the philosophical ideas behind them, it can help students establish correct mathematical concepts and gain a deeper understanding and application of mathematical knowledge. Secondly, exploring mathematical philosophy can also develop students' abstract thinking. Mathematics is a highly abstract discipline, and its symbols and concepts often detach from concrete objects in the real world. But it is precisely this abstraction that makes widely applicable mathematics and generalizable. By exploring the philosophical ideas behind mathematics, students can understand the logical relationships and abstract thinking patterns hidden behind mathematical symbols and concepts, develop their abstract thinking, and better solve abstract and complex problems. The third exploration

of mathematical philosophy can also stimulate students' creativity and imagination. There are many beautiful and interesting problems in the world of mathematics, which often require students to think and solve problems from different perspectives. By exploring the philosophical significance and concepts behind mathematics, we can provide students with more mathematical problems and challenges, stimulate their creativity and imagination, and cultivate their love and pursuit of mathematics. Enable students to experience the wonders of mathematics during the problem-solving process, thereby enhancing their interest and confidence in learning mathematics. The fourth exploration of mathematical philosophy enable students to integrate also can mathematics with daily life. Traditional mathematics teaching often makes students feel that mathematics belongs only to textbooks and exams, and has nothing to do with life. But mathematics is ubiquitous, and many phenomena and problems around students can also be explained and understood through mathematics [8]. By exploring the philosophical ideas behind mathematics, it helps students find the applications of mathematics in their daily lives, understand the significance and value of mathematics in solving practical problems, and thus improve their learning initiative and enthusiasm.

### 3.3 Expand Life Oriented Teaching

In today's rapidly developing information society, education is no longer simply about imparting knowledge and training students' exam taking abilities, but rather emphasizing the training of students' comprehensive qualities and innovative thinking abilities. Especially in the field of mathematics teaching, traditional abstract concepts and formulas be well adapted students' cannot to requirements, so expanding life oriented teaching has become the most important means in modern mathematics education [8]. Expanding life oriented teaching is a teaching model that combines mathematical concepts with real-life situations and problems, allowing students to acquire mathematical knowledge. develop logical thinking, and problem-solving abilities through practical experience. This teaching method can not only enable students to have a deeper understanding and application mathematical knowledge, but of also

strengthen their innovative consciousness and practical ability. When expanding life oriented teaching, teachers are no longer simply explaining concepts and formulas, but need to act as guides and organizers. They need to design good teaching situations so that students can discover and apply mathematical knowledge from specific problems. For example, teachers can use real-life issues such as urban planning and traffic flow to guide students in analyzing data and establishing models, in order to cultivate mathematical modeling and practical abilities. Expanding life oriented teaching focuses on cultivating students' spirit of exploration and teamwork. Through group cooperation and discussion, students can inspire each other, learn from each other's strengths and weaknesses, and form a thinking style of solving problems together. At the same time, students can also gain a profound understanding of the application of mathematics in daily life through visits, inspections, and interviews with actual places, broadening their knowledge horizons and ways of thinking. The biggest advantage of expanding life oriented teaching is to stimulate students' motivation and interest in learning. By combining mathematical knowledge with real-life situations, students will no longer find mathematics boring and useless, but can truly feel its magic and practicality. Students will actively think about and solve problems, and constantly seek to master new knowledge and skills. Of course, expanding life oriented teaching faces certain challenges and difficulties. Teachers need to have rich teaching experience and knowledge reserves in order to design interesting and challenging teaching situations. In addition, schools and parents need to support and cooperate with each other, provide the necessary resources and conditions, and thus provide a good environment for the expansion of life oriented teaching. From the perspective of HPM, expanding life oriented teaching is a forward-looking and innovative teaching method. It can not only improve students' math grades, but also cultivate their comprehensive quality and innovative thinking ability, thus laying a solid foundation for their future learning and work.

### 3.4 Integrate into the Mathematical Timeline List

In high school mathematics teaching, incorporating a math time list appropriately can not only improve students' learning effectiveness, but also cultivate their time concept and learning planning ability. From perspective of HPM, the combining mathematics with the concept of time makes mathematics more vivid and interesting. Firstly, a math time list can help students classify and organize their learning content. Mathematics, as a subject, is complex and intricate, making it easy for students to feel confused and at a loss. And when teachers arrange mathematical knowledge according to a timeline, such as the history of mathematics, the time when important mathematical theorems and formulas were proposed, the development process of mathematical applications, etc., students can see the context and internal connections of mathematical knowledge more clearly. By establishing a mathematical time list, students can divide knowledge points into relatively independent stages, better understanding and digesting mathematical content [9]. Secondly, a mathematical timeline can help students better understand the development of mathematics. Mathematics is a discipline with a long history, and its development is full of the crystallization of human wisdom. By listing the mathematical timeline, students can understand the development, changes, and breakthroughs of mathematics in various historical stages. They can learn about the famous works of ancient mathematician Euclid. as well as the contributions of modern mathematicians Gauss and Riemann. In this way, students can not only deeply understand the essence of mathematics, but also have a deeper understanding of the context of the mathematical knowledge they are learning, enhance their interest in mathematics, and stimulate their learning motivation. The third mathematics time list can also develop students' time concept and learning planning ability [10]. In students' daily learning, they often encounter difficult time arrangements. By setting up a math time list, students can learn how to scientifically and reasonably arrange their study time. Students can develop corresponding learning plans for different stages and contents in the mathematics timeline. For example, when students are about to learn a new mathematical knowledge, they can allocate corresponding study time and

review time based on the position of the knowledge point in the mathematical time list. This way, students can enhance their learning effectiveness and develop their ability for selfdirected learning.

## 3.5 Extracurricular Independent Exploration

Under the HPM perspective, high school mathematics teaching methods advocate learning from history, focusing on problems, and using methods as a supplement. The core idea of this method is to enable students to break free from the traditional mode of passively receiving knowledge, and truly become active participants and independent thinkers. Extracurricular exploration is further developed within this teaching philosophy [11]. Extracurricular independent exploration breaks the traditional teaching mode, breaks through the boundaries between disciplines, and provides a broader space for learning. Students can choose appropriate research directions based on their interests and needs to conduct specialized research, exploring the principles and applications behind mathematical knowledge. Students can choose to study the specific applications of mathematics in financial science and obtain engineering, and more comprehensive and profound mathematical knowledge through field research. interviews with experts, and reading relevant literature. Questioning is a learning motivation when exploring independently outside of class. Students raise questions of interest and seek answers through research independent and practical exploration, which stimulates their desire for knowledge and exploration spirit, and develops their problem awareness and innovative thinking ability. In solving complex geometric problems, students are required to independently propose hypotheses, construct reasoning chains, and seek proof methods [12]. This process develops students' logical thinking and reasoning, and learning is a means for students to explore and learn independently outside of class. Students can conduct indepth research on mathematical problems by using mathematical software, writing programs, and conducting simulation

experiments. This can not only deepen the understanding and application of mathematical knowledge, but also promote the development of students' information technology abilities and the cultivation of creative thinking. For example, after calculus, learning students can use programming to simulate the trend of function changes, giving them a better understanding of concepts such as derivatives and integrals. During the process of self-directed learning, teachers should provide scientific guidance to help students solve learning problems. At the same time, they can also use mobile terminals to closelv interact and communicate with students, improving their learning effectiveness.

### **3.6 Auxiliary Information Technology**

In today's digital age, auxiliary information technology has gradually penetrated into various fields, and the education sector is no exception. Applying auxiliary information technology to high school mathematics teaching can not only improve students' learning effectiveness, but also stimulate their interest in learning, making mathematics no longer boring, but a creative and enjoyable learning experience. The application of auxiliary information technology in high school mathematics teaching can be studied from multiple perspectives. Firstly, teachers can use devices such as electronic whiteboards or projectors to turn abstract mathematical knowledge into visual and intuitive images, making it easier for students to understand and master. For example, when teaching planar geometry, teachers can use electronic whiteboards to draw geometric shapes, and demonstrations through dvnamic and transformations, help students understand the concepts and laws of geometric transformations. This visual display can not only promote students' understanding of mathematical concepts but also stimulate their imagination and creativity. Secondly, auxiliary information technology can also provide students with richer learning resources and tools. For example, through the Internet, students can easily access a large number of teaching videos, online teaching math courseware and math software, which can bring intuitive interactive learning experience

to students [13]. Moreover, students can also participate in online discussion and learning communities through online learning platforms, sharing and exploring mathematical problems with other students to broaden their thinking and horizons. This learning environment can not only stimulate students' enthusiasm for learning, but also promote their self-directed Thirdly, auxiliarv information learning. is also beneficial technology for the development of students' problem-solving abilities and innovative thinking. In traditional mathematics teaching, students usually only passively receive knowledge imparting and mechanical calculation exercises, lacking practical application and innovative thinking. by utilizing auxiliary information And technology, students can apply mathematical knowledge to practical problems through simulation experiments and mathematical modeling, developing their awareness and innovative ability to solve problems. In dealing with practical problems, students can use mathematical software to draw graphs of functions and explore the characteristics and laws of functions by observing the changes in the graphs, such as adjusting the parameters in the functions. This learning method can not only promote the development of students' mathematical thinking ability, but also cultivate their creativity and practical ability. During the process of students encountering problems, teachers can encourage them to use the internet to search for relevant learning resources and overcome various difficulties in learning.

### 4. Conclusion

The HPM perspective provides new strategies for mathematics teaching, incorporating historical, philosophical, and socio-cultural factors, which can effectively strengthen students' understanding and application of mathematics, develop critical thinking and innovation abilities. Mathematics teaching should not be limited to imparting concepts and techniques, but should focus on students' comprehensive development and humanistic care. So in high school mathematics teaching, teachers should strive to use the HPM perspective to teach, by introducing history, philosophy, and social culture to open up a new window of mathematical understanding for students, stimulate mathematical interest and thinking, and develop creativity and innovative spirit. Only in this way can more geniuses and intelligent future mathematicians and scientists be created.

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