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Research on the Cultivation of Students' Autonomous Learning Ability in High School Mathematics Class

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***Abstract* – The new curriculum standards in China focus on the cultivation of students' autonomous learning ability and the training of students' sense of exploration and problem-solving. However, the current situation of high school classrooms is still dominated by teachers' teaching and the training of students' mathematical skills. In the classroom, teachers still take the examination outline as the standard, and students' learning motivation is not clear enough. Therefore, the situation of teachers and students makes the concept of autonomous learning difficult to be carried out in the classroom. Based on the analysis of the significance of cultivating students 'autonomous learning ability, this article puts forward the strategies of cultivating students' autonomous learning ability in high school mathematics classroom from two aspects: creating learning environment for students' autonomous exploration and guiding students' autonomous learning.**

***Keywords* – Autonomous Learning Ability, High School Mathematics Class, Autonomous Exploration.**

I. INTRODUCTION

Autonomous learning is a kind of ability for students. It is the process and ability of individuals to consciously determine learning goals, make learning plans, choose learning methods, monitor learning processes and evaluate learning results. As a very important subject, mathematics plays an important role in the development of many fields, so cultivating students' autonomous learning of mathematics is helpful to students' lifelong learning [1]. However, according to the actual teaching situation of mathematics, many teachers, influenced by the traditional teaching mode, pay more attention to the amount of students' knowledge and whether they can do the questions in the teaching process. In the classroom, they mainly focus on the content of the examination, blindly instill knowledge, and ignore the process of students' exploration and understanding of knowledge. From the student's point of view, they are used to listening to teachers, listening to what they say, and learning just for exams. Few students think and ask questions and solve problems on their own. In this way, it is easy for students to lose their initiative and interest in learning, which is not conducive to the cultivation of talents. Therefore, it is particularly important to cultivate students' autonomous learning ability and change their learning from passive to active.

The 2017 edition of the General Senior High School Mathematics Curriculum Standard states in the course goals: "Through the learning of the high school mathematics curriculum, students can increase their interest in learning mathematics, enhance their confidence in learning mathematics, develop good habits in mathematics, and develop their ability of autonomous learning ". It can be seen that the state attaches great importance to the cultivation of students' autonomous learning ability. At the same time, the new curriculum reform point out that teachers should be the promoters of students' learning and development [2]. Therefore, teachers are no longer the leader in teaching, but the guides, so that students become the leading roles in the classroom. There are many contents for high school students to learn. How to cultivate students' autonomous learning ability and give full play to their learning initiative within a limited class time has always been the subject of study by the majority of

mathematics educators. On the basis of summarizing the previous experience, this article proposes strategies for cultivating students' autonomous learning ability in high school mathematics classroom from two aspects.

II. THE SIGNIFICANCE OF CULTIVATING STUDENTS' AUTONOMOUS LEARNING ABILITY

A. *It Helps to Improve Students' Ability of Independent Thinking*

Halmos said, "The best teaching method is to let students ask questions and solve problems, not only to impart knowledge, but to encourage action." Asking questions is a sign of students' ability to think independently. However, the traditional teaching method pays more attention to the direct explanation of teachers, so students also rely on the help of teachers in the learning process. Students rarely have the opportunity to play their subjective initiative, which is not conducive to the cultivation of students' independent thinking ability [3]. Therefore, in the high school mathematics classroom, teachers can cultivate students' autonomous learning ability and enhance students' awareness of active learning through autonomous learning mode. Students can improve their ability of independent thinking in the process of constantly finding and raising problems. To cultivate students' ability of independent thinking and let them explore and solve problems independently will play a role in the development and promotion of students' study and life [4].

B. *It Is Helpful to Stimulate Students' Learning Motivation*

Einstein once said that "interest is the best teacher, and it always outweighs responsibility", so let students improve their interest in mathematics is the best motivation to stimulate students to learn. However, due to the influence of exam oriented education, many teachers pay more attention to whether students can solve exam questions, and classroom teaching tends to exam oriented teaching, which ignores students' interest in learning, resulting in the lack of students' learning motivation, reducing students' initiative in learning. So in the actual teaching, teachers should pay attention to student-centered, in the classroom can introduce vivid questions, or some concepts easily confused by thinking set. Let students put forward conjectures and solve their own questions, so as to improve their ability of autonomous learning, stimulate their desire for knowledge, make them feel the sense of achievement in the process of autonomous learning, experience the charm of mathematics, and then stimulate their learning motivation [5].

C. *It is Beneficial to Help Students Transfer Knowledge of Other Subjects*

Knowledge transfer refers to the use of previously acquired knowledge in new learning situations and the promotion of new learning [6]. In the process of autonomous inquiry, students help to deepen students' understanding of knowledge, so that students can understand other knowledge with the connotation of mathematical knowledge when studying other disciplines. In mathematics classroom, teachers can cultivate students' ability of autonomous learning. When students learn other subjects, they have good habits of independent thinking, and are more likely to associate mathematics with other disciplines. For example, in learning the formula and image of Simple Harmonic Motion in physics, it can be related to the trigonometric function in mathematics. Through autonomous inquiry, students understand the relationship between the formula of the trigonometric function and the image of the trigonometric function, and can better grasp the motion state of each point in the Simple Harmonic Motion image. Therefore, having a good ability of autonomous learning is conducive to students' learning of other subjects.

III. Strategies for Cultivating Students' Autonomous Learning Ability in High School Mathematics Class

A. *Creating a Learning Environment for Students to Explore Autonomously*

In the traditional mathematics classroom, teachers mainly explain the knowledge, which makes the students always in a passive learning state, leading to the students' inattention in the classroom and low enthusiasm for learning. Teachers should change the teaching mode, based on the student-oriented teaching concept, create more autonomous learning environment for students in the classroom, and design more questions, discussions, explorations and other links in the teaching design, so that students become the masters of the classroom. Teachers can build open classroom to let students to independently explore formula, theorem, etc., in mastering the difficult point in the book at the same time can also improve the students' interest in learning mathematics [7].

1. *Pay Attention to the Mathematics Classroom Life*

In the traditional teaching process, many teachers do not pay attention to the combination of mathematical knowledge and real life, which makes many mathematical knowledge become abstract and difficult to understand, and students' interest in learning will be reduced. Therefore, when designing teaching, teachers should pay attention to the life of mathematics classroom, and let students learn to apply mathematics knowledge to real life. For example, find some living mathematics problems, guide students to try to describe living problems in mathematical language, and use the knowledge they have learned to find solutions to problems. Or in the introduction of problem situations, find some mathematical problems in life to introduce, let students think about how to use the new knowledge to solve the problems raised by teachers. Teachers can also guide students to find mathematical phenomena in life, and think about them, and cultivate students' ability to find and solve problems. Teachers should inspire students to find the mathematics materials around them, so that students can improve their interest in learning mathematics and their ability of autonomous learning and thinking [8].

For example, the 2.12 exponential function and its properties in the compulsory 1 high school mathematics textbook of the People's Education Edition. Questions 1 and 2 are raised, which are partial living problems. Question 1 is the multiple of China's GDP growth after 2000 compared with 2000. Question 2 is the method by which archaeologists infer the time of biological death from the content of carbon-14 in organisms. These two problems are related to real life, which is easy to arouse students' desire to explore independently. In particular, question 1, under the guidance of teachers, students learn the properties of exponential function and realize the growth and prosperity of national economy through autonomous exploration. Students not only improve their ability of autonomous learning, but also cultivate the spirit of patriotism. Therefore, teachers create problem situations that are closely related to life in the classroom, stimulate students' enthusiasm for learning, and help students develop their autonomous learning ability.

2. *Encourage Students to Think More*

In the process of teaching, teachers should pay attention to inspiration and encouragement. In the process of teaching design, teachers should use appropriate methods to encourage students to think, design appropriate problems, stimulate students' thinking, and encourage students to explore new knowledge boldly. Encouraging students to think can improve students' thirst for new knowledge and allow students to change from passive

learning to active learning. It also improves students' cognitive ability and cognitive level. At the same time that students increase their interest, they can actively think and explore new knowledge. In the classroom, teachers guide students to actively participate in learning activities, encourage students to observe and think more, and gradually improve the ability to find and propose problems and solve problems. At the end of the course, students are led to systematically organize and summarize their knowledge to improve their learning consciousness and thus improve their autonomous learning ability.

For example, the distance formula between the two points in the space in 4.3.2 of compulsory 2 of the senior high school mathematics textbook of the People's Education Edition. Page 136 of the book gives a thought: analogizing the derivation of two-point formula between planes, let students guess the distance formula between two points $P_1(x_1, y_1, z_1)$, $P_2(x_2, y_2, z_2)$ in space. The teacher can encourage the students to guess the distance formula of P_1 and P_2 boldly in class, and ask the students to say the basis of guesses, then guide the students to prove their guesses. In this process, teachers should not only praise the students who guess right, but also encourage the students who guess wrong, and analyze the reasons together with the students. Teachers should let students realize the progress of thinking on learning, and encourage students to dare to think, dare to question, and have the ability to prove their guesses.

3. *Give Students Sufficient Time to Think*

Cultivating students' autonomous learning ability in the classroom should not only focus on form. Teachers should give students sufficient time to think after asking questions. Teachers can't just make students think simply for the sake of teaching progress, which is no essential difference from the traditional classroom teaching. The questions put forward by teachers should have space for thinking so that every student can have some opinions on the problems after full thinking. Teachers should have patience in class, and summarize or prove their guesses with the students after they have fully thought about them.

For example, the geometric meaning of the derivative in section 1.1.3 of elective 2-2 in the senior high school mathematics textbook of the People's Education Edition. This part is the content that students should learn immediately after learning the concept of derivative. In this class, teachers can let students observe the four images on page 7 of the book, and then summarize the geometric meaning of the derivative through thinking and guessing. Because of the connection between geometry and algebra, some students may find it difficult to understand some abstractions. At this time, teachers should give students time to think fully, which is also a process for students to understand the geometric meaning of derivative in their own way. After the students have fully thought, they come to the conclusion. No matter whether the conclusion is correct or not, the students have experienced the process of thinking and exploring. In this process, students can know their own shortcomings, and in the next time of autonomous exploration, they will be more rigorous, and have a deeper understanding of knowledge, thus improving the ability of autonomous learning.

B. *Guiding Students to Learn Autonomously*

1. *Guide Students to Preview Autonomously*

Students' autonomous learning is inseparable from the guidance of teachers in the classroom. Teachers can guide students' autonomous preview before explaining new knowledge. Teachers make full use of class time and require students to summarize new knowledge within a specified time, and let students discuss in groups what

they do not understand or have difficulty understanding. Students understand what they have learned through autonomous learning. This will not only increase students' interest in learning, but also cultivate their ability to solve problems [7]. At the same time, it will motivate students to clarify learning goals and then actively analyze textbooks. Students think while preview, improve the focus of the classroom and improve the ability of autonomous learning.

For example, the monotonicity and the maximum (minimum) value of section 1.3.1 of the compulsory 1 of the senior high school mathematics textbook of the People's Education Edition. Teachers can let students preview the knowledge on the books themselves, summarize the connotation of the monotonicity of the function and discriminate methods, and let students find what they do not understand during the preview process. Listening to classes with questions in this way will help students understand the knowledge. While students are learning autonomously, teachers should give appropriate encouragement so that students have confidence in themselves and increase their interest in learning [7].

2. *Moderately Guide Students to Learn Autonomously*

Cultivating students' autonomous learning ability should emphasize the student's subjective position in the teaching process. At the same time, the teacher's guiding role can't be ignored in the process of student learning knowledge, so teachers should pay attention to their own guidance methods in teaching. The process of students' autonomous learning is the process of understanding problems, acquiring knowledge, using knowledge and solving problems. Teachers put forward appropriate questions in class to let students explore autonomously, and give proper guidance in the process of students' exploration. The degree of teacher guidance should be reasonable. If the teacher gives too much guidance, it will lose the significance of students' autonomous learning. If the guidance is too little, students can't solve the problem, it will reduce students' interest in learning mathematics, and it is not conducive to the cultivation of students' autonomous learning ability [3].

For example, the tilt angle and slope of section 3.1.1 of the compulsory 2 of the senior high school mathematics textbook of the People's Education Edition. After talking about the concept of slope, the teacher can ask the students to explore the slope formula of line $P_1(x_1, y_1)$, $P_2(x_2, y_2)$ $(x_1 \neq x_2)$ in rectangular coordinate system. According to the actual situation of students, when students have some difficulties in autonomous exploration, teachers can give appropriate tips. For example, prompting students to get the slope formula can be discussed by classification and then summarized later.

3. *Guide Students to Study Autonomously According to Learning Situation*

When teaching, teachers should consider the actual situation of students, consider the difference of students' understanding ability, and teach students according to their ability. Teachers can also use layered teaching to raise different questions for students of different learning levels: for students with strong autonomous learning ability, they should raise more difficult questions, and for students with weak autonomous learning ability, they should raise relatively simple questions. In the process of teaching design, it is necessary to make a more accurate analysis of students' learning situation, and put forward questions that each student should have space to think. It is necessary to pay attention to design problems that can break the rules and have new ideas, but also pay attention to the understanding of each student's problem, guide students to think more, and cultivate students' divergent thinking and imagination [9]. Let every student can inspire their potential after thinking about problems, and make

continuous progress through thinking in the process of learning.

Similarly, take the 2.12 exponential function and its properties in the compulsory 1 high school mathematics textbook of the People's Education Edition as an example. Teachers can let students draw function images to summarize the properties of exponential function. However, due to the differences in students' learning ability, students with strong autonomous learning ability can summarize the definition domain, range, the relationship between the base number and the monotonicity of the exponential function, and the properties of the over fixed point (0, 1) of the exponential function image. On the contrary, it is difficult for students with weak autonomous learning ability to get all the properties of exponential function through function image. Therefore, when teachers ask questions, they should pay attention to teaching students according to their ability. They can ask questions at different levels, so that every student can participate in thinking, and constantly improve their autonomous learning ability through thinking in the classroom.

IV. Conclusion

Under the new curriculum standard of senior high school, it is very important to cultivate students' autonomous learning ability in class. In the process of explaining knowledge, teachers should pay special attention to the use of autonomous learning mode to provide students with autonomous learning opportunities. Students as the main body of the classroom, teachers should give full play to the role of students, so that students can learn to draw inferences from one example, summarize, rather than only do exercises in books. Let students realize that mathematics is closely related to life, so that students can develop in an all-round way, and meet the needs of social development.

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