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High School Teaching Design Based on the Development of Students ' Core Literacy Based on Chemical History-Taking ' Redox Reaction ' As an Example

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Abstract **Original Research Article**

‘General High School Chemistry Curriculum Standards (2017 Edition 2020 Revision) ' emphasizes the development of students ' core literacy in chemistry, and chemistry history education should be integrated into chemistry classroom. Taking the teaching of ' Redox Reaction ' as an example, this paper expounds the importance of implementing the core literacy of chemistry and the connotation value of chemical history, follows the context of chemical history to create situations, guide thinking and carry out activities, and discusses the teaching design from the aspects of textbook analysis, teaching objectives, teaching process, teaching design, teaching feedback and teaching implementation suggestions, aiming to improve the classroom teaching effect with the help of chemical history materials, help students build a knowledge system, improve their thinking ability, cultivate the core literacy of chemistry, and achieve the fundamental task of establishing morality and cultivating people.

Keywords: Core literacy of chemistry, History of chemistry, Redox reaction

1.INTRODUCTION

The ' General High School Chemistry Curriculum Standards (2017 Edition 2020 Revision) ' (hereinafter referred to as the ' New Curriculum Standards ') points out that it is necessary to comprehensively develop students ' core literacy in chemistry and pay attention to the implementation of ' literacy-based ' teaching[0]. The " new curriculum standard " reflects the content of chemical history education in the " situational material suggestion " of the core literacy of chemistry. It is suggested that the education of chemical history should be infiltrated into the chemistry classroom, and that the chemistry curriculum should be combined with the process of human exploration of natural laws and the trend of chemical science development. However, in the first-line teaching, most teachers often think that the teaching of chemical history in the classroom will waste classroom time. The history of chemistry in the teaching materials is often taken as a background material for a brief introduction[2]. As a result, the educational ideas given to the history of chemistry have not been excavated, and the function has been marginalized. Therefore, based on the core literacy of chemistry, this paper attempts to integrate the history of chemistry into the teaching of ' redox reaction ', aiming to infiltrate the ideas and spirits contained in it into students in different ways, help students have a deeper understanding of the connotation of the core literacy of chemistry, so as to internalize the goal of literacy in the heart and promote the improvement of the core literacy of chemistry.

2.THE IMPORTANCE OF IMPLEMENTING THE CORE LITERACY OF CHEMISTRY

The core literacy of chemistry is the correct values, necessary characters and key abilities gradually formed by students through chemistry learning[3]. Its core focuses on the ' ability ' of students in solving chemical problems, and the ' soul ' of this ' ability ' lies in what they can do. As an important part of cultivating students ' core literacy development, it is a comprehensive embodiment of students ' development in chemical knowledge, ability, thinking mode, values and other aspects[4]. The ultimate goal is to enable students to comprehensively use the knowledge they have learned to solve real problems in complex situations in the future society. It embodies the important value of chemistry course for students

' future development. Promoting the development of students ' chemical core literacy has become the most critical teaching task in chemistry teaching[5]. Only when chemistry teaching is carried out closely around the cultivation of students ' core literacy of chemistry, and it is effectively integrated into all aspects of teaching content, teaching methods and teaching evaluation, can students truly build and continuously strengthen this core literacy in the process of chemistry learning. This also means that promoting the development of students ' chemical core literacy has become an important yardstick to measure the effectiveness of chemistry teaching.

3.CONNOTATION AND VALUE OF CHEMICAL HISTORY

The history of chemistry is the history of people 's exploration of chemical knowledge in the long social practice. It reflects the dynamic generation process of chemical knowledge and reflects the scientific thinking, spirit and attitude of the predecessors[6]. The history of chemistry is an indispensable material in chemistry teaching. It is not only the course of the development of chemistry, but also the embodiment of the ideal and belief, national feelings and social responsibility of chemical researchers[7]. The organic integration of chemistry history and chemistry teaching content can help students see the dynamic process of human exploration of the material world through historical materials. Attracting students ' attention while allowing them to learn in interest, thereby increasing the interest of learning and deepening the understanding of chemical knowledge, helping students understand the unique and far-reaching educational values contained in the treasure house of chemical history, and comprehending the pioneering and innovative scientific spirit shown by scientists, thereby improving their internal core discipline literacy. In the process of chemistry teaching, the integration of chemical history materials with unique educational value is an indispensable part of cultivating students ' chemical core literacy.

4.TEACHING DESIGN

4.1 Textbook Analysis [7]

The new curriculum standard points out that through the study of redox reaction, it is necessary to help students understand that redox reaction is a reaction with valence change, understand that its essence is electron transfer, and know the common oxidant and reducing agent0. This content is located in the third section of the first chapter of the compulsory chemistry of the people 's education edition. After the ion reaction and before the content of the element compound, it can not only consolidate the microscopic understanding of the material and the reaction, but also help the students to predict the material properties from the perspective of valence, and lay a good theoretical foundation for the study of element compounds.

The value of education is reflected in: ' macro identification and micro analysis ', focusing on cultivating students ' ability to understand chemical reactions from the macro and micro levels, so that they can understand the micro nature behind the phenomenon. 'Evidence reasoning and model cognition ' aims to guide students to reason based on phenomena and data to grasp the concept and essence, and construct a cognitive model. 'Scientific inquiry and innovation consciousness ' stimulates students ' enthusiasm for inquiry and cultivates their innovation consciousness by carrying out relevant activities, while the other two core qualities are demonstrated in the relationship between material and energy changes in chemical reactions and environmental protection.

The teaching value covers: ' perfect understanding of schema ', to help students understand the redox reaction more comprehensively and deeply; 'Knowledge framework construction ' is helpful to connect the properties of chemical substances, which is conducive to students ' understanding and memory. 'Thinking mode shaping ' can cultivate students ' dialectical and logical thinking ability, so that they can learn to analyze problems from different perspectives.

4.2 Teaching Objectives

4.2.1 Knowledge objectives

Taking the history of chemistry as the context, it helps students to accurately grasp the concept of redox reaction, the definition of oxidant and reducing agent and common types from shallow to deep, deeply understand its essence as electron transfer, and skillfully use valence and electron transfer judgment.

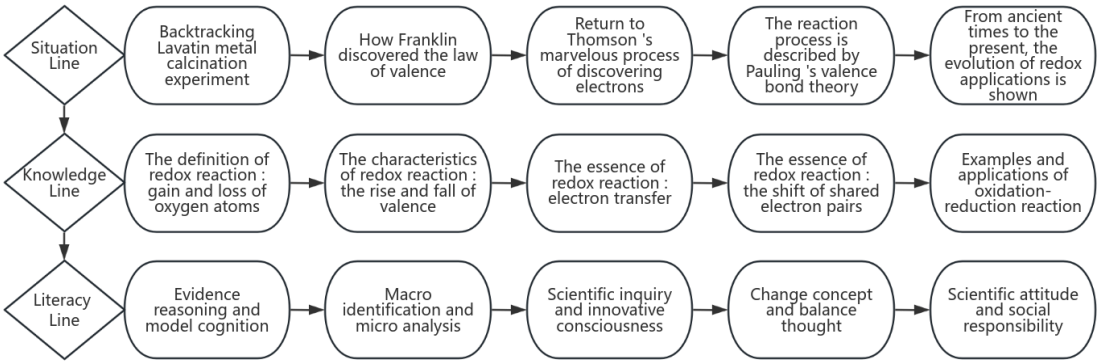
4.2.2 Ability targets

Through the analysis of chemical history and experimental inquiry, students ' logic, critical thinking, evidence reasoning and model cognitive ability are improved, and students ' experimental operation, observation and analysis ability are enhanced.

4.2.3 Literacy targets

Deeply understand the spirit contained in the history of chemistry, plant the concept of chemical love and innovation, firmly establish the concept of green chemistry and the sense of responsibility of chemistry to serve the society and environmental protection, realize the combination of macro and micro, enhance the dialectical logical thinking, and promote the all-round development of core literacy.

4.3 Teaching Process



4.4 Teaching Design

4.4.1 Link 1 : Definition Exploration - ' Oxidative Enlightenment ' in the History of Chemistry'

Situation creation : Returning to the 18 th century, Lavoisier explored the essence of combustion with metal calcination experiments. The metal is heated in the curved neck retort, the gas is captured by the gas collecting bottle, and the properties and quality of the reaction between metal and oxygen are changed, such as metal loss and weight gain, and oxygen is integrated into the compound.

Ask the driver : What are the changes before and after the reaction of metal and oxygen ? What are the conditions and relationships between oxidation reaction and reduction reaction ?

Student discussion : the metal has been oxygen, oxidation reaction occurred ; oxygen loses oxygen, and the reduction reaction occurs. The oxidation reaction and the reduction reaction require the transfer of oxygen atoms between the reactants, and the two reactions are always carried out simultaneously.

Activity promotion : carry out experimental design activities, and let the student group cooperate to design and verify the experimental scheme of oxygen atom transfer.

Design intent : With the help of the history of Lavoisier chemistry, stimulate students ' interest in learning, connect the knowledge of redox reaction in junior and senior high schools, and improve the cognitive schema. In the process of designing the experiment, students need to select appropriate reagents and experimental methods according to the concept and characteristics of redox reaction, cultivate students ' practical ability and innovative thinking, as well as the ability of ' evidence reasoning and model cognition ', so as to provide practical opportunities for the improvement of thinking ability and the construction of subject concept.

4.4.2 Link 2 : Characteristic analysis- ' Exploration of valence ' in the history of chemistry'

Situational creation: telling the story of Franklin’s unexpected discovery of the valence law of elements when he explored the chemical properties and reaction rules of substances in electrical research.

Question analysis : in the reaction of zinc and copper sulfate solution, is there any oxygen or oxygen loss ? Is this reaction a redox reaction ? How to judge according to the law of valence found by Franklin ?

Students ' inquiry : after careful study of the data, the change of element valence before and after the reaction was analyzed. It was found that the valence of zinc increased and the valence of copper decreased. It was recognized that the essential characteristic of redox reaction was the change of valence, which echoed Franklin 's discovery and deepened the understanding of the basis of reaction judgment.

Activities : The knowledge competition of " valence law and redox reaction " was held, and various types of topics were set up, covering Franklin 's cognition of valence, examples of reaction judgment and modern extended application, so as to stimulate students ' competitive consciousness and knowledge application ability.

Design intent : With the help of Franklin 's chemical history, guide students to deeply analyze the nature of redox from the valence of valence, and enhance analytical induction and logical thinking. The competition consolidates knowledge, improves thinking mode and knowledge framework, and cultivates the core literacy of chemistry subject of " changing concept and balancing thought. "

4.4.3 Link 3 : Uncovering the essence - the ' electronic discovery journey ' of micro-exploration'

Situation Creation : Returning to Thomson 's laboratory at the end of the 19 th century, Thomson discovered electrons in the interweaving of the old dilemma and the germination of new thinking.

Ask driving : Why does the valence change in the redox reaction ? What is the number ratio of electron transfer to valence change ?

Students ' discussion : Following the atomic cognitive trajectory, focusing on the reaction between sodium and chlorine, analyzing the change of chemical valence caused by sodium losing electron chlorine to obtain electrons, excavating the quantitative relationship between electron transfer and chemical valence change, and shaping the micro-cognitive model.

Activity promotion : simulating academic contention, students play as scholars to debate the relationship between electron transfer and valence change according to empirical hypothesis, and teachers guide them in a timely manner.

Design intent : adhering to the context of chemical history, guiding students to go deep into the microscopic world of chemical reactions, and implementing the core literacy of ' evidential reasoning and model cognition '. Under the coordination of historical evolution and the deconstruction of the micro-world of chemistry, it helps students construct the concept of chemistry and implement the core literacy of chemistry of ' scientific inquiry and innovation consciousness '.

4.4.4 Link 4 : Essence deepening - ' offset analysis ' of shared electron pairs'

Scenario creation : Based on the valence bond theory proposed by Pauling, the process of electron pair shift in the reaction of hydrogen and chlorine and the basis of theoretical formation are described in detail.

Inspiration : How to transfer electrons in the reaction of hydrogen and chlorine ? What are the fundamental differences in the electron transfer mechanism of the reaction with sodium and chlorine ? How does Pauling 's theory accurately explain the redox nature of this reaction ?

Students ' analysis : Students study the data, clarify the redox caused by the shift of the valence change of the hydrogen chloride reaction electron pair, compare the gain and loss of electrons of sodium chloride, deeply understand the diversity of electron transfer and the complexity of redox, and understand the essence of Pauling 's theory.

Activity organization : Carry out the " micro-deduction of Pauling 's theory " activity. The students are divided into groups to simulate the electron pair offset of hydrogen chloride reaction in the form of creative short drama, micro-model display or animation production, and interpret the core viewpoint of Pauling 's theory and the micro-nature of the reaction.

The design intention is to deepen the understanding of redox through the history of Pauling 's science, strengthen the quality of micro-analysis and evidence reasoning, improve the systematicness and innovation of knowledge, and shape the thinking and scientific spirit of chemistry.

4.4.5 Link 5 : The protagonist 's debut-redox reaction of life application

Situation creation : in ancient times, metal rust prevention mostly relied on simple physical isolation methods such as grease and wax. Although alchemy involved chemical transformation, its principle was obscure. In modern times, antioxidants for food preservation accurately control oxygen and delay deterioration, and metal corrosion is accurately protected by electrochemical protection technology. From the accidental chemical discovery of ancient alchemy to the precise redox regulation of modern material synthesis and energy conversion, it shows a panoramic view of the evolution of redox in life.

Questioning expansion : the core difference between ancient and modern redox application principles ? The new characteristics and application mode innovation of oxidant reducing agent in modern science and technology ? Future development trends and challenges of redox technology ?

Students ' thinking : students analyze historical cases and modern technology, summarize the transformation from empirical application to deep control of scientific principles, and explore the innovation points and breakthrough directions of performance improvement, environmental friendliness and interdisciplinary integration of new oxidants and reducing agents.

Activity implementation : The ' Redox Innovation Life ' creative workshop was held, and students designed innovative redox applications according to their life needs, such as intelligent responsive antioxidant packaging, self-healing anticorrosive coatings, and a new system of green energy redox, and showed exchanges. After mutual evaluation and improvement of the program, innovative practice and problem-solving ability were cultivated, and the value of chemical service life was deeply rooted.

Design intention : present the differences between ancient and modern redox, stimulate innovative inspiration, improve students ' comprehensive quality through creative practice, highlight the core value of chemistry to promote life progress, and cultivate students ' enthusiasm for chemical frontier exploration and social responsibility.

4.5 Teaching Feedback

Through the above five teaching links carefully designed based on the history of chemistry, students can gradually and thoroughly understand the conceptual connotation, characteristic expression, essential law of redox reaction and its wide application in daily life in the rich and diverse situational experience, in the process of challenging problem exploration, in the close cooperative discussion and exchange, and in the creative practical innovation activities. This teaching mode not only helps students build a systematic and logical chemical knowledge system, but also comprehensively and effectively cultivates students ' ' evidence reasoning and model cognition ',

' change concept and balance thought ', ' macro identification and micro analysis ', ' scientific inquiry and innovation consciousness ', ' scientific attitude and social responsibility ' chemistry core literacy from multiple dimensions.

5.SUGGESTIONS FOR TEACHING IMPLEMENTATION

5.1 Collection of Situational Materials for Chemical History

The history of redox reactions in ancient chemical books, academic literature, popular science books, and scientific documentaries was excavated. Original experimental records, anecdotes of scientists, and materials for the evolution of major chemical processes were collected, such as the historical materials for the creation of Lavoisier 's oxidation theory and the evolution of copper hydrometallurgy. Sorting out the scattered materials in teaching materials, teaching references and network education resources, classifying and sorting out the construction material library, associating knowledge nodes, and accurately retrieving and calling according to teaching needs, such as classification according to reaction type, historical period and subject thought.

5.2 Rational Use of Materials

In line with the teaching objectives, according to the students ' knowledge reserve and cognitive rules to cut the material. For example, the enlightenment section uses intuitive and vivid ancient metallurgical materials, deepens the theory by selecting micro-mechanisms to explore historical materials, and moderately expands cutting-edge research results to stimulate innovation. Situation creation emphasizes reality and perception, integrating multimedia, experiment and role playing. For example, link four uses animation to simulate electronic offset, link one organizes students to simulate ancient smelting, strengthens subject perception through multi-sensory experience, improves teaching efficiency, and cultivates the core literacy of chemistry in an all-round way.

6.CONCLUSION

The new textbook of high school chemistry is rich in chemical history materials. In the classroom, teachers need to make good use of these materials and use the teaching method flexibly according to the examination standard of the core literacy of high school chemistry. With the help of materials, students are guided to clarify the context of chemical knowledge, promote the internalization of knowledge, build a knowledge system, deeply understand the essence of the discipline, improve their thinking ability, cultivate their core literacy, and promote the achievement of the fundamental task of moral education. Let the material of chemical history become a powerful booster on the way of students ' chemistry learning, and open a new chapter in the education of literacy improvement and moral shaping.

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