Universe Scientific Publishing

STEM Based Junior High School Science "Lever" Teaching Activity Design

Shijie Gao, Yige Zheng, Ke Jin, Jiahao Jiang

Hangzhou Normal University, Hangzhou 311121, China.

Abstract: With the core quality attention more and more high, in the junior middle school classroom project learning are developed, then STEM curriculum emphasizes to let the students gain the ability to apply knowledge of contextualized, at the same time able to understand and recognize different situation of knowledge expression, namely can according to background information in context to identify nature and flexible to solve problems. This paper designs the science "lever" teaching activity in junior middle school based on STEM education concept.

Keywords: STEM; Junior High School Science; Lever

1. The Research Background

STEM curriculum refers to the four courses of science, technology, engineering and mathematics education, among which science is to understand the world and explain the objective laws of nature; Technology and engineering are to transform the world on the basis of respecting the laws of nature, to achieve harmonious coexistence with nature, and to solve the problems encountered in the process of social development; Mathematics is the basic tool of technology and engineering.

STEM education awareness and behavior is not deep enough; School policies are far from perfect; The enabling conditions are very imperfect; Behavioral intention and perceived performance need to be enhanced. Meanwhile, there are significant differences in some variables in gender/discipline and teaching years. [1] According to the characteristics of science teaching courses in junior high schools, STEM teaching forms can be carried out in class to improve the comprehensive ability of junior high school students in all aspects.[2]

2. Curriculum Activity Design

2.1 The Teaching Goal

2.1.1 Knowledge and Skills

Master the definition of leverage and learn to judge what leverage is; Learn to identify the five elements of leverage; Master the balance conditions of leverage; Master the classification of levers; Apply leverage to your life.

2.1.2 Process and Method

Make assumptions; Group communication and exploration; Conduct experiments, record data and form experimental reports; Analyze experimental data and summarize and verify.

2.1.3 Feelings, Attitudes and Values

Relying on real and effective life-style situations and following the characteristics of students' thinking development, students can improve their ability to observe, analyze and solve problems through exploration and discovery such as observation and conjecture, reasoning, questioning and imagination, reflection and evaluation;

Let the students do experiments or make small inventions in groups, improve the ability of innovative thinking, hands-on operation and teamwork, and cultivate the patience of listening to students and the courage to express ideas;

On the basis of professional knowledge, make phenomena theoretical and concrete, guide students to explain phenomena through calculation, and consolidate their grasp of scientific knowledge;

Return the knowledge learned to life, make scientific knowledge closely linked with life, inspire students to live in learning, learn in life, explore the science in life;

In the multi-dimensional mode of teaching activities, students can construct physical knowledge, acquire scientific methods, develop engineering literacy, technical literacy and scientific literacy, so that students can get personalized development.

2.2 Activity Design Idea

2.2.1 Overview

The relevant knowledge of leverage is a very important learning content in Zhejiang Education Edition junior high school science, and the use of leverage is very common in our life. Understanding the principle of leverage and the correct use of leverage can help us save effort on some occasions. The wrong use of leverage may cause great inconvenience. Therefore, it is of great significance to understand the principle of lever and master its application in theoretical study and life practice. This course will lead students to have an in-depth understanding of the use of leverage "from life to textbooks and back to life", and not only stop at textbooks, but also penetrate into life and serve life.

2.2.2 Teaching Activity Design Elements

1.Course introduction and conjecture setting: In the form of pictures, videos and other forms of classroom introduction, teachers can ask effective heuristic questions for scientific phenomena in videos, encourage students to make bold guesses, and design verification schemes to solve problems by themselves.

2. Science as the basis of the curriculum: The classroom is based on scientific knowledge, which is enriched and expanded based on the knowledge network of science, engineering, mathematics and other disciplines.

3. Carry out teaching activities in the form of group cooperation: Students need to solve problems through discussion among group members, data collection, scheme design, hands-on practice and other processes, and finally form a survey report, designed experimental scheme or physical invention.

4. Engineering the classroom: In class, the teacher set the students to study the project tasks or given students the main task line of inquiry. Under the guidance of teachers to analyze problems, constantly explore based idea, take a different approach for the design of scheme, and through testing and improving constantly to search for better solutions to problems, let the students comprehensive understanding learning objects, improving their observe and analysis innovation ability.

5. Technicalize the class: Classroom teaching activities are no longer limited to paper, but in the form of group cooperation, give play to professional knowledge thinking, use certain materials and tools for hands-on operation and production, and improve students' ability of inquiry, hands-on practice and innovation.

6. Mathematics as an application: Use mathematical knowledge to interpret, calculate and analyze data, verify the conjecture with specific data, and make the results of exploration more basis.

2.3 Course Contents

The class is carried out in the form of a series of driving task chains with gradients to fully mobilize students' thinking activity. In the process, teachers give auxiliary measures to help students spread the task chain smoothly, so as to achieve the goal of comprehensively analyzing and solving problems and realizing two-way effects.

3. Activity process

3.1 Course Import

The teacher shows the students several common objects in life, which are: cutting the iron wire with a vice,

old-fashioned water pressure well, seesaw, bicycle handbrake, stepping on the garbage can and balance. Students watch the picture or video carefully.

Design intention: let the students carefully observe the objects in life and find out the characteristics and commonalities. Resource preparation: pictures or videos of cutting iron wire with vice, old-fashioned water pressure well, seesaw, bicycle handbrake, stepping on garbage can and balance.

3.2 Questions and Speeches

The teacher asks the students: what are the common characteristics of these items? And encourage students to answer.Students answer questions. Design intention: to improve students' ability of observation and analysis, and exercise their courage to stand up and speak.

3.3 Summarize the Definition of Leverage

The teacher guides students to summarize the definition of leverage. Students summarize the definition of leverage.

Design intention: to cultivate students' ability to summarize laws from phenomena, and to transition from life knowledge to scientific knowledge.

3.4 Physical Experience

On the premise of ensuring safety, teachers guide students to understand scissors, vice, balance and other tools in the toolbox. Students link the definition of lever and observe the characteristics of the tool

Design intention: after understanding the definition, we can observe the real object, so that we can better understand the definition. Prepare resources: each team is equipped with a tool box with scissors, vice, balance, etc.

3.5 Understanding the Five Elements of Leverage

The teacher drew the lever on the multimedia whiteboard, and asked the students to summarize the five elements of the lever (comprehensively analyze what a lever needs to know), and asked the students to point out the five elements of the lever with real objects on the stage, and then the teacher gave the correct answer. And point out the lever on the body according to the characteristics of the lever. Students observe and answer.

Design intention: from the abstract plan to the concrete object, students can skillfully identify the five elements of the lever and learn to apply the knowledge of leverage.

3.6 Creating Problem Situations

The teacher demonstrated on the platform, prepared hook weights of different weights, used a hook weight hanging point to adjust the position of the balance, and hung hook weights of unknown weights (actually the same weight) at two hanging points at different distances from the fulcrum. As a result, the balance was not balanced, but inclined to the right. Students watch the demo.

Design intention: display in kind to make the introduction of knowledge points more specific, closer to life and attract students' attention. Resource preparation: balance with adjustable position of hook weight suspension point and weights of different weights.

3.7 Ask probing Questions

After watching the first demonstration, the teacher asked the question: why didn't the balance keep balance? Teachers can make the following guidance: is the hook weight different? Why is it inclined if the hook weight is the same? Students listen to questions, think autonomously, guess and infer.

Design intention: elicit questions, let students think and answer independently, expand students' thinking, and stimulate students' enthusiasm and enthusiasm for exploration. Resource preparation: explore problems.

3.8 Suggest a Hypothesis

The teacher use the example of seesaw to guide students to guess the relationship between power F1, resistance F2, power arm L1 and resistance arm L2 acting on the lever during balance. Students make assumptions

Design intention: encourage students to guess boldly, which is an effective way to cultivate students' innovative consciousness and train their thinking ability.

3.9 Explore the Equilibrium Conditions by Hands

The teacher gives students a project-based list: 1. Explore and list as many schemes as possible to balance the balance; 2. fill in the form to record the grid number and hook weight of the balance; 3. discuss and summarize the balance law within the group. And guide students to explore. Students will take groups as units, use the balance with adjustable position of hook code hanging point and hook code to explore, fill in the data table, summarize the rules and get the balance conditions. Finally, an experiment report is formed.

Design intention: the project task can guide students to conduct scientific inquiry, realize from phenomenon to law, and cultivate students' rigorous scientific attitude. Resource preparation: data tables.

3.10 Group presentation and evaluation

The teacher organizes students to present in groups. Students send group representatives to the stage to demonstrate various schemes of balance, and use the projection screen to display the experimental report, analyze, demonstrate, summarize and draw conclusions.

Design intention: to train students' ability to dare to show on stage, language expression ability, logical analysis ability, induction and summary ability.

3.11 Evaluation and reflection

The teacher shall evaluate the group presentation, pay attention to the cultivation of students' good experimental habits (such as keeping valid figures correctly), and encourage the groups to evaluate each other. Students listen to the deficiencies pointed out by the teacher, give suggestions, and conduct inter group evaluation.

Design intention: highlight the dominant position of students in the classroom, promote mutual communication and learning among students, and constantly reflect and improve.

3.12 Define equilibrium conditions

Combining the analysis of students, teachers teach the formula of equilibrium condition $F_1l_1=F_2l_2$. Students listen carefully and take notes.

Design intention: give students scientific formulas in theory, use mathematical knowledge to calculate and analyze, and verify the conjecture with specific data, so as to make the inquiry results more based. Resource preparation: balance condition knowledge in textbooks.

References

[1] Fang X& Shi NN.(2018). An empirical study on the current situation of STEM education for Primary and secondary school teachers in China. Education Informatization in China (03),1-5.

[2] Sha YP. (2022). Stem Concept and the path of science teaching in junior middle school. Academy Education (16),72-73+76.

Brief introduction of the author:

1. Gao Shijie (2001.01--), Female, From Nanping, Fujian Province, Han nationality, Undergraduate, Studying in Hangzhou Normal University, Physics

2. Yige Zheng, Hangzhou Normal University

3. Ke Jin, Hangzhou Normal University
4. Jiahao Jiang, Hangzhou Normal University