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Research on high school mathematics classroom teaching based on deep learning—Take the teaching of "determination of parallel planes and planes" as an example

Fu Xiaowei

Henan Normal University, Xinxiang, Henan, 453000, China

Abstract: *Deep learning is the basic way to implement core literacy, which can promote the development of students' thinking ability and help students break through the shackles of traditional teaching. By summarizing the characteristics and basic strategies of deep learning, this paper conducts classroom teaching in the section of "Parallel decision between planes" and finds that the use of deep learning teaching methods can stimulate students' interest in learning, strengthen students' ability to solve problems independently, and form good learning habits, hoping to provide references for front-line teachers.*

Keywords: *Deep learning; High school mathematics; Classroom teaching*

1. Introduction

With the educational reform in China, deep learning has become a hot topic. Deep learning refers to a meaningful learning process in which students, under the guidance of teachers, actively participate, experience success, and achieve development around challenging learning topics [1]. Deep learning is the critical absorption of knowledge by students on the premise of understanding knowledge. It focuses on reflecting the initiative and subjectivity of students in learning activities. Students can internalize knowledge and form long-term and stable personal ability through real understanding of learning content and flexible application on this basis. In the learning process, students learn knowledge, master mathematical thinking and methods, cultivate sentiment, and form a positive learning attitude and correct values [2].

At present, there are still backward teaching methods such as full classroom teaching, one word teaching, rote memorization, etc., which leads to low learning efficiency and declining learning interest of students, which is not conducive to the long-term development of students and does not meet the quality goal of curriculum reform. Deep learning can further improve students' ability to comprehensively use knowledge, enable students to master mathematics learning methods, develop mathematics core literacy, and finally achieve meaningful learning.

2. Features of deep learning

First, deep learning is social. Deep learning focuses on students' deep participation and successful experience in the learning process. In the process of learning, students should be able to communicate with classmates and teachers, take the initiative to participate in classroom activities, actively speak and show their ability in the process of activities, experience the joy brought by success, and in the effective interaction with the teaching environment, the formation of their own sociality.

Second, deep learning is deeply layered. Deep learning focuses on students' construction of the meaning of knowledge. Students' mathematics learning is not just the accumulation of mathematical knowledge. On the basis of their own knowledge, students can deeply study mathematics through problem-driven, classroom activities and other teaching processes, experience and appreciate the occurrence and development of knowledge, and carry out advanced thinking activities. Form their own stable knowledge system to promote the improvement of mathematics core literacy.

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3. Teaching strategies for deep learning

3.1 Classroom teaching should arouse students' interest in learning

Interest is the powerful motivation and inner strength of learning, and it is the driving force to promote students to learn consciously. When students have a strong interest in knowledge, they can go deep into learning activities to explore, and gradually enhance the willpower to overcome difficulties. Interesting tasks can stimulate the desire and interest of students to study seriously, so that students can experience the satisfaction and sense of achievement in the process of learning. The famous psychologist Piaget once pointed out that "all intellectual work depends on interest." It can be seen that the interesting task should be paid attention to in the teaching design.

In classroom teaching, teachers can set some practical and mathematical problems to stimulate students' interest in learning. For example, probability knowledge is closely related to real life. Teachers can design classroom activities with lottery questions and selection questions, so that students can organize and design activities by themselves. Every student can actively participate in classroom teaching, which can greatly stimulate students' interest.

3.2 Create situations close to the actual life of students

Deep learning cultivates students' ability to rationally analyze, solve problems and make decisions in the face of real and complex problems. The cultivation of this ability can only be achieved in real and complex situations. Therefore, when teaching, teachers should appropriately select materials that are close to life and let students take the initiative to think with existing life experience and knowledge basis, which is conducive to the improvement of students' thinking level and cognitive development, and improve their ability to analyze and solve practical problems, so as to bring what they learn in class into real life and form a solid cognitive method.

When learning the sine theorem, the teacher can set up a problem situation: if some conditions such as measurement angles are known, can the students do not know the width of the river? Such practical problems are closely related to students' life, which stimulates students' interest and makes them have the desire to explore, so as to better enter the classroom learning.

3.3 Develop open and probing mathematical problems

American mathematician Halmos once said that "problems are the heart of mathematics", and solving mathematical problems is an important way to learn mathematics. Mathematics subject has its particularity, mathematics is an abstract science, must be in the open problem environment, through the continuous exploration of thinking, can get the corresponding results. In the traditional teaching, teachers occupy the main guiding position in the classroom, students passively accept knowledge, it is difficult to abstract mathematical knowledge from concrete things. In high school mathematics teaching, teachers should carefully polish each question and explore the answer together with students, so as to stimulate students' interest in learning and guide students to go deeper step by step.

When learning the concept of function, teachers can set questions based on actual life, guide students to summarize mathematical problems in life in the form of a string of questions, and then summarize the concept of function and its expression methods. Meanwhile, teachers should constantly raise questions according to the corresponding relationship of function in the teaching process, so as to arouse students' thinking. This can not only promote students' deep cognition of concepts, but also cultivate students' logical thinking ability.

3.4 Set up experiential learning activities appropriately

Mathematics is closely related to real life, and students need to realize that mathematics comes from life and is applied to life. Therefore, when the knowledge has a certain contextual background, it is helpful for students to realize the meaning construction of knowledge. Experiential learning activities refer to that teachers allow students to carry out practical operations in real situations according to the needs of teaching content, with the goal of completing learning tasks, so that students can experience the process of knowledge discovery and participate in learning.

For example, when teaching the shortest path of geometry, cube section and other problems, students can be allowed to operate according to physical teaching AIDS, and experience the generation

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process of knowledge in the process of discussion and communication. At the same time, teachers should also be good at using computer software to provide students with abundant geometric models, meet the needs of students to understand and observe geometry, and let students draw more hands-on drawings to establish a sense of space.

3.5 Promote the development of thinking through deep communication

The process of students' deep learning is not only an individual psychological process, but also a social and cultural process[3] . Deep learning is inseparable from the interaction and collaboration between teachers, students and students, and requires responses based on listening to each other's views, thoughts and emotions [4]. In classroom teaching, teachers should pay attention to classroom observation, actively communicate with students and give feedback in time. When teachers find special difficulties or common problems encountered by students, they should help and solve them in time, play the role of guidance and guidance, adjust the teaching direction in time, and ensure the successful completion of teaching tasks.

The process of deep learning is a process in which many people participate together. Students are of the same age and have similar cognitive styles, so it is easy to form a relaxed and pleasant atmosphere in the process of communication and discussion. Communication between students can exercise the ability of cooperation between students, and the stronger the degree of participation of students, the more they will gain. In the process of continuous practice, discussion and reflection, students use existing knowledge to analyze and solve unfamiliar problems, constantly broaden their learning ideas, and promote the development of thinking.

4. Classroom teaching based on deep learning "plane and plane parallel decision"

4.1 Learning objectives and direction guidance

Students start from the definition to explore the plane and plane parallel, through intuitive perception, operation confirmation, the conclusion of the plane and plane parallel theorem.

Students explain the decision theorem of parallel aspects from the perspective of vectors, and can apply the decision theory to real life.

Students can appreciate the scientific value and application value of knowledge. By virtue of the reasoning process of determining theorems, students can penetrate the mathematical thoughts of mathematical abstraction and induction and analogy, form a rational, rigorous and realistic learning attitude, and develop the core mathematical qualities of intuitive imagination and logical reasoning.

4.2 Situation introduction and problem guidance

In the past decade, China's electricity generation has nearly doubled, and green energy has played a major role. China currently has the world's largest photovoltaic power generation scale, the use of clean energy, not only reduces the waste of earth resources, but also greatly shows China's determination to take the path of green and low-carbon development!

Please observe Figure 1 and Figure 2, what kind of position relationship exists between the photovoltaic panels in the photovoltaic power generation base? What is the position relationship between the ceiling, the table and the floor of our classroom?

Figure 1: Photovoltaic panel

Figure 2: Classroom

The teacher asked: Plane and plane parallel in life is so widely used, how do we determine the plane and plane parallel?

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Design intention: Teachers guide students to abstract mathematical knowledge from real life, let students initially understand the idea that mathematics comes from life, and reflect the application value of plane and plane parallel in real life. The teacher introduces the task of this class according to the actual problems, stimulates the students' interest and helps the students quickly enter the class state.

4.3 Problem-driven, in-depth exploration

Question 1: What are the position relationships between planes in space? What are they?

Students review what they have learned and answer questions about intersection and parallel position relationships.

The teacher guides the students to review the definition of horizontal parallelism, and points out that the definition is a sufficient and necessary condition, and the adequacy has the judgment function, so the two planes can be judged by the fact that there is no common point between the two planes. This method is called the definition method.

The teacher asked: Plane is infinite, it is difficult to determine whether two planes of infinite extension have a common point, is there a more concise determination method?

Student activities: The students in the group discussed with each other, reviewed the reasoning ideas of the judgment theorem of line and surface parallel, and put forward the conjecture of line and surface parallel to determine the parallel aspect by using the analogy idea.

The teacher guides the students to think that two planes can be judged parallel by several straight lines, and determines the verification idea together: verifying a straight line or two straight lines is used to determine that the plane is parallel to the plane.

Question 2: If a line in a plane is parallel to another plane, does it show that the two planes are parallel?

Student example: the top bottom edge of the blackboard is parallel to the ceiling, but the plane on which the blackboard is located is not parallel to the ceiling.

Teacher evaluation: affirmed that students are good at observing the performance of life, and said that we live in three-dimensional space, there are geometric relations everywhere in life, we should be good at observation and thinking.

The teacher guides the students to watch the dynamic video, as shown in Figure 3, and makes use of information technology to feel intuitively again.

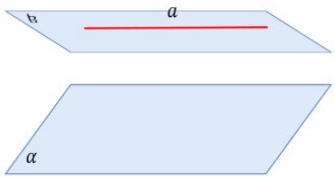

Figure 3: Dynamic video

Question 3: If there are two lines in the plane that are parallel to the other plane, can it be shown that the two planes are parallel?

Because of the different position relationship between the two lines, it is necessary to carry out experimental investigation and comparison verification respectively. The teacher explained the experiment requirements and organized students to conduct experimental research in small groups.

4.3.1 Hands-on experiment and operation confirmation

The teacher explained the experiment requirements: As shown in Figure 4, with the aid of learning tools, observe whether the rectangular paper and the triangle ruler are parallel to the desktop when the two opposite sides a and b of the rectangular paper and the adjacent sides c and d of the triangle ruler are parallel to the desktop. Organize groups of students to cooperate in research.

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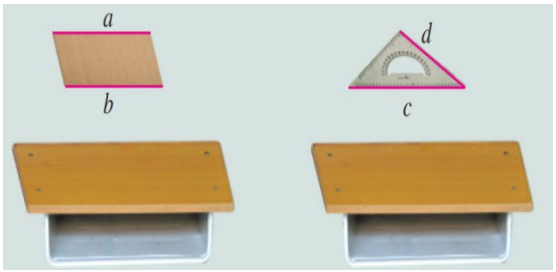

Figure 4: Inquiry experiment

The students in the group carried out experimental research with the aid of rectangular paper and triangular ruler. At the end of the exploration, the students in the group first exchanged and shared with each other. After that, the teacher randomly selected group representatives to show the experiment process and summarize the experimental results, and reached the experimental conclusion:

Conclusion 1: When two parallel lines are parallel to the desktop, the two planes cannot be judged to be parallel.

Conclusion 2: When two intersecting lines are parallel to the desktop, the two planes can be judged to be parallel.

Students evaluate each other, evaluate the student's operation and results, point out its advantages and disadvantages, and affirm the student's enthusiasm and operation ability.

4.3.2 Geometric model, intuitive perception

With the help of the cuboid model in Figure 5 and Figure 6, the teacher guides the students to intuitively perceive the experimental conclusion.

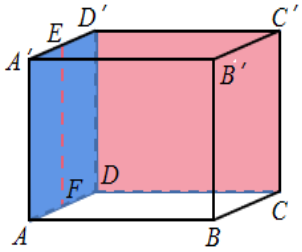

Figure 5: Cuboid model

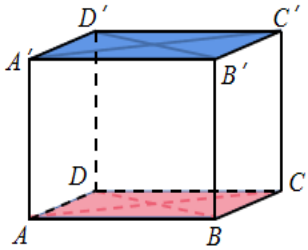

Figure 6: Cuboid model

Through the cuboid model, students can experience the difference between two parallel lines and two intersecting lines in the plane to determine the parallelism of the field in space, and then help students to clarify the sufficient conditions for determining the parallelism of the field.

Students observed the position relationship between planes in the cuboid model and discussed it. They found that two intersecting lines could determine the two planes to be parallel, while two parallel lines could not determine the two planes to be parallel.

Question 4: Can you generalize the content of the decision theorem for surface parallelism by yourself?

Students think independently and try to summarize the written language of the decision theorem:

If two intersecting lines in one plane are parallel to the other plane, then the two planes are parallel.

The teacher randomly selects two students to show the symbolic language on the blackboard and draw pictures, as shown in Figure 7 and Figure 8. Teachers and students modify and evaluate the blackboard writing, and then summarize the points that need attention in the judgment theorem.

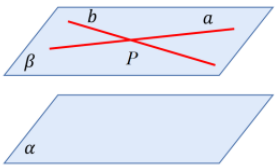

Figure 7: Graphical representation of parallel facets

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$$\left.\begin{array}{c} a \subset \beta \\ b \subset \beta \\ a \cap b = P \\ a \parallel \alpha \\ b \parallel \alpha \end{array}\right\} \Longrightarrow \beta \parallel \alpha$$

Figure 8: Face parallel symbol representation

Question 5: Can you explain the decision theorem of horizontal parallelism in terms of vectors?

Students raise their hands after thinking independently: Two intersecting lines can determine two vectors that are not collinear, and by the fundamental theorem of plane vectors, they can represent all vectors in the plane, and thus all lines in the plane.

The teacher evaluates the students' answers, affirms the students' mastery of the existing knowledge, and further explains the principle that parallel lines cannot determine the parallel planes from the perspective of vectors.

Design intention: Through the steps of "logical reasoning and discussion -- problem inquiry -- analysis conclusion -- communication and evaluation", the research content, ideas and methods of judging parallel lines and planes are compared, and the exploration activities of intuitive perception and operation confirmation are used to help students understand the ideas of induction and analogy. It is the so-called "research object is changing, the research method is unchanged", which helps students establish the overall structure of three-dimensional geometry, fully reflects the teaching concept of "teacher-led, students-subject", helps students improve their inquiry ability, cultivate innovative thinking, and promote students' deep learning.

4.4 Consolidate practice, review and improve

Example 1. Figure 9 is the model of Zhangjinggao Bridge, which is the first in the world with six items. The designer needs to ensure that the model bridge floor is level, so he places the level instrument across the model bridge floor twice, and the bubbles of the level instrument are both in the center, so as to judge the level of the bridge floor. Can you explain how that works?

Figure 9: The model of Zhangjinggao Bridge

Students think independently, raise their hands to answer, combined with the decision theorem of plane and plane parallel, explain the principle of this operation, and realize the practical application of mathematical knowledge.

Example 2. The square ABCD-A 'B' C 'D' as shown in Figure 10 can be verified: plane AB 'D' // plane C 'DB.

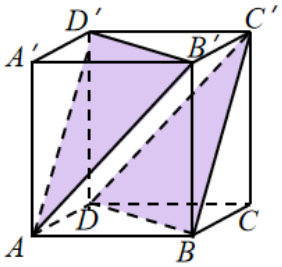

Figure 10: Cube

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Combined with the knowledge of theorems learned before, I try to complete the topic independently, deepen my understanding of the transformation relationship between lines, lines and surfaces, and build a complete knowledge system.

Design intention: Through example 1, it is hoped that students can abstract geometric figures from real life, understand and solve problems in real life through the theorems they have learned, and make students realize that mathematics comes from life and is applied to life. Through example 2, let the students try the simple application of the symbolic language of the decision theorem in the proof problem, and deepen the understanding of the symbolic language.

4.5 Class summary, assignment

The teacher asked the students what they have learned from this lesson.To summarize:

Knowledge: the determination of plane and plane parallel.

Thinking methods: analogy, transformation, induction of thinking methods.

Learning process: Experience the learning process of doubt - discussion - experiment - analysis - summary.

Teacher assign homework:

Required questions: Human Teaching A version of Mathematics Volume 2, page 142, 1, 2, 3.

Make mind maps of parallel lines, parallel lines and parallel surfaces.

Selected questions: Understand the application of the judgment theorem of plane and plane parallel in life, and explore the nature theorem of plane and plane parallel.

Design intention: To promote students' understanding of the content and methods learned in this lesson by summarizing and reflecting on knowledge and methods, so that students can improve their ability to summarize and form the core quality of mathematics in the process of reviewing knowledge. The setting of different question types takes into account different students, and this hierarchical teaching reflects the idea of teaching students according to their aptitude, so that every student can get a good development in mathematics.

5. Conclusion

To sum up, mathematics teaching in high school based on deep learning provides students with sufficient opportunities for communication and discussion, so that students can understand knowledge in deep thinking, feel the connection between knowledge and real life in mathematical situations, feel the generation of knowledge through mathematical activities, and improve the transfer and transformation ability of knowledge in the design of analog learning. In short, deep learning is of great significance to the development of students. The basic strategies and teaching methods given in this paper can stimulate students' interest and motivation in learning mathematics, exercise students' thinking ability and improve their comprehensive quality through practical verification. It is hoped that teachers can apply deep learning methods in teaching practice according to the actual situation of students, so as to improve the teaching situation. This paper hopes to provide some references for teachers.

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