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Research on Cultivating Senior High School Students' Innovative Thinking in Mathematics Based on Bloom's Taxonomy of Educational Objectives

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Abstract. Bloom's taxonomy of educational goals divides the educational goals in the cognitive field into different levels from low-level to high-level, and the highest level is innovation. Our country is stepping into the era of knowledge economy step by step, cultivating students' innovative thinking is the need of The Times development, the key to maintain the prosperity of national culture, and the development of national science and technology needs the promotion of education innovation. But the vast majority of middle school students lack of thinking in the learning process in our country, the lack of space imagination ability and logical thinking ability in the process of teaching, and teachers failing to cultivate students' various mathematical ability, based on this the paper in bloom education target on the basis of how to improve the students' mathematics creative thinking put forward the following Suggestions: Teachers should attach importance to preview before class and introduction, and students' learning methods should be reformed: skillfully use "flipped classroom", "group cooperative learning", attach importance to the cultivation of students' observation and analysis ability, attach importance to classroom summary and form knowledge system. And under the guidance of the classification of educational objectives, the teaching design of the sum of the first n terms of geometric progression is carried out.

Keywords. Bloom's taxonomy of educational objectives, high school students, innovative thinking in mathematics

1. Bloom's Taxonomy of Educational Objectives

In 1948, a group of testing experts first proposed the establishment of educational goal classification system at the Annual meeting of the American Psychological Society in Boston.

As shown in Table 1, the lower the level is, the more basic and critical the revised cognitive dimension goal classification is, and the higher the level is, the more complex it is [1].

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Table 1. Revised cognitive dimension target classification.

Memory	Understand	Application	Analysis	Evaluation	Create
identify	interpretation	implement	difference	check	produce
memory	For example	implementation	organization	comment	plan
	classification	attribution		generate	
	summarize				
	inference				
	compare				

2. Strategies for Cultivating Students' innovative Thinking

2.1. Pay Attention to Pre-class Preview and Classroom Introduction

The lowest and most basic level in Bloom's classification of cognitive dimension goals is memory. There are many different ways of memorizing, and the results are different. Rote, repetitive memorizing is far inferior to active exploration.

Teachers can set preview task to the students before the class, can be related to the next class a questions, can also be a preview of what part, students to preview before class not only can better grasp the difficult point of the whole class, to go to the lecture with questions can improve the teaching efficiency of the whole class, to explore knowledge actively, take the initiative to deepen our memory[2].

2.2. The Transformation of Students' learning Styles

On the basis of memory, further improve the level of cognition, to achieve the understanding and application of knowledge. The traditional teaching mode is teacher-student and teacher-student, although the classroom efficiency is high, it is not conducive to give play to the students' subjectivity. Teachers can reasonably divide the teaching content so that students can fully prepare before class and independently consult materials to learn the corresponding content. On the basis of "flipped classroom", students can communicate and discuss with each other. Teachers only play a guiding role in controlling the overall situation and return the initiative of learning to students [3].

2.3. Pay Attention to the Cultivation of Students' observation and analysis Ability

On the basis of understanding and applying knowledge, improve students' analytical awareness and ability to solve problems, and achieve the subdivision of analysis dimension in Bloom's cognitive dimension goal, namely distinction, organization and attribution. When students get a topic, they should not rush to apply the formula or theorem solution, but should guide students to analyze the context of the topic, make a distinction between key information and secondary information, and guide students to

draw the key information when reading the topic. Only by analyzing the topic thoroughly can we put forward creative questions on this basis. It can be seen that students can carry out innovation on the premise of careful observation and rigorous analytical ability.

2.4. Attach Importance to Classroom Summary and Form Knowledge System

A good lesson should begin and end, beginning with introduction and ending with summary. Guide students to evaluate their mastery of knowledge. Summary should not be limited to the end of the class, but can also be interspersed in the teaching process to establish the connection of various knowledge points. Teachers should clarify students' classroom subjectivity, guide students to summarize by themselves, make full use of mind mapping, gradually connect single knowledge points into lines, form knowledge blocks and transform them into complete knowledge areas, and establish a good knowledge system [4].

3. Teaching Design of "The Sum of the First N Terms of Geometric Progression " Under the Guidance of Educational Objective Classification

Taking "the sum of the first n terms of the arithmetic progression" as an example, this paper tries to integrate Bloom's theory of classification of educational objectives in cognitive field into practical high school mathematics teaching.

3.1. Textbook Analysis

The teaching period is divided into 2 periods, and this lesson is the first period. Before learning this lesson, students have learned the definition of arithmetic series, and can master the general term formula of arithmetic series, the first n term and formula and its derivation method, and the general term formula of arithmetic series, etc. All these knowledge lay a foundation for learning this lesson.

"Sum of the first n terms of geometric series" is widely used in real life, such as the calculation of housing loans, population growth rate and so on. In addition, some mathematical ideas and methods involved in the process of formula derivation, such as analogical reasoning, classification discussion, from special to general, are necessary mathematical ideas and methods for students [5].

3.2. Learning Situation Analysis

Students have learned the first n arithmetic progression and formula and its derivation process, from the level of the students' cognitive and thinking characteristics to infer, from the formula derivation method and application of the student union for an analogy, the consciousness of the students have the analogy is encouraging, but in this section, the formula derivation process in terms of quality and different from those of the arithmetic progression and referred to in the preceding paragraph, This will be a breakthrough for students' habits of thought n Besides, students tend to ignore this special situation $q=1$.

3.3. Establishment of Teaching Objectives

（1） Knowledge and Skills

Master the first n terms and formulas of geometric sequence, understand their derivation process, and be able to apply the formulas to solve the corresponding problems.

（2） Process and Method

Understand the principle of dislocation subtraction and master the calculation method of dislocation subtraction. Develop mathematical thinking such as analogical reasoning, from special to general, classification discussion, improve logical thinking ability such as classification, inference and abstraction.

（3） Emotional Attitude and Values

Gain new knowledge through analogical reasoning, improve the ability to find, propose, analyze and solve problems. By independently exploring the derivation process of the formula, improve the awareness of exploration and innovation, enhance the mathematical thinking.

3.4. Teaching Key Points

Teaching emphasis: application of geometric progression's first n terms and formulas
Teaching difficulties: derivation of the formula of the sum of the first N terms of geometric progression

3.5. Analysis of Teaching Process

The teaching mode of this class is guided discovery, and the theoretical basis is Bloom's taxonomy of educational objectives. Teachers assign preview tasks to students before class, preview pages 35-37 of the textbook. In the classroom, teachers guide students to explore, in the form of group cooperation and exchange, provide students with opportunities to fully express, discuss and explore problems, so that students can obtain new knowledge through individual self-study, group discussion, collective explanation and other ways [6].

3.6. Teaching Process

Part 1: Introduce the story and explore new knowledge

Apple orchard apples are ripe, the farm long hired several workers to help collect apples, the farm long said, you work in the orchard for a month is 30 days, wages and so on to sell these apples to you. One of the workers said, "I don't want to be paid. I only want 1 apple on the first day, 2 apples on the second day, 4 apples on the third day, and then give me twice as many apples as the previous day. What do you say?" The farmer thought to himself, "If I give only one apple on the first day, two apples on the second day, and four apples on the third day, I can keep the workers working for a month with just one bag of apples." Think of here the farmer readily agreed. Can you help the farmer figure out how many apples he will have to pay the workers at the end of a month?

The student replied, "You have to pay the worker $1+2^1+2^2+2^3+...+2^{29}$ apples.

Design intent: After the questions are thrown out, the teacher guides the students to summarize the essence of the questions and seek the sum of the above geometric progression. The introduction of interesting stories related to real life can stimulate

students' desire to explore and interest in learning, thus deepening students' memory of this knowledge point. Teaching on the basis of students' preview, students coming into the classroom with questions, attending lectures in a targeted way, and answering doubts, is conducive to improving the efficiency of the classroom.

part 2: Analogical reasoning, explore the formula

Students discuss: how to solve it $S_{30} = 1+2^1+2^2+2^3+...+2^{29}$

Teacher guide: What are the rules? $S_{30} = 1+2^1+2^2+2^3+...+2^{29}$ If you multiply both sides of this equation by 2, you get, look at the similarities and differences on the right hand side of these two equations $2S_{30} = 2+2^2+2^3+2^4+...+2^{30}$

Students work together and communicate with each other in groups. The teacher gave the answer: This method is called dislocation subtraction, and it is a general method for us to find the sum of the first N terms of geometric progression.

Teacher: now if the first term of the geometric sequence is a_1, the common ratio is q, how to find the sum of the preceding terms?

Teacher-student activities: students independently calculate and explore, teachers patrol, and give appropriate hints: for the example of the farmer giving apples to workers, how did you just eliminate some items in this geometric sequence? After the teacher's reminder, students analogize the method used in this example, multiply the common ratio first, and then use the dislocation phase subtraction.

$$S_n = a_1 + a_1q + a_1q^2 + ... + a_1q^{n-1} \quad (1)$$

$$qS_n = a_1q + a_1q^2 + a_1q^3 + ... + a_1q^{n-1} + a_1q^n \quad (2)$$

Formula (1) minus formula (2) can be obtained: $(1-q)S_n = a_1(1-q^n)$

After thinking, the students will answer, and the teacher will guide them step by step. When $q = 1$, what are the characteristics of the sequence?

After the students write on the blackboard, the teacher projects the correct results

$$S_n = \begin{cases} \dfrac{a_1(1-q^n)}{1-q}, q \neq 1 \\ na_1, q = 1 \end{cases} \quad (3)$$

Design Intention: The teacher guides the students through the process of understanding knowledge in Bloom's classification of educational objectives, grasping the students' thinking and making them follow the rhythm and route preset by the teacher, go through the process of independent inquiry, and gradually master the method of solving problems. Show the similar problem situation, induce the general formula by analogy, and realize the mathematical thought from the special to the general, which is helpful for students to break through the difficult points and master the key points in the future study. Students tend to take it for granted and ignore the situation $q = 1$ in the formula. Teachers question students and give students to explore, which is conducive to deepening students' understanding of the formula, improving their awareness of classification and discussion of problems, and developing rigorous thinking and problem-solving habits.

part 3: Tracking training, consolidation exercises

Design intention: Guide students to apply and analyze, and develop their analogical reasoning thinking. Let students' habit of solving problems gradually change from applying formulas to flexibly using deformation formulas, and solve problems not limited to fixed routines, encourage multiple solutions to a problem, and cultivate students' divergent thinking and innovative thinking.
Step 4: Summarize and form a knowledge system
Student activity: Guide the students to answer and summarize (teacher presents the frame in the form of mind map):
Design intention: Communicate with each other in groups, share the harvest of this lesson, check the omissions and make up for the deficiency, and the teacher makes up for the deficiency, reflecting the students' subjectivity and cooperation consciousness. In the form of mind mapping, show the knowledge system of this lesson and guide students to establish the whole knowledge vein of this chapter.

4. Conclusion

Throughout the teaching design of the whole lesson of the sum of the first terms of geometric sequence, it is based on the cognitive dimension objective classification of Bloom's educational objective classification. n First, before teaching, according to the requirements of the new curriculum standard and based on Bloom's taxonomy of educational objectives, the educational objectives of the whole lesson are divided into three dimensions of cognition, emotion and motor skills, and then a series of teaching activities are designed according to the educational objectives of the cognitive dimension. With students as the main body and teachers as the auxiliary, let students experience the memory, understanding, application, analysis and evaluation of knowledge, and develop students' innovative thinking in mathematics on the basis of the first five dimensions. Let students learn in "activities", develop in "initiative", improve in "cooperation" and innovate in "exploration".

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