# On Cultivating Core Mathematical Literacy of High School Students from the Perspective of Learning Styles

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***Abstract***
*Learning style is the sum of learning strategies and tendencies, which to a certain extent influences students' logical thinking and practical application abilities. Through semi-structured interviews with senior mathematics teachers and high school students at X High School, this paper explores the current status of core mathematical literacy and the impact of learning styles on high school students' core literacy. Based on learning styles, strategies for cultivating high school students' core mathematical literacy are proposed from three aspects: the content of core mathematical literacy in high school, high school students' logical thinking literacy in mathematics, and high school students' practical application literacy in mathematics.*
***Keywords:*** *Learning style; High school mathematics; Core literacy*

## Introduction

With the continuous development of society and advances in technology, the role and value of mathematics are becoming increasingly apparent. Therefore, the academic community has begun to focus on cultivating students' core mathematical literacy. This cultivation aims to develop students' cognitive qualities and essential skills that meet the demands of personal lifelong development and societal needs, which are fundamental characteristics of mathematical literacy. Research on the cultivation of mathematical literacy among high school students at specific academic stages holds practical significance. Fostering high school students' mathematical literacy not only equips them with the cognitive qualities and essential skills to adapt to personal lifelong development and societal needs, but also helps them accurately grasp the depth and breadth of mathematical knowledge. Moreover, from the perspective of mathematical literacy, it can help teachers improve their teaching. Therefore, this study, through semi-structured interviews with high school students and mathematics teachers, aims to explore the influence of learning styles on enhancing the mathematical literacy of high school students.

### 1. The Connotation of Mathematical Literacy

In terms of mathematical literacy, there is currently no unified definition in the academic

community. The term "mathematical literacy" originated in Australia, where the Australian Institute for Teaching and School Leadership (AITSL) first defined mathematical literacy in 1989 as the ability of individuals to effectively apply mathematical knowledge to meet the needs of family life, work, social participation, and daily life. Subsequently, the Programme for International Student Assessment (PISA) defined mathematical literacy as the ability of individuals to form, apply, and interpret mathematics in different contexts, including mathematical reasoning, mathematical concepts, mathematical procedures, mathematical facts, and mathematical tools to describe, explain, and predict. Mathematical literacy can help individuals understand the role of mathematics in real life, as well as make good judgments and decisions, enabling them to become participative, constructive, and reflective citizens.

In recent years, the concept of mathematical literacy has become a fundamental goal in contemporary mathematics education. The definition of mathematical literacy (ML) has been influenced by the international PISA tests and the comprehensive framework provided by the OECD in 2006 [1]: ‘‘Mathematical literacy is an individual’s capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual’s life as a constructive, concerned and reflective citizen.’’

Mathematical literacy is a notion used to define the body of knowledge and competences required to meet the mathematical demands of personal and social life and to participate in society as informed, reflective and contributing citizens (Geiger et al., 2015) [2-3].

As per the Program for International Student Assessment (PISA) conducted by the Organisation for Economic Co-operation and Development (OECD) in 2019[4], Mathematical literacy is described as “an individual’s capacity to formulate, employ, and interpret mathematics in a variety of contexts.”

In China, students' core literacy is defined as the essential qualities and key abilities that students should possess to adapt to lifelong and societal development needs. The core literacy of mathematics mainly includes six aspects: mathematical abstraction, logical reasoning, mathematical modeling, intuitive imagination, mathematical operations, and data analysis[5]. Some recent research by Chinese scholars on Mathematical literacy can be seen in [6-10].

**2. Influence of Learning Styles on Mathematical Core Literacy of High School Students**

Kolb's Learning Styles Inventory[11], developed in 1984, is a widely used framework, especially within the United States. It conceptualizes individuals' learning processes as varying across two dimensions: preferred mode of perception (concrete to abstract) and preferred mode of processing (active experimentation to reflective observation). The Inventory categorizes individuals into four types based on their positions along these dimensions: divergers (concrete, reflective), assimilators (abstract, reflective), convergers (abstract, active), and accommodators (concrete, active). The self-assessment involves individuals indicating their agreement or disagreement (on a 4-point scale) with statements such as whether they learn best when they listen and watch carefully, or whether they prefer to analyze things and break them down into parts when learning.

Through semi-structured interviews with 10 experienced mathematics teachers and 15

high school students of different grades at X High School, this study aims to explore the impact of learning styles on the mathematical core literacy of high school students and the current situation of high school students' mathematical core literacy.

**2.1 Current Situation of High School Students' Mathematical Core Literacy**

Among the 10 interviewed experienced mathematics teachers, all expressed concerns about the current state of high school students' mathematical core literacy. Mathematical core literacy is considered as an implicit cognitive quality, a necessary skill for serving society and personal development, and a reflection of students' characteristics in learning mathematics, integrating mathematical knowledge, abilities, and emotional attitudes and values. Mathematical literacy should be based on mathematical knowledge and abilities, enabling students to develop a natural and active habit of using mathematical thinking for communication. However, the majority of high school students' mathematical core literacy currently remains mostly at a basic level of understanding mathematical content such as mathematical operations and data analysis. Many students lack comprehensive core literacy in areas such as mathematical emotions, visual imagination, logical reasoning, and mathematical thinking.

Teacher 1 mentioned, "Most high school students nowadays only consider mathematics as a main subject, thinking they only need to memorize formulas and practice problems to pass their exams, without truly understanding the importance of mathematics in their growth."

As a result, many students tend to disconnect from the mathematics classroom, appearing bewildered in aspects such as visualizing geometric figures and mathematical logical operations in their daily lives. In addition, a few interviewed teachers pointed out that some less experienced teachers currently have limited understanding of mathematical core literacy and cannot effectively integrate mathematical content with core literacy in the mathematics classroom.

Teacher 3 pointed out, "Currently, there are some teachers who are not clear about the six major elements of core literacy, and they do not know how to integrate it with high school mathematics. For example, in the chapter on geometric shapes, they only explain the formulas for the shapes, without teaching how to develop logical thinking and improve students' spatial imagination."

**2.2 The Impact of Learning Styles on the Mathematical Core Literacy of High School Students**

Learning style is a preferential way of learning during the learning process, which is a unique cognitive mode for learners. The learning environment plays an important role in shaping learning styles. Learning styles encompass individual differences among students, determining their learning tendencies and methods. The interviewed teachers and students pointed out the impact of learning styles on the mathematical core literacy of high school students from three aspects: mathematical knowledge, mathematical thinking ability, and mathematical application ability.

**2.2.1 Impact on High School Mathematical Knowledge**

The interviewed teachers stated that learning style is a determining factor in influencing

students' learning thinking and behavioral tendencies. Therefore, tailoring group teaching models based on students' learning styles can greatly promote academic performance, as well as the development of logical thinking and abstract generalization. Moreover, the knowledge in high school mathematics subjects, such as measurement, algebra, geometry, and statistics, all play an important foundational role in cultivating the mathematical core literacy of high school students.

As mentioned by Teacher 5, "In actual mathematics classroom teaching, teachers can conduct grouped teaching based on different mathematical learning styles and levels, and design mathematics course content for each group according to their learning styles."

Mathematics, as a rational discipline, may not be operationally strong if the research is primarily based on reasoning. It requires an analysis of the content and structure of its subject knowledge, leveraging its role as a bridge and medium, and then initiating teaching activities. This ensures that mathematical thinking methods in the entire teaching activity function as a sharp sword, connecting various core literacies and breaking them down individually.

**2.2.2 Impact on High School Mathematical Thinking Ability**

High school mathematics is characterized by stringent logic, which requires students to have strong logical reasoning abilities in order to learn mathematics. The cultivation of students' logical reasoning abilities is an inevitable process for constructing the core literacy of mathematics. The interviewed teachers pointed out that the essence of learning mathematics is to use mathematical knowledge to solve mathematical problems. A good learning style can enable students to independently explore the relationships between mathematical information, and find the thinking and methods for transforming mathematical phenomena into their essence, thereby enhancing students' mathematical thinking abilities in practice.

As stated by Teacher 7, "Learning styles are very important for the cultivation of students' mathematical logical thinking. For example, students with an assimilating learning style can demonstrate independent reasoning or reflective traits very well in the classroom. On the other hand, adaptive students have poor abilities in applying concepts to new situations. For instance, when a problem is presented in a different way, they struggle to reason and answer."

Among the interviewed high school students, a strong dependency on learning styles was also evident. Some students expressed that although their understanding of learning styles may not be profound, their own thinking patterns have a significant impact on their mathematics grades.

For example, Student 5 expressed, "My math grades can only be average because my learning style does not favor logical reasoning. Thus, for topics like geometry or algebra in mathematics, I can only understand the problems explained by the teacher in class, and I don’t have the habit of independent thinking outside of class."

**2.2.3 Impact on High School Mathematical Application Abilities**

The application ability of mathematics in high school is one of the key elements of high school mathematics core literacy. The interviewed teachers expressed that in cultivating high school students' mathematical application abilities, it is important to develop students'

abilities to identify and pose problems in real-life situations, enabling them to apply the relevant mathematical knowledge and thinking skills to address specific practical issues, and to apply and refine mathematics in real-life contexts. Students' learning styles not only manifest as behavioral tendencies in learning but also reflect their cognitive application abilities in their daily lives. High school mathematics core literacy requires high school students to have the ability to apply mathematical skills in their daily lives, meeting their practical mathematical application needs. Therefore, forming good learning styles and cultivating high school students' mathematical core literacy based on the characteristics of their learning styles becomes particularly important to tailor teaching to individual students.

For instance, Student 7 remarked, "I feel that the mathematics knowledge we are learning currently has little practical relevance, as I don't sense the help and changes it brings to me in my daily life."

Teacher 10 also stated, "It is ideal to conduct grouped teaching according to students' learning styles, as this allows for a focus on enhancing the practical application abilities of students with weaker skills in practical application, such as those with convergent or assimilating learning styles, based on their individual traits."

## 3. Cultivation Strategies for High School Students' Mathematical Core Literacy

### 3.1 Establishing Teaching Content for High School Mathematical Core Literacy Based on Learning Styles

Currently, the revision of the curriculum plan and the new round of curriculum standards for ordinary high schools in China is underway. The teaching content for mathematics should adhere to the curriculum standards, fully embody the core literacy within the teaching content, and take into account the characteristics of the four learning styles of high school students comprehensively when compiling the teaching content. The specific teaching objectives should showcase mathematical core literacy to cater to students with various learning styles.

For example, in the formulation of mathematical concepts and theorems, emphasis should be placed on connecting the background of concept generation and the process of concept formation with students' real-life experiences, enabling them to relate the concepts back to their actual lives. This approach can prompt adaptive learning style students to analyze mathematical concepts based on their specific experiential examples, making tedious and abstract concepts more vivid and understandable. Alternatively, setting exercise problems that integrate with real-life experiences can help students with weaker abstract imagination abilities in their learning styles, such as divergent thinkers, to initially have a subjective and personal understanding, making it easier for them to accept abstract mathematical symbols or language. Additionally, this approach also contributes to the integration and logical presentation of knowledge across various domains, enhancing a better understanding for students with different learning styles on how mathematical knowledge can be applied in real life.

### 3.2 Cultivating High School Students' Mathematical Logical Thinking Literacy Based on Learning Styles

Logical thinking, as one of the six elements of high school mathematical core literacy, requires the cultivation of students' ability to identify problems and propose propositions, as

well as mastery of reasoning patterns and the ability to articulate arguments using mathematical language. Students should understand the context of mathematical knowledge and be able to construct a framework of mathematical knowledge, enabling them to form mathematical thinking qualities that are well-supported, well-organized, and logically rigorous, thereby enhancing students' mathematical communication abilities. Therefore, high school mathematics teachers should be able to conduct grouped teaching based on different learning styles. For groups with weaker logical reasoning abilities, such as convergent groups, emphasis should be placed on explaining the logical reasoning aspects of formulas or exercise problems. This can be achieved through various divergent thinking techniques, such as changing example problems, transforming formulas, reverse reasoning, algorithm transformation, and analogical reasoning, to enhance students' logical thinking and reasoning abilities in mathematics.

For example, in the teaching design process for sequences, teachers can first guide students with weaker assimilating abilities to think about whether a general term formula for the sequence exists, and if it does, what it is. This can be combined with real-life examples to explain the definition of the general term formula for sequences. Subsequently, for students with weaker logical reasoning abilities, such as those in convergent and adaptive groups, they can be encouraged to observe and study the relationship between each term in the sequence and its position, leading them to discover patterns. Through analogical exploration, they can induce the general term formula for each sequence. Finally, students can be challenged to generalize the general term formula to a general arithmetic sequence to assess their mastery. Throughout the teaching process, teaching methods should be designed based on the characteristics of each group's learning styles to comprehensively enhance every student's mathematical logical thinking literacy.

### 3.3 Enriching Situational Teaching Based on Learning Styles to Cultivate High School Students' Mathematical Practical Application Literacy

Mathematics is closely intertwined with our real-life experiences. Fundamentally, the cultivation of high school students' mathematical core literacy aims to enable students to observe the world from a mathematical perspective, describe the real world using mathematical language, and recognize that mathematics "arises" from the needs of real life and should therefore also return to reality. Therefore, situational teaching is an important way to cultivate and develop high school students' mathematical core literacy.

Due to the outdated emphasis on concept teaching in traditional education, it is challenging to reveal the essence of concepts, leading to students having a one-sided and shallow understanding of core concepts. Therefore, high school mathematics teachers can design appropriate teaching scenarios that integrate students' learning styles with real-life models. The selected materials should be rich, comprehensive, and insightful, helping students connect their existing experiences with the knowledge they are acquiring, thus encouraging active and passionate thinking about the seemingly cold and beautiful world of mathematics. This approach is more conducive to students' abstract understanding of concepts, their appreciation of mathematical thinking, and the formation of concepts.

Additionally, the diverse situational teaching designed based on learning styles is also

beneficial for sparking students' interest and desire to learn, yielding a more efficient learning process. For example, the study of equations is closely related to our daily lives. In traditional teaching methods, teachers often directly present the graph of the equation, and students typically rely on rote memorization, failing to comprehend how equations are applied in real-life situations. Instead, teachers can use situational simulation to guide learning. For students with less real-life experience, such as those in convergent groups, teachers can introduce real-life transaction examples before class to help students connect equations with functions and gain a preliminary understanding of using function-based thinking to solve equation problems.

## 4. Conclusion

Learning style is the sum of learning strategies and learning tendencies. Learning strategies refer to the process of students processing information, and learning style to some extent determines students' logical thinking and practical application abilities. In the 21st century, talent cultivation is no longer just about the cultivation of knowledge, but rather emphasizes the cultivation of core literacy. The core of core literacy is to cultivate "well-rounded individuals." High school is an important stage for knowledge transmission, individuality development, and overall quality enhancement, and high school mathematics, being a major subject, makes the cultivation of high school students' mathematical core literacy particularly important. From the perspective of learning styles, high school mathematics teachers should select and use teaching strategies that align with the learning characteristics of different students, develop teaching content, and cultivate their mathematical core literacy. This approach helps to enhance high school students' adaptability and the essential character and capabilities required for lifelong and social development.

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