Frontiers in Educational Research
ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

Chemistry History Education Infiltrating Cultivation of Scientific Literacy

Yang Yaru, Xue Liang*, Yang Yanan, He Chenyang, Guo Yingying

College of Chemistry and Chemical Engineering, Shaanxi Normal University, Xi'an 710119, China

ABSTRACT. *The teaching of chemical history is of great educational significance for improving students' scientific literacy. It is not only conducive to the cultivation and improvement of students' scientific spirit and scientific thinking, but also enables students to develop their scientific thinking and scientific inquiry ability and establish a scientific essence view.*

KEYWORDS: *Scientific literacy; Chemistry history education; Scientific essence view*

"The Curriculum Standard for General Senior Middle School Chemistry (2017 Edition)"points out that the training goal of general high schools is to further improve the comprehensive quality of students, focus on developing core literacy,and make students have ideal beliefs and sense of responsibility,scientific and cultural literacy and lifelong learning ability.Chemistry history education provides rich and philosophical materials for cultivating and improving students' scientific literacy.It is of great significance in stimulating students' interest in learning,enhancing understanding of chemistry knowledge,developing chemistry thinking,and expanding students' vision.Therefore,the implementation of science literacy education in chemistry teaching should be in line with chemistry history education.

1 Scientific Literacy and Chemistry History Education

The purpose of the new round of basic chemical education reform is to improve students' scientific literacy.Cultivating and continuously improving students' scientific literacy is one of the main goals of chemical education.The so-called scientific literacy is internationally recognized to consist of three parts:one is to have a basic understanding of scientific knowledge;The second is to have a basic understanding of scientific research processes and methods;The third is to have a basic understanding of science and technology.It not only includes the basic knowledge,skills and methods that students need to adapt to future social development,but also students' strong sense of social responsibility,patriotic sentiment,cooperative innovation,practical operation,realistic scientific attitude and

ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

values.Scientific literacy is an important goal of chemical education,Active and stable discipline literacy not only helps improve students' academic performance,but also can effectively predict students' discipline selection behavior,It has always been the focus of attention in the field of chemical education research[1].The history of chemistry is one of the branches of chemistry,It is a discipline that stands at the historical level of chemical development and vertically expounds the emergence, development and research direction of chemistry at this stage[2]. Chemistry history is the history of chemistry creation and development, which contains rich teaching resources and teaching value.It includes the research and discovery process of a theorem by scientists,the research spirit of unremitting exploration, and the interesting things in research,etc.All of these can be used to design a teaching situation combining chemistry history,which is both interesting and consistent with the teaching theme, and can also avoid the simple listing of chemical historical facts in the traditional teaching process[3].The history of chemistry is also a record of the history of the formation,emergence and development of chemistry and its evolution rules.It not only contains the epistemology of chemistry accumulated from the exploration and application of chemistry science,but also includes the profound scientific thought, attitude and spirit of chemistry science of chemistry scientists.

The quality concept of chemical history is to organically combine the basic knowledge and skills of chemistry to be taught with the education of chemical history, to fully disintegrate and excavate the educational value function of chemical history, to explore the best fit point between chemical formula education and quality education,to stimulate students' thirst for knowledge,to enable students to be educated in scientific awareness and subject quality,to be inspired by scientific methods and innovative spirit,and to promote the development and improvement of students' quality.Therefore,it is an important topic for quality education to carry out the research on the scientific thinking methods contained in chemistry teaching materials and to construct a teaching mode that organically combines knowledge teaching and scientific thinking methods education.

2 Chemistry History Education Infiltrating Cultivation of Scientific Literacy

2.1 Chemistry history education helps to cultivate students' scientific spirit and scientific thinking methods

Scientific spirit is the sum of all kinds of values,ideas,codes of conduct,morality and will qualities required by scientific nature.Its connotation includes:the spirit of seeking truth and being practical,the spirit of competition and cooperation,the spirit of inheriting innovation,the spirit of dedication and dedication,etc.The chemical historical materials contain abundant materials for scientific spirit education. Scientific thinking method is the soul of scientific discovery,the thinking method used by scientists to solve problems and explore new knowledge, and the source of scientists' creativity.In the history of chemistry,there are many successful examples and lessons of failure in the flexible application of scientific methods,which can attract people's thinking and enlighten people.It reveals how chemists are good at

ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

seizing opportunities,how to use imagination, how to carry out careful experimental design,and how to carry out scientific logical thinking and reasoning,which will provide us with many vivid and vivid learning models.There are mainly the following ways of thinking in chemical research: observation, imagination, investigation, simulation, decomposition and combination, experiment, reasoning, etc. These methods are the main contents of our education on scientific methods.Scientific thinking method is the soul of scientific discovery, the thinking method used by scientists to solve problems and explore new knowledge,and the source of scientists' creativity. In the history of chemistry,there are many successful examples and lessons of failure in the flexible application of scientific methods, which can attract people's thinking and enlighten people.It reveals how chemists are good at seizing opportunities,how to use imagination,how to carry out careful experimental design,and how to carry out scientific logical thinking and reasoning, which will provide us with many vivid and vivid learning models.There are mainly the following ways of thinking in chemical research: observation, imagination, investigation, simulation, decomposition and combination, experiment, reasoning, etc. These methods are the main contents of our education on scientific methods.In combination with the chemical knowledge content in the relevant chemistry textbooks, the historical materials on the development of chemical science are introduced,the historical process of the development of chemical science is displayed to studentsand historical cases are analyzed,so that students can understand the thinking process and scientific research methods of chemists in discovering scientific knowledge,theories and laws.To enable students to learn specific knowledge of chemical science,while continuing to accept the influence of scientific methods,imperceptibly cultivate scientific thinking mode.Scientific method is the general name of all kinds of methods and means that people follow in the process of scientific research.It is a tool for people to reveal natural mysteries and explore truth.In scientific research, people always have to use certain methods to obtain certain knowledge achievements.Through the education of chemical history, students can imitate chemists' research methods,repeat the successful research approaches and scientific methods chemists have experienced,and carry out scientific inquiry activities under the guidance of teachers.For example,in the teaching of air composition,lavoisier's experiment of finding air composition is introduced,and students are guided to measure the oxygen content in the air through red phosphorus combustion,so as to train students' scientific methods and scientific inquiry skills and develop scientific inquiry ability.Through the education of chemical history,students can learn from chemists the scientific spirit that they dare to question,dare to explore and pursue for scientific cause.For example, lavoisier questioned and denied the "phlogiston theory" through experiments and established the historical facts of oxidation theory;Madame Curie spent several years separating 0.1 gram of radium compound from waste slag of two tons of uranium.When explaining Mendeleev's periodic law of elements,he explained how Kekule broke the conventional thinking and realized the benzene ring structure from his dream by describing his thinking process of discovering the periodic law of elements and talking about the structure of benzene molecules,so that students can think and exercise continuously along the thinking track of chemists and gradually master

ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

scientific thinking methods.These historical facts are undoubtedly conducive to the cultivation of students' scientific spirit and scientific methods.

2.2 Chemistry history education helps to cultivate students' scientific thinking and scientific inquiry ability.

Scientific thinking is also called scientific logic,that is a theoretical system of ways and means of forming and applying scientific cognitive activities and processing perceptual cognitive materials;It is the organic integration of various scientific thinking methods in the process of the unification of knowledge of truth,and it is the product of human practical activities.V.Talanquer etal. put forward the chemical thinking mode,which refers to "the thinking mode based on this specific field of chemistry.This thinking mode has been proved to be so powerful and successful in analyzing and modeling to skillfully transform the world around us[4]." In the process of chemical history education,teachers can design scientific inquiry activities.This kind of scientific inquiry based on historical facts is like a dialogue between students and scientists.Students can understand some scientific processes such as hypothesis,experiment,logical reasoning and scientific methods such as comparative classification,induction and deduction.Inquiry is not only the goal of scientific learning,but also the way of scientific learning.Personal experience of inquiry-based learning activities is the main way for students to learn science.Inquiry accomplishment includes not only the study of scientific knowledge but also emotion,attitude and values. Schwab was one of the pioneers who advocated exploring and implementing based on historical facts.In "science as inquiry" and "teaching through inquiry",he gives priority to the former.He regards the structure of the subject as an "added concept",and knowledge is a hypothesis and conjecture,not a dogmatic truth.On this basis,combined with historical materials of scientific development,the "inquiry into inquiry" is carried out.Scientific inquiry is a systematic investigation and research activity,the purpose of which is to discover and describe the relationship between objects and things[5].Some people propose to create and use inquiry-based laboratory modules,so that students and scientists can work together to explore problems and experience the real research process,so that students can participate in surveys,collect data, draw conclusions and carry out scientific exchanges,so that students can participate in real research and improve their participation and learning motivation[6].The combination of chemistry history teaching and inquiry learning is an important way to construct knowledge teaching and scientific thinking method education.By using chemistry history,students can learn the concept,principle,characteristics and attributes of chemistry from the essence through the research process of scientists,and more accurately construct the framework of chemistry learning through matching with chemists' thinking.Senior high school chemistry curriculum standards emphasize the importance of scientific inquiry and activities in chemistry classroom teaching.For example,when learning the periodic law of elements, the high school chemistry curriculum standard emphasizes scientific inquiry and activities,requires students to consult the historical data of the discovery of the periodic law of elements,and discusses the significance of the discovery of the periodic law of elements to the development of chemistry

ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

science.Therefore, in the chemistry classroom teaching,through the introduction of the history of chemistry,to guide students to use scientific methods to carry out inquiry learning can play a very important role in improving students' inquiry ability.

2.3 Chemistry History Education Helps Students to Establish Scientific Essence View

Generally speaking, the essence of science refers to the epistemology of scientific knowledge.Science is a way of value and belief in the intrinsic development of scientific knowledge[7].And as early as the 1960s,the goal of helping students acquire a complete understanding of the nature of science has been taken as "one of the most common goal statements in science education[8]."Professor Lederman,an American expert in education and research on the nature of science,pointed out that the study of the nature of science should be explicit and reflective rather than implicit learning by doing.Research shows that students' mastery of scientific concepts depends on their understanding of the nature of science.A more comprehensive understanding of the nature of science can enable students to make wiser decisions on scientific issues in daily life[9].In order to promote students' understanding of the nature of science,it is necessary to guide students to master knowledge in the process of inquiry,to understand the social and cultural background from which chemical knowledge originates,who discovered or proposed it,what development process they have experienced,and how knowledge affects society.To achieve such a goal,it is obvious that only chemical historical facts can bear such a function.Therefore,the implementation of chemistry teaching based on the understanding of the essence of science must take the historical materials of chemistry as the curriculum resources.In the process of teaching, teachers can analyze and use the history of chemistry to teach,guide students to learn scientific methods,master knowledge,understand the social and cultural background of the theory of chemical knowledge,the development process to have an impact on society and so on,and help students establish a connection between the learning content and the essence of science.It is an important content of contemporary education reform to carry out education on the nature of science and help students form a correct view of the nature of science.As there are abundant educational materials on the nature of science in the history of chemistry,teachers should attach importance to using this important material to carry out education on the nature of science in different forms so as to achieve the goal of improving students' scientific literacy.

3 Conclusion

The introduction of chemical history plays a vital role in improving students' comprehensive quality.It plays a vital role in stimulating students' interest,cultivating students' observation consciousness,problem consciousness,inquiry consciousness and innovation consciousness.Not only that, history and logic are unified. The historical process of people's research on chemistry reflects the logical law of the development of scientific knowledge on a macro level.Creating a good chemistry

ISSN 2522-6398 Vol. 3, Issue 12: 1-6, DOI: 10.25236/FER.2020.031201

learning situation through the research of chemical scientists plays an important role in students' understanding of the laws of scientific development and can make up for the deficiencies in other aspects of teaching.Based on this, we should attach great importance to the important role played by chemical history in the cultivation of students' chemical science and make full use of its advantages.

References

[1] Osborne J.Simon S, & Collins, S.Attitudes towards science:A review of the literature and its implications[J].International Journal of Science Education,2003, 25(9): 1049-1049

[2] Wandersee J H, Griffard PB.The History of Chemistry:Potential and Actual Contributions to Chemical Education[M].Chemical Education: Towards Research-based Practice, 2002.

[3] Berg K C D.History and Philosophy of Science Inside Chemistry: Implications for Chemistry Education[J].Science & Education,2016,25(78):917-922

[4] V.Talanquer, J.Pollard.Let’s teach how we think instead of what we know. Chemistry Education Research and Practice in Europe, 2010,(11):74-83

[5] Kenneth D.Peterson. Scientific Inquiry training for high school students: Experimental evaluation of a model program[J].Journal of Research in Science Teaching 1978,15(2):153-159

[6] Deffit,S.N.,C., & Kowalshi,J.R.(2017).Exploring Caenorhabditis elegans Behavior:An Inquiry-Based Laboratory Module or High School Students. Americn Biology Teacher(University of California Press),79(8),661-667. https://doi.org/10.1525/abt.2017.79.8.661

[7] Lederman, N.G.Students’and teachers’conceptions of the nature of science:A review of the research[J].Journal of Research in Science Teaching,1992, 29(4):331-359

[8] Kimball, M.E. Understanding the nature of science:A comparison of science teachers[J].Journal of Research in Science Teaching,1968(5):110-120

[9] B.Ibrahim, A.Buffler, F.Lubben. Profiles of freshman physics student’s view on the nature of science[J].Journal of Research in Science Education,2009, 46(3): 248-264