

# A Study on the Application of Task-Driven Teaching Method in High School Mathematics Teaching: Taking “The Determination of Vertical Line and Plane” as an Example

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**Abstract:** The “Ordinary High School Mathematics Curriculum Standards (2017 Edition, 2020 Revision)” clearly stated in “Teaching Suggestions” that “teaching activities based on the core literacy of mathematics should grasp the essence of mathematics, create appropriate teaching situations, put forward appropriate mathematical questions, stimulate students to think and communicate, and form and develop the core literacy of mathematics.” The task-driven teaching model is a new type of teaching method that takes tasks as the main line, teachers as the guide, and students as the main body, which can enable students to engage deeply in classroom discussions and think actively. Based on the characteristics and principles of the task-driven teaching method, this paper designs a high school mathematics classroom teaching based on the task-driven teaching method, hoping to provide a reference for the majority of front-line teachers.

**Keywords:** Task-driven; High school mathematics; Instructional design

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## 1. Introduction

The “Ordinary High School Mathematics Curriculum Standards (2017 Edition, 2020 Revision)” clearly put forward in the “Teaching Suggestions” that “teaching activities based on the core literacy of mathematics should grasp the essence of mathematics, create appropriate teaching situations, put forward appropriate mathematical questions, stimulate students to think and communicate, and form and develop the core literacy of mathematics.” Therefore, teachers’ classroom teaching should be student-centered, problem-oriented, and supported by activities or tasks, so as to promote students’ deep thinking, focus on the essence of mathematics, cultivate students’ rational thinking, and improve the core quality of mathematics<sup>[1]</sup>. Task-driven teaching method enables students to carry out inquiry learning around tasks, experience the logic and formation process of mathematical knowledge in the process of inquiry, experience the fun of learning mathematics through the completion of tasks, and cultivate students’ spirit of active inquiry, cooperation, communication, and innovation.

## **2. The characteristics of the task-driven teaching method**

In the course of the implementation of the task-driven teaching method, it embodies the dual subject teaching mode. Teachers and students have their own division of labor. In the course, with the proposed and solved tasks, teachers and students constantly change their active status in the classroom. The entire teaching process is task-oriented, gradually encouraging students to explore in order to achieve teaching goals and enhance their knowledge, skills, and emotional development. This process is interlocking and progresses step by step. It is important to note that tasks cannot exist in isolation. They are interconnected, follow the structure of knowledge, and have a strict logical relationship. Consequently, the task group, composed of individual tasks, forms a complete system with a logical structure.

## **3. The principle of task-driven teaching method applied in high school mathematics teaching**

### **3.1. Student-oriented interactive principle**

In teaching design, teachers should fully respect students' main position, pay attention to students' learning, and give full play to students' potential. However, this does not mean that the teacher should relinquish control of the class entirely to the students. Students may not yet have the capacity to understand problems from the teacher's perspective. Therefore, teachers should acknowledge the students' limited abilities and provide necessary guidance and support. Therefore, in the teaching design, teachers should pay attention to the different responsibilities of teachers and students in the classroom. Teachers propose tasks related to this lesson, stimulating students to think deeply, and students can complete the task through thinking and exploration. Teachers should provide appropriate guidance and actively communicate with students to complete various classroom tasks.

### **3.2. Operational principles with clear objectives**

In the teaching design, teachers should first determine the corresponding teaching objectives according to the requirements of course standards and teaching materials, ensuring that the design tasks can meet the requirements of teaching objectives in knowledge, skills, emotional development, and other aspects. At the same time, the determination of the teaching goals must also take into account the students' situation. Teachers must recognize the students' knowledge foundation. The tasks assigned should be of medium difficulty—challenging but solvable through thinking and effort. This approach encourages students to engage deeply with the material and develop problem-solving skills. In addition, the form of the task should be operable for students. Teachers can divide the teaching content of the entire lesson into several major tasks, and then break these major tasks down into smaller, manageable tasks. This step-by-step approach helps achieve the teaching goals progressively.

### **3.3. The principle of authenticity and close to life**

High school mathematics textbooks attach importance to raising problems in actual situations and solving practical problems through learning mathematics knowledge, thus forming a closed loop of teaching, which is not only conducive to cultivating students' problem-solving skills but also enables students to understand the practicability of mathematics in daily teaching. Therefore, when designing tasks, teachers should dig deep into teaching materials and choose materials that are close to students' lives with educational significance,

which is conducive to stimulating students' interest and broadening their cognitive structure on the basis of existing experience, so as to bring knowledge learned in class into real life and realize the application value of mathematical knowledge.

### 3.4. The principle of diversification of the forms of tasks

The forms of tasks need to be varied to suit different math classes, so as to ensure the successful realization of the teaching effect. The forms of tasks include open tasks, closed tasks, cooperative tasks, self-study tasks, etc. Teachers should flexibly use a variety of task forms according to the teaching needs when designing tasks, and no form can be fully adapted to all math classes. Moreover, a single type of task can easily cause students to become bored, reduce their desire to explore, and hinder the depth of the class. In the process of performing the task, students give full play to their cognitive ability in various ways such as experience, cooperation, and challenge. This diversified form of participation is conducive to the exploration of students' potential and the balanced development of students' abilities.

## 4. The application of task-driven teaching method in high school mathematics

### 4.1. Pre-class preparation

In pre-class preparation, the task-driven teaching method involves teachers' preparation and students' previews (Figure 1).

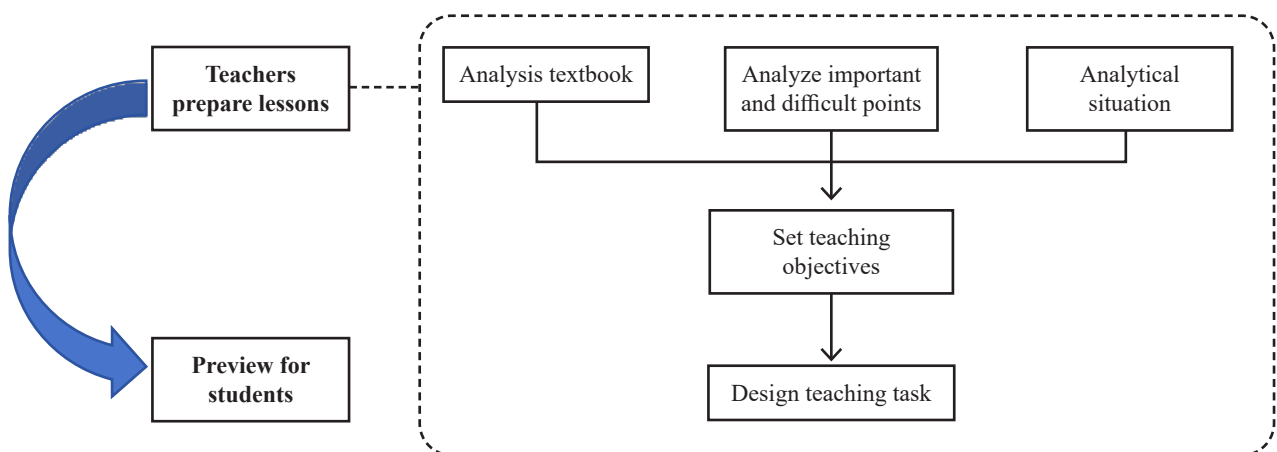


Figure 1. Pre-class task-driven teaching method

#### 4.1.1. Comprehensively analyzing and understanding the teaching situation

The determination of teaching content is the carrier to achieve teaching objectives. Teachers should first determine the teaching content when designing teaching, analyze the status, knowledge context, and key and difficult points of the teaching content, and fully grasp the content of this lesson.

(1) Analyzing the content of the textbook from macro to micro: Teachers, as the person to impart knowledge, should not only be familiar with the teaching content of each lesson but also grasp teaching from a macroscopic perspective. In the teaching design, teachers should first understand the chapter of the teaching content and the correlation and sequence between the knowledge before and after it, so as to determine its position in the entire mathematical knowledge system and its role in mathematics learning, and subsequently carry out an in-depth interpretation of the teaching content. Based on the above considerations, teachers need to reasonably arrange teaching content and teaching methods.

For example, from a macroscopic point of view, it belongs to the part of the relationship between the position of the straight line and the plane in the solid geometry module, which is the expansion of the relationship between the vertical position of the straight line and the straight line, and is also the foundation of the vertical relationship between the plane and the plane, and the core of the transformation of the vertical relationship in space. From the microscopic point of view, this lesson needs to first clarify the definition of vertical line and plane, then experience the idea of transforming from “infinite” to “limited,” learn the judgment theorem of vertical line and plane, and understand the meaning and application of the judgment theorem from multiple angles.

(2) Analyzing the important and difficult points of teaching and breaking through the bottleneck of teaching: The teaching focus is the basic knowledge and skills that students must master, which can also be said to be the core knowledge of a lesson. Teaching difficulty refers to the knowledge that is challenging for students to understand or skills that are difficult for them to master. There is a difference between the key and difficult points in teaching, and the difficult points are not necessarily the key points, some content is both difficult and important. The key and difficult points in teaching are those that need to be emphasized and solved in a class. Teachers should carefully study the curriculum standards and textbooks, fully grasp the teaching content, fully understand the teaching key points and difficult points contained in the teaching content, and choose appropriate teaching methods to highlight the key points and break through the difficulties.

Taking “The Determination of Vertical Line and Plane” as an example, the vertical line and plane are defined by the vertical line and any line in the plane, and the judgment theorem is to convert any line required in the definition into only vertical two intersecting lines, which contains the transformation from complex to simple, from vertical line and plane to vertical line. Therefore, the focus of this lesson is the definition of vertical line and plane and the exploration of the judgment theorem, the difficulty is to confirm and summarize the definition of vertical line and plane and the judgment theorem.

(3) Analyzing students’ situation and implementing the student-oriented principle: Classroom teaching is a dynamic process of bilateral participation of teachers and students. In the classroom, every student is an independent individual and an active subject of knowledge exploration. The curriculum standards also point out that the development of students should be oriented, and the core qualities needed for students to adapt to social development and personal development should be cultivated in teaching. Therefore, in the classroom design, teachers must ensure their teaching ideas are suitable for the basis of students’ knowledge and ability and the needs of their physical and mental development, which is conducive to assisting, promoting, and stimulating students’ learning. When analyzing learning situations, teachers can adopt various methods, such as understanding students’ knowledge and ability basis through textbook analysis and daily tests, understanding students’ learning attitude and learning status through conversations with students, communicating with teachers to analyze students’ learning disabilities, and predetermining the difficulties students encounter in the learning process as well as the parts prone to mistakes and difficult to understand.

Meanwhile, students’ situation should also be taken into account in the determination of teaching goals. Teachers should be mindful of students’ knowledge foundations. Tasks assigned to students should be of moderate difficulty, challenging enough to require thoughtful problem-solving but manageable with effort. Students should clearly understand why each task is assigned. For instance, when exploring the determination theorem of vertical lines and planes, students might question the theorem’s rigor if they arrive at results through intuitive perception and operational confirmation. Therefore, teachers need to acknowledge students’ cognitive development levels and guide them to understand the rationale behind using “two intersecting straight lines” from multiple perspectives during instruction.

#### 4.1.2. Determining objectives and designing teaching tasks

(1) Determining the teaching objectives and guiding the teaching direction: Teaching goal is the expected learning outcome of students, which is not only the starting point of teaching but also the final goal of teaching <sup>[2]</sup>. It is necessary to correctly and reasonably formulate the teaching objectives of the course, rely on the curriculum standards, combine the teaching materials and students' learning situation, and integrate the cultivation of literacy and ability into the teaching objectives and reflect in the design of tasks, so as to achieve the consistency of classroom teaching effects and training objectives.

After teachers fully grasp the teaching content and thoroughly understand the students' learning situation, they must know the knowledge to be imparted and the skills to be cultivated before determining the teaching objectives. Before analyzing the content of each lesson, the teacher should also have a comprehensive understanding of the position of the knowledge within the overall knowledge structure. For example, in the teaching of theorem content, the teacher should conduct a comprehensive analysis of the decision theorem and the property theorem to clarify the logical relationship between them.

Taking "The Determination of Vertical Line and Plane" as an example, the teaching objectives of this lesson are as follows:

(a) To understand the meaning of vertical line and plane, explore and understand the judgment theorem of vertical line and plane, and apply the judgment theorem to prove the simple problem of vertical line and plane.

(b) To develop reasonable reasoning ability, perception, and experience transformation thoughts in the process of exploring straight line and plane vertical, and further cultivate the core mathematical literacy of intuitive imagination and logical reasoning.

(2) Designing teaching tasks and highlighting target methods: Task design is the most important part of task-driven teaching, and the task is the blueprint of students' learning <sup>[3]</sup>. Classroom task is the top priority of task-driven teaching methods in senior high school mathematics teaching. Specifically, this means that students complete task activities under the guidance of teachers, which then influence the evaluation and assessment activities conducted afterward. This approach helps cultivate students' abilities to think independently and solve problems, leading to greater progress in both learning and personal values.

Teaching tasks should clearly define both "what to do" and "how to do it." "What to do" refers to the goal students need to achieve by completing the task, while "how to do it" outlines the methods students should use to accomplish the task. Thus, teaching tasks consist of objective elements and methodological elements. Teachers should consider both aspects when designing tasks to ensure clarity and effectiveness in the learning process.

#### 4.1.3. Pre-class previewing and improving classroom efficiency

A pre-class task list serves as both a learning tool for students and a direct bridge to the classroom. Teachers should clearly articulate the design concepts and considerations behind these task lists, ensuring they are hierarchical and challenging, and directly related to the teaching content. This approach helps students understand the lesson's learning objectives, key points, and difficulties. By previewing content they have not yet mastered, students can focus more effectively during class, enhancing their overall grasp of the material and improving classroom outcomes.

#### 4.2. In-class tasks: Student-oriented and teacher-led tasks

Classroom tasks are the top priority of task-driven mathematics teaching in high school. Specifically, it means that students, under the guidance of teachers, students complete task activities through four key steps. These

activities influence subsequent evaluation and effectiveness assessments, helping to cultivate students' abilities to think independently and solve problems, thereby promoting significant progress in both their learning and values. The specific analysis is as follows.

#### **4.2.1. Creating context and introducing tasks**

Well-designed scenarios can effectively boost students' interest in lectures and help them quickly engage with the learning material. The selected context also needs to be highly relevant to the content of the lesson, so as to facilitate the introduction of tasks. Taking "The Determination of Vertical Line and Plane" as an example, the teacher first put forward a practical problem: the school wants to erect a flagpole on the playground, how to ensure that the flagpole is perpendicular to the ground? This problem is closely related to students' real-life experiences, making it more engaging for them. Additionally, it is directly tied to the judgment theorem of line and plane vertical. By introducing this compelling and thought-provoking "doubt," teachers can spark students' interest in learning and seamlessly introduce the teaching tasks.

#### **4.2.2. Exploring new knowledge**

This stage refers to the students exploring the new knowledge of this lesson and completing the teaching objectives according to the tasks assigned by the teacher, driven and guided by the interlocking tasks. Through participating in the inquiry task, students experience the process of knowledge discovery and development and finally realize the significance of learning new knowledge. In this link, teachers need to pay attention to the clear purpose of the task. Taking "The Determination of Vertical Line and Plane" as an example, the question is considered: "Can you explain from the perspective of vectors why two intersecting lines can be used to determine that two planes are parallel, but two parallel lines cannot?" In addressing this issue, teachers should build on students' existing knowledge and review the basic theorem of plane vectors, which was covered in Chapter 6. The goal is to help students understand why intersecting lines provide sufficient information to determine the parallelism of planes, while parallel lines do not. Clear guidance can effectively improve students' inquiry efficiency and avoid detours in the process of inquiry. At the same time, the communication evaluation and summary reflection on the task are also conducive to promoting the students' construction of the meaning of new knowledge, which can greatly promote the improvement of teachers' and students' emotions.

#### **4.2.3. Consolidating practice, reviewing, and improving**

This part is the continuation of the previous section and is also an important part of students' internalization of knowledge and realization of knowledge transfer and application. First of all, question practice is an effective way to test whether students really understand knowledge. Through solving mathematical problems and practical problems, students can test their mastery of new knowledge and understand how to apply knowledge. Secondly, as students gain new knowledge, new knowledge exists outside of students' knowledge structure as scattered new knowledge. Only by practicing certain questions can new knowledge be incorporated into students' knowledge structure by connecting old knowledge with new knowledge. Lastly, through practice, students can improve their ability to analyze and solve problems and form a stable learning ability. In addition, teachers can evaluate and provide feedback to students through the completion of exercises, which can not only point out the perplexities in students' minds and motivate students to learn but also discover the problems in teaching and correct them in time.

#### **4.2.4. Summarizing the lesson and assigning homework**

In the last stage, the teacher leads the students to summarize what they have learned in this lesson and make

a comprehensive review and summary of the knowledge and methods gained, which can play a role in consolidating and improving. At the same time, the class summary is also helpful for teachers to understand students' learning status, key abilities, and emotional attitudes, as well as whether the tasks designed in this lesson are appropriate. In addition, homework is an extension and supplement to this lesson. Due to the limited class time, students need to practice after class to fully understand the application of knowledge if they want to consolidate their new knowledge.

### **4.3. Post-class assessment: Multiple evaluations for the learning process**

First of all, students conduct self-evaluation, which is to review and reflect on the problems and achievements in the process of solving the task. Students can evaluate their knowledge and ability in all aspects through the self-assessment form, so as to self-correct and improve their learning process and sum up their learning experience.

Secondly, students should also conduct mutual evaluation, so that the evaluated can form a clear cognition of themselves, know their strengths and weaknesses, and find the direction to improve themselves. The evaluators can not only exercise their classroom observation skills but also cultivate their expression and logical thinking skills. Lastly, teachers make a comprehensive generalization based on students' self-evaluation and other evaluations, which is conducive to students' comprehensive and profound understanding of themselves.

## **5. Summary**

To sum up, the application of the task-driven teaching method in high school mathematics teaching can stimulate students' interest and motivation in learning mathematics, exercise students' thinking ability, and improve their comprehensive quality. However, this teaching mode is used in different courses, and it should be adjusted flexibly to achieve the best teaching effect. This paper hopes to provide some references for teachers.

## **Disclosure statement**

The author declares no conflict of interest.

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