The Curriculum Design of Junior High School Physics Activities Based on the Concept of STEAM Education——Taking "the Design and Production of Floating Sinks" as an Example

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Abstract: "Physics Curriculum Standards for Compulsory Education (2011 Edition)" requires that physics teaching in junior high schools should focus on the development of students' scientific abilities, including the development of scientific knowledge and skills, scientific methods and attitudes. In view of the problems existing in middle school physics teaching such as being out of touch with real life, lack of interest, and traditional indoctrination teaching, integrating STEAM education concepts into physics experiment courses can greatly improve the interest of physics teaching and put students first. , teachers as instructors and assistants to improve the existing problems in the current physics teaching. Therefore, how to reasonably apply the STEAM education concept to the physical experiment course is a question worth exploring. I take "the design and production of floating sinks" as an example. The general idea is to build the main line of classroom teaching: the smoothness of knowledge logic, the progress of students' cognitive laws, the smooth design of teaching activities, and how to learn buoyancy and explore objects. To better understand the floating and sinking of objects when floating and sinking, interspersed with the educational concept of STEAM.

Keywords: STEAM Teaching Philosophy; Junior High School Physics; Curriculum Activity Design; Floating and Sinking

1. Overview of STEAM Education Philosophy

Science refers to the principles of various knowledge; Technology refers to the connection and use of various equipment; Engineering refers to overall planning, such as drawing paper; Art refers to optimizing the overall structure and beautifying the appearance, Communication; Mathematics (Mathematics) refers to the measurement and calculation in the whole production process. During this process, students' thinking is constantly being restructured. The comprehensive course tests students' ability to flexibly use knowledge in different disciplines, reflecting the integration and intersection of disciplines. Students can jump from the shallow thinking of mechanically receiving knowledge, which is only used for written questions, to applying it. Knowledge, the high-level thinking of output products, from which to implement the cultivation of aesthetics and art, is an excellent exercise for students' cognition and thinking, and also meets the requirements of new era, new youth and new minds, and is conducive to the cultivation of "from 0 to 1 " creative talent.

2. "Design and production of floating sink" activity course design

2.1 Academic situation analysis

2.1.1 Student characteristics

① In terms of knowledge and skill reserves, this course is open to middle school students in the third grade of junior high school and above. Students have initially mastered the basic knowledge of buoyancy and liquid pressure, which is conducive to students' grasp of autonomy in inquiry-based course activities; middle school students in the formal operation stage have flexible and abstract thinking, strong hands-on ability, and Certain aesthetic concepts and opinions.

② In terms of spiritual quality, students have strong curiosity and thirst for knowledge. In the school teaching method that mainly focuses on traditional lectures, they will have a strong interest in experimental activities, which is conducive to the development of the course.

2.1.2 Learning Disability

① Restrictions on students' thinking activity by fixed thinking and functional fixation

② The lack of relevant courses leads to students having a blind spot in the knowledge of the basic steps and rules of the experiment

2.2 Teaching objectives

2.2.1 Knowledge and skills:

① Know what is a floating sink through popular science videos and teachers' demonstrations

② Under the guidance of teachers, be able to combine the relevant knowledge of buoyancy to explain the phenomenon principle and production principle of floating sinkers

2.2.2 Process and method:

① Master the basic steps of scientific inquiry through experimental inquiry and discussion

② Learn to use a variety of methods to solve the difficulties encountered in the experimental process, learn to use mathematical tools, computer tools, drawing tools, etc. scientifically and effectively.

2.2.3 Emotional attitude and values

① Through learning, exploration and experimental production, generate scientific interest, cultivate correct scientific attitude and good scientific spirit.

② By making and designing floats by hand, you will have a deeper understanding of beauty and have more artistic needs for physics.

2.3 Production preparation and principle of float and sink

This part belongs to the pre-class preparation and knowledge theory input stage. For experimental activity courses, from the teacher's point of view, the premise of a good class is to prepare the class including the preparation of experimental equipment. From the student's point of view, the premise of making experiments smoothly is to fully grasp the theoretical principles of the experimental objects.

Experimental equipment: plastic bottles, scissors, paper clips, straws, water, students prepare small decorations according to their own aesthetics

Principle teaching:

Introduce the teaching part, watch the video of the submarine, and guide the students to think about the principle of its floating and diving. Through the perceptual experience of life, it can be concluded that the submarine changes its position in the water by changing its own weight through water intake and drainage.

In the part of principle teaching, the teacher demonstrates the floating-sink model, reviews Pascal’s law and Archimedes’ principle, and asks students to discuss in groups on the reason why floating-sunk objects float up and down:

When the plastic bottle is pinched by hand, the air in the bottle is compressed. According to Pascal's law, the pressure will be transferred to the water, so some water will be "pressed" into the float and sink. According to Archimedes' principle, the drainage volume remains unchanged at this time. The weight of the float is greater than the buoyant force it is subjected to, so the float sinks.

When the hand is released, the volume of the air above the water surface in the bottle increases, and the pressure decreases, and the air in the sinker "presses" the water out. At this time, the gravity is less than the buoyancy force, and the sinker floats up.

Summary: The floating sink changes the volume of the gas inside the floating sink through the change of the external pressure, thereby changing its own weight. Since the drainage volume of the floating sink remains unchanged, the buoyancy it receives remains unchanged, and the movement of floating up and down is realized.

2.4 Design and manufacture of float and sink

A large number of education and teaching research results can show that only by relying on students' hands-on experimental practice in science education can students' thinking enthusiasm and flexibility be mobilized to the greatest extent, stimulate their motivation to think, dare to put forward conjectures, question difficulties, and cultivate creative spirit.

2.4.1 Design and make the base model

The teacher hands over the sinker model to the students for hands-on touch and experiments to form a more intuitive understanding. After the observation, a group discussion was held to discuss the design and production plan of the floating sinker. The teacher randomly selected a student as a representative to share the design of the group. The student's design at this time was basically imitated and engraved according to the teacher's floating sinker. The principle of design, so teachers need to ask and guide students when they report, to help students understand the reasons for each step.

Step 1: Cut a piece of straw (about 5~6cm), fold it in half, and clamp and fix the two adjacent straws with paper clips. (Question: How does this float increase or decrease its own weight? Answer: The mouth of the straw is downward, allowing water to enter and exit the float with the help of external pressure changes)

Step 2: Pour water into the plastic bottle until the water level reaches about 1/6 of the bottle body. (Question: Why can't it be filled too full? Answer: Too much water will cause the air volume in the bottle to change insignificantly when the plastic bottle is squeezed by hand, and it will not be possible to float up and down)

Step 3: Gently put the float into the bottle, and the part that is required to float out of the water should not exceed 0.5-0.8cm. (Question: Why is there such a requirement for the initial position of the sinker? Answer: The floater cannot stand upright if it floats too high, and submersion will make the follow-up experiment phenomenon not obvious; Question: How to control the weight of the sinker to meet the requirements? Answer: Pass Increase or decrease the number of paper clips to achieve the goal)

Teacher's guidance: Each group can design the shape of the basic model to make it more beautiful, make it more close to the living situation, and improve its applicability.

(2) think about and improve the model

Questions:

① It is difficult to control the change of air pressure by hand pinching. The position of the float and sink in the water changes too fast, and the viewing effect is weak. Is there any way to improve it?

② How to determine the critical point of sinking of the floating sinker?

Idea:

Fast position changes → hard to control changes in air pressure → how to easily control the air pressure in the bottle? On the premise of keeping the whole device airtight, a syringe is connected. The syringe has a scale and is easy to operate, which can effectively achieve the purpose. The observability of the experimental process is improved, and the critical point is easy to find.

Improvement steps: Under the guidance and help of the teacher, the students do it or observe the teacher's use of hot melt guns, drills and other tools. Drill a small hole in the bottle cap, insert an elastic hose, connect the other end to the syringe head, and use a hot melt gun to ensure its tightness.

3. The embodiment of STEAM education concept in the design and production of Fushenzi

3.1 Implementation 300

For the creative and experimental class of making floats and sinkers, when learning science (S) and mathematics (M), the development and application of theoretical knowledge come from the pre-knowledge construction. Therefore, in the first half of this activity course, the teacher led the students to review buoyancy-related theorems and formulas in time to connect new and old knowledge, and used multimedia resources to help students recall past perceptual experiences.

In the actual design and hands-on link, allowing students to observe the teacher's demonstration instrument and design it by themselves requires students to carry out engineering (E) construction of the production object, have an overall grasp and

understanding, and with the guidance of the teacher, students can understand the operation steps It is deeper and the understanding is more thorough; therefore, it is handy in the next production process. Due to the differences among students, there may be individual problems in technology (T), but as long as a certain amount of help is given, students can basically complete the task.

The recent emphasis on aesthetic education by the Ministry of Education has made art (A) an aspect that cannot be ignored in teaching work. In this class, all students can perform artistic treatment on the application of floats and sinks.

3.2 Teaching achievements and feedback 200

After the teaching activities were over, the teacher collected the students' works and tested and evaluated their float instruments. All the students' floats could go up and down in a stable and controlled manner. Some of them imitated submarines by dressing them up, and some Decorate the bottle and syringe to simulate the fisherman's fishing...

In this activity course, through the various conjectures and innovations put forward by the students on the basic model of the floating sinker, we can see that the students' flexible thinking ability and rich imagination have well stimulated the creativity that middle school students at this age should have. It can make the classroom full of vitality, arouse students' interest in learning, and this effect has a certain persistence, which is beneficial to students' future study of physical science.

4. Epilogue

The general idea of this event course is to build the main line of classroom teaching: to ensure the smoothness of knowledge logic, the progress of students' cognitive rules, the smooth design of teaching activities, and the educational concept of STEAM interspersed in it. When the teaching steps are basically completed, the students' cognition of the principles and grasp of the skills can all achieve the teaching objectives. Compared with the traditional teaching mode and method, the classroom running through the STEAM teaching concept can obviously better fulfill the teaching requirements of this part.

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