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Implications of Meaningful Learning Theory for High School Mathematics Classroom Teaching—Take "Plural" as an Example

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Abstract: *With the introduction and development of some foreign learning theories, meaningful learning theories have gradually been understood and recognized by everyone. Based on the Ausubel theory of meaningful learning, this paper takes "plural" as an example to find that meaningful learning provides cognitive basis for mathematics learning, provides practical guidance for the implementation of mathematics classroom, conforms to the actual situation of mathematics teaching, and gives three enlightenments for high school mathematics classroom teaching: paying attention to the logic of mathematical knowledge, stimulating students' desire to learn mathematics according to academic conditions, and establishing diversified mathematics classroom forms.*

Keywords: *Meaningful learning; High School Math; Classroom teaching*

1. Questions asked

The "Mathematics Curriculum Standards for General High Schools (2017 Edition)" requires the full implementation of the concept of cultivating virtue and cultivating people, deeply excavating the educational value of mathematics, establishing a teaching awareness oriented to the development of students' core literacy in mathematics, and running the cultivation of core literacy in mathematics throughout the whole process of teaching activities [1]. At a time when subject core literacy has become a new leading idea in the current education sector, thinking about how learning occurs from the perspective of students' effective learning is of great significance to truly implementing the scientific concept of curriculum reform and the formation of students' real subject literacy. Practice needs to be supported by theory, and classroom teaching also needs to be supported by theory. Among the classical learning theories, Osubor's theory of meaningful learning has always been valued, so it is also valuable to think about the theory of meaningful learning. In high school mathematics teaching, thinking about the value of this theory and its inspiration for teaching can make us understand the context of students' mathematical learning more clearly [2]. In the classroom, we should pay attention to not only how to teach, but also how to learn, continue to explore and innovate teaching methods, cultivate their learning habits, stimulate their interest in mathematics as much as possible, let them have a strong interest in mathematics, and achieve real meaningful learning.

2. Literature review

Ting Zeng believes that teachers carry out life mathematics teaching under the guidance of meaningful learning theory, and guide students to experience the formation process of mathematical knowledge, accumulate cognitive experience, develop mathematical concepts, and continuously improve the knowledge system, which is of great significance to the implementation and achievement of curriculum standard requirements[3]; Wenqi Zeng believes in the enlightenment of meaningful learning theory to mathematics teaching of high school art students, saying that Ausubel meaningful learning theory suggests that we should make full use of the achievements of scientific and technological development according to the characteristics of art students, based on the original cognitive structure, and use rich teaching resources to stimulate the interest of art students in learning mathematics, so that their learning can develop in a meaningful direction, so that students can gain and improve the efficiency of teachers' teaching [4]; Jieqiong Tang believes that looking for classical teaching theories such as meaningful learning theory as a fulcrum in high school mathematics teaching can make the entire idea of mathematics teaching be pried, and the author believes that this is the basic guarantee for achieving

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effective teaching and truly improving students' core mathematical literacy [5]. There are different views on the implications of meaningful learning theory for mathematics teaching, and this article will combine my own views to talk about the implications of meaningful learning theory for high school mathematics classroom teaching.

3. Integrate the theory of meaningful learning into mathematics classroom teaching

3.1. Meaningful learning provides a cognitive basis for mathematics learning

Meaningful learning is the non-artificial and substantive connection between the new knowledge represented by symbols and the appropriate ideas already in the learner's original cognitive structure [4]. Non-artificial connection refers to the connection between new knowledge and old knowledge that is not arbitrary, but is established on the basis of some reasonable logic [6]. For example, before high school students learn "complex numbers", students think that the equation has no solution when they encounter $\Delta< 0$ when solving the equation, and after learning "complex numbers", they understand that when $\Delta< 0$, there is no solution on the set of real numbers, and there is a solution on the set of complex numbers. In fact, students have established a connection between old and new knowledge.

Ausubel proposed that "assimilation" is an intrinsic psychological mechanism that builds on students' existing concepts and enables them to acquire new knowledge. The interaction between new knowledge and ideas related to old knowledge promotes the assimilation of old and new knowledge [7]. There are three methods of assimilation, namely: lower learning, upper learning, and combined learning. The so-called subordinate learning is the concept that the newly learned knowledge is subordinate, and the original knowledge is the general concept. For example, first learn the concept of function, and then learn the concept of power function, exponential function, logarithmic function, they have a subordinate relationship. The so-called superior learning is that the newly learned knowledge is a general concept, and the original knowledge is a subordinate concept. For example, on the basis of learning ellipses, hyperbolas, and parabolas, and then learning ellipses, hyperbolas, and parabolas are collectively called conic curves is superior learning. Combinatorial learning means that the original knowledge and the new knowledge level are the same, and the two are neither superior nor inferior relationships, but are produced through juxtaposition or union. For example, learning the addition and subtraction of complex numbers and learning the multiplication and division of complex numbers is combinatorial learning. Under the guidance of teachers, students will automatically use assimilation theory in the process of receiving knowledge, integrate knowledge according to categories, interact with old and new knowledge, and students continue to accumulate mathematical knowledge and have a more comprehensive understanding of knowledge points.

3.2. Meaningful learning provides practical guidance for mathematics classroom implementation

Ausubel believes that the method of gradual differentiation and reorganization coordination should be applied in meaningful learning, and then the application strategy of "first organizer" is developed according to this method. Stepwise differentiation refers to the fact that students start learning the simplest and most inclusive knowledge, and then gradually differentiate them according to specific details. Reorganization and coordination is the recombination of existing elements in the student's cognitive structure. For example, when learning the chapter on complex numbers, because there is more content in this part, when writing the textbook, it is divided into three subsections: the concept of complex numbers, the four operations of complex numbers, and the trigonometric representation of complex numbers. Prior to this, students learned the concept of real number sets or numbers smaller than real number sets, the four operations of numbers, etc., and had some understanding of the logarithmic system, but now it has been extended to complex number sets. After learning these contents, students need to integrate and coordinate them, so that students can clearly understand the difference between the knowledge related to the complex number set and the knowledge related to the real number set, and form a clear, stable and integrated knowledge framework in the brain. In this way, the specific knowledge points in the plural number also have a meaningful understanding and form a certain cognition. This teaching method actually corresponds to the teaching methods and application strategies in meaningful learning.

3.3. Meaningful learning is in line with the actual situation of mathematics teaching

Receptive learning, discovery learning, machine learning, and meaning learning are Ausubel's

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classifications of learning. He emphasized that both receiving learning and discovering learning can be meaningful or mechanical. Due to the discovery of problems that take a long time to learn and are difficult for students to understand in some learning situations, the traditional teaching method is biased towards accepting learning, the teacher speaking, the student listening, and the teacher occupying the dominant position in the classroom. Meaningful receptive learning, on the other hand, emphasizes student-centeredness, with their classroom learning as the research center, student dominance, and advocating didactic teaching. When learners are stimulated by new knowledge, students can consciously absorb new knowledge and expand their cognitive system, which is called meaningful. In classroom learning, students can also learn knowledge through indirect discovery learning. Students spend most of their time in school, mainly acquiring knowledge through classroom teaching. Mathematical knowledge covers a wide range, students have to learn a lot of complicated mathematical knowledge in a short period of time, and the teaching method of meaningful acceptance learning is a good choice. Through the teacher's explanation, students can quickly accept new knowledge, understand the history and culture of mathematics, broaden the knowledge structure system, improve their own ability, and gradually have correct mathematical thinking and broaden their mathematical vision.

4. Implications of meaningful learning for high school mathematics classroom teaching

4.1. Pay attention to the logic between mathematical knowledge

The so-called logic of mathematical knowledge refers to the connection formed by the combination of mathematical knowledge and the learner's own knowledge system. The key to learning students' mathematical knowledge depends on the explanation of mathematics teachers, the reading of students' texts and the understanding of various mathematical symbols. For example, when a teacher is teaching a math problem, students understand the meaning of the question, and understand that the knowledge point it is going to test is the basis for solving the problem. If you can't even read the meaning of the question, then there is no way to start with this question. No matter how the topic varies, it is a relevant knowledge point for the mathematics. Like some comprehensive question types, several knowledge points will be combined to test, no matter how the question-maker comes up with the question, there must be logic between these combined knowledge points, and there will be some causal relationships, thereby promoting the teaching of mathematics classrooms. For example, when learning complex numbers, knowing that $Z=\bar{Z}$ and $Z=a+bi$, then there is $a=b=0$, and they are causal. It can be seen that there is a logical relationship between knowledge points, and students understand and analyze knowledge points according to the analysis topic, that is, the knowledge points, so as to clarify the relationship between the knowledge points, which is also meaningful learning, and at the same time can strengthen students' impression of knowledge.

4.2. According to the academic situation, stimulate students' desire to learn mathematics

According to the needs of students, find out what are the factors that drive learning, so as to guide students in learning activities. First, it can stimulate students' curiosity, and then through the later training, let students always be full of love for learning. For example, when learning "complex numbers", you can find some interesting short stories related to "complex numbers", or introduce its mathematical history, show it in the form of multimedia, so that students have curiosity to explore mathematics, and teachers will guide them in a timely manner to help students correct their attitude towards mathematics learning and lay a good foundation for mathematical learning. Second, give students more opportunities to perform and give positive evaluations. For example, if some students have other ideas about "plural" during class, the teacher should give them the opportunity to speak, whether right or wrong, and give affirmation. Third, impart higher-level knowledge and cultivate students' core competencies. In high school, academic competition is fierce, and learning has higher requirements for themselves, which is reflected in grades. Some simple basic knowledge students can figure out by themselves, and teachers blindly talk about basic knowledge in the classroom to reduce students' interest in learning. Teachers can teach students higher-level mathematical knowledge, such as the basic principles of algebra at the end of the "plural" chapter, which can not only stimulate their interest in learning, but also cultivate students' core literacy and develop students' mathematical thinking. In teaching, teachers can first understand the real needs of students, such as students' interests and hobbies, teach in the teaching way that students like, stimulate students' love, and implement meaningful learning to the end.

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4.3. Establish a diversified mathematics classroom format

Ausubel carefully divides learning into receptive learning, discovery learning, mechanical learning, and meaning learning. But he tends to accept learning meaningfully. Ausubel believes that guided discovery learning is effective in getting the knowledge you want. When learning mathematics, some knowledge is dull and dull, such as some concepts, some theorems, etc., but with these memories, students can further analyze the whole process of mathematical problems on this basis, and there will be a process of teacher-student interaction in the mathematics classroom, which is the process of mathematics learning. When teachers explain mathematical knowledge, students should recall what they have learned and see whether they have digested the knowledge in the form of questions and answers from teachers. For example, before explaining the "four operations of complex numbers", students have previewed the relevant knowledge in advance, can follow the teacher's thinking, know what to do next, and even draw inferences through independent exploration. Situational teaching, cooperative communication, etc. are the teaching methods that most teachers will use, but students want to understand most of the knowledge points and get satisfaction in exploring mathematical knowledge, and must effectively apply acceptance learning and discovery learning. As long as students gain something and the knowledge structure is updated, then learning is meaningful.

5. Summary

Due to the implementation of the new curriculum reform, the teaching concept of taking students as the main body and teachers as the lead has been implemented. The theory of meaningful acceptance learning can not only help students automatically form a knowledge framework in their minds, in line with the teaching philosophy of taking students as the main body and teachers as the lead, but also provide a pillar for the teaching of mathematical knowledge and the establishment of multiple mathematics classrooms. Taking "plural" as an example, this paper explains that meaningful learning provides cognitive basis for mathematics learning, provides practical guidance for the implementation of mathematics classrooms, adopts the basic teaching principles of gradual differentiation, integration and coordination, conforms to the actual situation of mathematics teaching, and also helps students form a relatively complete mathematical knowledge system. And tell us to pay attention to the logic between mathematical knowledge, to stimulate students' desire to learn mathematics according to the academic situation, to establish a diversified mathematics classroom form, to teach students how to learn effectively.

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