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Design of Teaching Activities for "Electric Charge and Current" in Junior High School Science Based on Core Literacy

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Abstract: Science is a discipline that integrates physics, chemistry, biology and other disciplines. The pursuit of organic integration of science disciplines, the learning and practice of multiple disciplines, the development of students' ability to analyse problems comprehensively and to integrate and apply knowledge, and core literacy are the trends and priorities of education reform in the world today. In this context, this study designed a project-based teaching activity on "Electric charge and current" based on the development of core literacy among secondary school students.

Keywords: Core Literacy; Project-Based Learning; Electric Charge and Current

1. Background of the study

Core literacy is the trend and focus of education reform in the world today. Moreover, it is the basic task of comprehensively deepening curriculum reform and implementing moral education, as well as an important starting point for basic education in China, which is worthy of serious study, innovation and implementation.

The 2022 edition of the Compulsory Science Curriculum is contemporary, with many new changes compared to previous editions. It points to core literacy, strengthens the overall design, emphasises core concepts, is more comprehensive and practical, and will have a profound impact on teaching and learning. Teachers should develop literacy-oriented teaching, promote the integration of learning and thinking, and strive to achieve consistency in teaching-learning- assessment.[1]

The 2022 edition of the compulsory science curriculum standards for the science curriculum specifies the developmental requirements for students' core literacies in four areas: scientific concepts, scientific thinking, inquiry and practice, and attitudes and responsibilities. [2]Through this, it is conducive to reflecting students' qualities of critical thinking, cooperative and collaborative skills, communication and communication skills, independent learning skills and social responsibility, which are interdependent and together form a complete science teaching and learning system that guides the design and implementation of the science curriculum.[2]

The science curriculum aims to foster core literacies in students. Understanding the connotations and components of the core literacies that the science curriculum aims to develop in students is a prerequisite for effective implementation of the science curriculum. Scientific concepts are the general understanding of objective things based on the understanding of scientific concepts, laws and principles. The content requirements and academic requirements of the science curriculum spiral and progress in design from superficial to deep, from surface to substance, and from phenomenon to essence, which together form the vertical content spiral structure of the science curriculum and require teachers to have a clear understanding of the progression of each core concept in the implementation process.[2]

In this paper, we design activities for a junior high school science lesson on "Electrical charge and Electricity" based on the development of students' core literacy and a project-based learning approach.

2. Teaching evidence and learning objectives

2.1 Requirements of the curriculum

Know the phenomenon of frictional electricity, understand the interaction between electrical charges and know the basic components of an electrical circuit.

2.2 Analysis of important and difficult points

2.2.1 The understanding and application of the scientific nature of frictional electricity.

The reason is the study of the nature of frictional electricity is an important modelling idea that reduces the macroscopic phenomenon of static electricity to the transfer of electrons in the microscopic and the change in the number of particles in an object, while the scientific nature of frictional electricity is fundamental to the study of electricity.

2.2.2 The understanding and application of the laws of interaction between charges.

The reasons are: simplifying the action between electrostatically charged objects to the interaction between different kinds of charges, summarising the laws from experimental phenomena, model building is an element of scientific thinking in the core literacy of physics, while generalising the laws through observation is a very important way of thinking about physics, in addition, the laws of interaction between charges is a fundamental knowledge for the study of electricity.

2.2.3 The basic components of a circuit.

Experiencing how to control a circuit by connecting it with their hands and stating the detailed path of the current will exercise students' hands-on skills, in addition to the basic components of a circuit being the fundamental knowledge of circuit learning.

2.3 Learning objectives

Observing electrostatic phenomena in objects through experiments and grasp the nature of two different charged particles within an object and the scientific nature of frictional electricity by listening to lectures or reading learning materials, and be able to explain electrostatic phenomena in life using the idea of gaining and losing electrons.

Observing the interaction between two electrostatically charged objects through hands-on experiments, summarise the law of interaction between charges and be able to use the law to determine the type of charge an object is carrying.

Stating the conditions for the formation of a continuous current and the characteristics and relationship between the direction of electron movement and the direction of current by reading the study materials and be able to discern the direction of current (direction of electron movement) from the direction of electron movement (direction of current).

Experiment with connecting circuits and closing and breaking switches to experience how to control a circuit, state the detailed path of the current, recognise the basic components of a circuit and be able to define a circuit in scientific terms.

3. Design of teaching activities

3.1 Access to learning

3.1.1 Teacher activities

The teacher shows a video about how electricity makes the world go round, and encourages students to share their experiences in their own lives.

3.1.2 Student activities

Students watch the video and share their experiences of the importance of electricity to human development and social

progress.

3.2 The scientific nature of frictional electricity

3.2.1 Teacher activities

Conducting an experiment in which silk is rubbed against a glass rod and brought close to a small piece of paper. Organise and guide students to observe the phenomenon and consider: Why is the glass rod able to attract the small piece of paper? How is the glass rod charged? Students will be taught the nature of different charged particles and the microscopic explanation of how objects are charged. They will be guided to understand that the transference of electrons makes objects charged, so that they can grasp and be able to state the scientific nature of electricity caused by friction and be guided to use the idea of gaining and losing electrons to explain electrostatic phenomena in their lives.

3.2.2 Student activities

Observing the electrostatic phenomena, listen and read, grasp the nature of different charged particles, the scientific nature of fictional electricity and explain the electrostatic phenomena of life in terms of electron gain and loss. Reflect on the following questions.

(1) Why would a glass rod rubbed against clean silk near a small scrap of paper attract it?

(2) How is the glass rod charged?

(3) Can you state the scientific nature of electricity by friction by listening to the lecture?

(4) Can you explain electrostatic phenomena in life using the idea of gain and loss of electrons?

3.2.3 Evaluation criteria

(1) Be able to state the scientific nature of electricity from friction.

(2) Be able to use the idea of gaining and losing electrons to explain electrostatic phenomena in life.

3.3 The law of interaction between charges

3.3.1 Teacher activities

Guide students to design and implement experiments to investigate the laws of interaction between charges and organise them to observe the experimental phenomena to complete the fill in the blanks of the activity questions in the textbook, guide them to summarise the laws of interaction between charges, display the questions on the textbook for the whole class to judge the type of objects with dots, ask three students to answer and let those who get the right answers to explain, and then the teacher to summarise and emphasise.

3.3.2 Student activities

Design and implement an investigation experiment to observe the interaction that occurs between two electrostatically charged objects, to generalise the laws of interaction between charges and to determine the type of charge the objects are carrying. Reflect on the following questions.

(1) How would you design an experiment to investigate the laws of interaction between charges?

(2) What did we observe from the experimental investigation of the interaction between charges and complete the activity questions on page 122 of the textbook to fill in the blanks?

(3) Can you conclude that there are any laws governing the interaction between charges?

(4) Can you determine the type of charge of this object based on the law?

3.3.3 Evaluation criteria

(1) Observe carefully and complete the activity questions accurately to fill in the blanks.

(2) Be able to summarise and generalise the laws of interaction between point charges.

(3) Correctly determine the type of charge charged according to the laws of interaction.

3.4 Conditions of Current Formation and its Microscopic Explanation

3.4.1 Teacher Activities

Stimulate students to contact life experience to think about how to produce a continuous current, let students say the role of power supply, organize students to read materials to master the micro-explanation of the formation of current and the characteristics of the relationship between the direction of electron movement and the direction of current. Show the questions on the courseware to let the whole class judge the direction of the current / the direction of electronic movement in the circuit. Ask the two students to answer, let the students who answered correctly explain, and the teacher will summarize and emphasize.

3.4.2 Student Activities

Read the text materials in the textbook, state the conditions for the formation of the continuous current and its microscopic explanation, and distinguish the direction of the current / the direction of electron movement. Think about the following questions:

(1) If a continuous current is needed in daily life, how can a continuous current be generated?

(2) What is the function of power supply?

(3) Can you tell the microscopic explanation of the formation of the current and what is the relationship between the direction of the electron and the direction of the current by reading the text material?

(4) Can you judge the current direction / electron movement direction in the circuit shown in the courseware according to the relationship between the electron and the current direction?

3.4.3 Evaluation Criteria

(1) Accurately state the function of the power supply.

(2) To give an accurate microscopic explanation of the formation of the current.

(3) Accurately describe the relationship between the direction of electron motion and the direction of current.

(4) Accurately judge the direction of current / electron movement in the given circuit.

3.5. The Basic Composition of the Circuit

3.5.1 Teacher Activities

Emphasize the matters needing attention in the process of connecting the circuit with the students, guide the students to connect the circuit correctly in pairs, and guide the students to say the detailed path of the current and the basic composition of the circuit according to the circuit connected by the students. guide the students to say the definition of the circuit in scientific language.

3.5.2 Student Activities

Hands-on experiment to connect the circuit, experience how to control the circuit, say the detailed path of the current, understand the basic composition of the circuit, and describe the definition of the circuit in scientific language. Think about the following questions:

(1) After connecting batteries, small light bulbs, switches and wires according to the diagram and experiencing how to control the circuit, can you tell the detailed path of the current?

(2) What are the basic components of the circuit?

(3) Can you tell the definition of circuit in scientific language?

3.5.3 Evaluation Criteria

(1) Connect the circuit correctly.

(2) The detailed path of the current can be given.

(3) Accurately describe the basic components of the circuit.

(4) To state the definition of circuit in scientific language.

(5) Group cooperation is active and the division of labor is clear.

References

[1] Yu, BJ. (2022). Main characteristics and teaching suggestions of Science Curriculum Standard for compulsory Education (2022 Edition). Teaching monthly Primary School Edition (Comprehensive) (05), 17-21.

[2] Hu, WP. (2022) Cultivating Scientific Literacy in Inquiry practice-- interpretation of Science Curriculum Standard for compulsory Education (2022 Edition). Basic Education Curriculum (10), 39-45.

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