Proceedings of the 5th International Conference on Education Innovation and Philosophical Inquiries
DOI: 10.54254/2753-7048/56/20241616

# *Explore the Innovative Path of Chemistry Teaching Based on the Subject Characteristics*

**Fei Ren**[1,a,*]

[1]*College of Material, Chemistry and Chemical Engineering, Hangzhou Normal University, Hangzhou, Zhejiang, 311121, China*
*a. 2021211705148@stu.hznu.edu.cn*
**corresponding author*

***Abstract:*** In today's society, the competition between countries is the competition of talent, so the country pays more and more attention to the cultivation of talent. Chemistry has a vital role in both production, life, and scientific research. In high school, students' contact with chemistry is gradually deepening, so it is an important stage to cultivate students' chemical literacy. However, there are still some problems in the current chemistry teaching. This paper analyzes the teaching characteristics of chemistry and the Core Literacy of Chemistry subject in detail. What's more, this paper shows that chemistry teaching has characteristics of attaching importance to experiments, making abstract knowledge intuitive, linking chemical knowledge with life, applying interdisciplinary methods, and keeping up with the trend of The Times. Chemistry teaching should take cultivating and developing students' chemistry core literacy as the core goal, and emphasize the understanding of the nature of science. Based on this, this paper puts forward the following suggestions, teachers can use the situational teaching method, experimental research method, or task-driven method to improve the existing three major problems in high school chemistry teaching and help to cultivate comprehensive, application-oriented, and innovative talents.

***Keywords:*** Chemistry, Teaching, Core Literacy, High School

## 1. Introduction

At present, China has entered a new stage of development, and strengthening basic research is an inevitable requirement for realizing high-level scientific and technological self-reliance. Therefore, the country pays more and more attention to the cultivation of talent. What's more, chemistry plays a vital role in production, life, and scientific research. In high school, students' contact with chemistry is gradually deepening so it is an important stage to cultivate students' chemical literacy. Therefore, teachers need to teach according to the current learning situation and development goals. However, there are still some problems in the current chemistry teaching, so the teaching effect has not reached the expectation, and the students' core literacy of chemistry has not been fully developed, so it is necessary to explore some new teaching paths. These inquiry results will be of great significance to chemistry education. Through the detailed analysis of the teaching characteristics of chemistry science and the core elements of the chemistry discipline, this paper expounds on the several problems existing in the current chemistry teaching and analyzes the feasible teaching paths from multiple angles and combined with the teaching objectives.

DOI: 10.54254/2753-7048/56/20241616

## 2. Teaching Characteristics of the Chemistry Subject

Chemistry teaching should attach importance to chemistry experiments. Chemistry is a subject based on experiments, so teachers should attach importance to chemistry experiments in the teaching process. Throughout the whole history of chemistry, chemistry has been a theoretical system that scientists constantly conclude and summarize in the process of experimenting and observing phenomena. Therefore, the chemistry subject also contains a large number of experiments. Teachers arrange experiments in the teaching process to help students better understand and master chemical knowledge through vivid and intuitive phenomena. More importantly, the experiments can improve students' observation ability, induction and summary ability, experimental operation ability, and problem-solving ability, and cultivate students' quality of scientific inquiry [1].

Chemistry teaching should make abstract knowledge intuitive. Chemistry is a basic natural science that studies the composition, structure, properties, transformation, and application of substances at the atomic and molecular levels. The content of chemistry is extensive and abstract [2]. In the process of teaching, teachers can use real objects or models to make abstract knowledge more intuitive, so that it is easier for students to understand and master.

Chemistry teaching should closely link chemistry knowledge with life. Because, chemistry is closely related to people's clothing, food, shelter, and transportation, and is widely used. Teachers introduce some examples of real life in teaching, which can help students better understand some phenomena in life, and understand the application of chemistry in daily life, agriculture, industry, medicine, and other fields, which cultivates students' awareness and ability to solve problems and connect theoretical knowledge with practical application.

Chemistry teaching can be applied to interdisciplinary teaching methods. Interdisciplinarity can promote the mutual penetration and mutual promotion of research results in different fields, thus promoting the innovation and development of scientific research, and may produce major scientific breakthroughs. Chemistry has an important position in the interdisciplinary field. Chemistry can be crossed over with many other subjects. For example, chemistry can intersect with medicine, biology, botany, energy, environment, and many other fields. Therefore, interdisciplinary teaching in chemistry classrooms is conducive to breaking the separation between disciplines, promoting knowledge transfer, and cultivating comprehensive, application-oriented, and innovative talents.

Chemistry teaching should keep up with the trend of The Times. Chemistry is a developing subject. Every year, there are a large number of scientists research and constantly improve the chemical system. With the development of science and technology, chemical experiment instruments also upgraded and become more precise, so the development of modern chemistry has become quicker. The chemistry textbooks are also constantly updated, but the speed of textbooks update is certainly not as fast as the speed of science and technology development, so chemistry teaching needs to keep up with the trend of The Times, which helps students to deeply realize the rapid development of society and broaden students' knowledge and horizon.

## 3. Explain the Development Direction in Combination with the Core Literacy

### 3.1. Core Literacy of Chemistry Subject

The core literacy of the subject is the concentrated embodiment of the significance of the subject education, and it is the correct values, necessary qualities, and key abilities gradually formed by students through learning the subject. The core literacy of chemistry in high school is an important part of the development of the core literacy of high school students. It reflects the basic requirements of chemistry education under the socialist core values and reflects the important role of chemistry curriculum in the future development of students.

DOI: 10.54254/2753-7048/56/20241616

The Core Literacy of Chemistry subject includes five aspects: "macro identification and microanalysis", "change concept and balance thought", "evidence reasoning and model cognition", "scientific inquiry and innovation consciousness" and "scientific attitude and social responsibility" [3].

"Macro identification and microanalysis" means that students can improve the following three abilities. First, students can understand material from different levels and classify them. Second, students can understand the composition, structure, nature, and change of matter from the micro level, forming the concept that "structure determines nature". Third, students can use the combination of macro and micro thinking to analyze problems and solve practical problems.

"Change ideas and balance ideas" means that students can improve the following three abilities. First, students can realize that substances are moving and changing, know that chemical changes need certain conditions, and follow certain rules. Second, students can realize that the essential characteristic of chemical changes is the formation of new substances and energy conversion and that chemical changes, which have certain limits and rates, can be regulated. Third, students can dynamically analyze chemical changes from multiple angles and use chemical reaction principles to solve simple practical problems.

"Evidence reasoning and model cognition" refers to students' awareness of evidence cultivation and model building. Students can make hypotheses about the composition, structure, and changes of the matter according to the evidence and then prove whether the hypothesis is correct through analysis and reasoning. Students can establish logical thinking that can transform opinions, conclusions, and evidence into each other and know that they can understand the essential characteristics and constituent elements of the research object through analysis, reasoning, and other methods. What's more, students can establish models, use models to explain chemical phenomena, and reveal the essence and laws behind the phenomena.

"Scientific inquiry and innovation consciousness" refers to the scientific practice activities in which students can conduct scientific inquiry and conduct some understanding, exploration, and application of scientific knowledge. Students can find and put forward some valuable questions of inquiry can put forward hypotheses for these problems, design inquiry schemes, and use chemical experiments and other methods for experimental exploration. This is conducive to cultivating students' scientific thinking ability so that students dare to question, explore, and innovate.

"Scientific attitude and social responsibility" means that students should uphold a scientific attitude, which means respecting facts, respecting objective laws, daring to pursue, and adhering to the truth. Students should deeply realize the chemistry to create more material wealth and spiritual wealth is a huge contribution, and should have a social responsibility, to save resources, and protect the environment through sustainable development consciousness. Starting from oneself, they can in green carbon way of life. For some social issues related to chemistry, students can make the correct value judgment.

The above five aspects have their priorities and complement each other.

### 3.2. Interpretation of the Development Direction

The curriculum goal of the new high school chemistry curriculum standard has been changed, which is no longer a three-dimensional goal, that is the requirements of knowledge and skills, process and method, emotional attitude and values, but puts forward specific requirements for the development of high school students according to the five aspects of the core literacy of chemistry. It takes the cultivation and development of students' core literacy of chemistry discipline as the core goal, highlights the educational requirements of scientific inquiry, scientific process, and scientific methods, and emphasizes the understanding of the nature of science [4]. Core literacy of chemistry subject is the necessary scientific literacy for students and is an important basis for students' lifelong learning

DOI: 10.54254/2753-7048/56/20241616

and development. It requires students to form the ideas and methods of chemistry, encourages students to innovate, and further reveals the value of pursuit of a higher level of chemistry learning. It guides teachers to shift the focus of teaching from knowledge level to ability level [4].

Core literacy emphasizes interdisciplinary thinking mode and comprehensive ability, which can promote the integration of disciplines and improve students' overall grasp of knowledge and application ability [5]. Teachers need to ensure that students have a solid foundation of chemical knowledge and can apply this knowledge to solve practical problems. This requires more challenging teaching methods to foster deep understanding and innovative thinking.

Core literacy emphasizes the skills requirements that students need to master, including experimental operation, data analysis, scientific communication, etc. The cultivation of these skills not only requires teachers to provide practical experimental experience but also needs to emphasize the actual participation and cooperation of students. Educators need to ensure that students can apply these skills in the real world, not just on paper.

Core literacy emphasizes the scientific spirit and social responsibility. Chemistry is closely related to society, the environment, sustainable development, and other aspects. Cultivating students to have a scientific spirit and a sense of social responsibility, so that they can apply chemical knowledge to solve practical problems and have a positive impact on society. This goal requires educators not only to impart knowledge but also to cultivate students' critical thinking and social responsibility. Therefore, teaching needs to promote the development of students' independent learning and critical thinking ability [6].

## 4. Current Problems

### 4.1. Existing "Do More Exercises" Thinking

Many teachers still have the "do more exercises" thinking, which means that letting students do a lot of exercises can let students master the knowledge points and improve their grades [7]. So that some students also think that as long as they do enough exercises, they can do well in the exam. Blindly doing a lot of exercise has many disadvantages. First, it is very inefficient. Second, doing the exercises becomes formulaic. Students do not consolidate the knowledge points behind the topic. Students will only do a kind of questions in the back and can not transfer the knowledge. Teaching under the thinking of "do more exercises" is not conducive to expanding students' thinking, which will limit students' learning abilities such as knowledge transfer, cultivating students 'innovation ability, and cultivating students' core literacy of "scientific inquiry and innovation consciousness". Although many teachers are aware of the disadvantages of simply brushing the questions and also realize that the classroom knowledge explanation needs a breakthrough, they may have no idea how to find a new way [8].

### 4.2. No Attention to Experiment

The current situation of high school chemistry experiment teaching is not optimistic, and many schools do not pay attention to experimental teaching [9]. First of all, at the school level, although there are policies on the number of laboratories that schools need to build, some schools do not pay attention to the development of experimental classes and do not arrange many experimental classes for classes and teachers. Most of the time, the laboratories are idle or used for other purposes. Second, from the level of teachers, some teachers lack of comprehensive profound understanding of the new college entrance examination and new curriculum. They do not take experiment teaching activities seriously, do not actively organize to explore the experiment, and use experimental teaching videos instead of experimental operations. These make the effect of experimental teaching greatly reduced and the effect of experimental teaching does not well meet the requirements of the new college

DOI: 10.54254/2753-7048/56/20241616

entrance examination and new curriculum. Finally, from the level of students, some students are not very interested in the experiment and are half-hearted in the experiment class. Some students are weak in their experimental operation ability. They want to operate in the experiment class, but their ability cannot meet the requirements. All of these will lead to a poor experimental teaching effect. Not paying attention to experiments will make students unable to more deeply understand and master chemical knowledge, unable to cultivate students ability of experimental operation, and unable to cultivate students core literacy such as "macro identification and microanalysis", "evidence reasoning", "scientific inquiry" and "scientific attitude".

### 4.3. Unrealized Educational Ideas

The concept of "Establishing morality and cultivating people" is very important in education. Establishing morality is to adhere to moral education priority, through education to guide people and encourage people. Cultivating people is to adhere to people-oriented, change people, and develop people through education.

As a branch course of natural science, chemistry should play a positive role in the development and construction of society. However, some teachers will only teach the class according to the textbook, which means that teachers only teach what knowledge content is in the textbook. Such teaching is very limited. Students can not learn chemistry from a more comprehensive perspective, understand the development of chemistry, and can not improve their relevant literacy. Some teachers have very little interaction with students in the teaching process and adopt the "cramming" teaching method, not implementing the idea that "students are the main body and teachers are the leading" [10]. Under this backward teaching mode, teachers occupy most of the time and space of the chemistry teaching classroom, and the main classroom content is filled by the theoretical knowledge of the textbook. Teachers blindly impart knowledge to students without considering whether the students master it. Students lack the initiative in the classroom to express their views boldly. This teaching method weakens students' interest and enthusiasm in learning and suppresses the development of students' innovative thinking and innovative ability. Some teacher's knowledge reserves and subject knowledge literacy are not enough, can only by the teaching material content arrangement to the classroom knowledge planning and transfer, not according to their knowledge accumulation of chemical knowledge and life, linked, unable to simply transfer and chemistry related each knowledge, unable to guide students to broaden the field of vision, so cannot implement Khalid ents concept [9]. In general, if teachers fail to implement the concept of "cultivating people by virtue", then students' learning enthusiasm and learning initiative will be reduced. Students can not have a deeper understanding of chemistry and students can not improve their core literacy such as "scientific inquiry and innovation consciousness" and "scientific attitude and social responsibility".

## 5. Suggestion

### 5.1. Situational Teaching Method

The situational teaching method refers to the teacher creating some situations in the classroom according to the textbook content and teaching objectives, and then carrying out teaching. This method is very suitable for high school chemistry classes. First of all, the content of the chemistry subject is extensive and abstract. Through the situational teaching method, students can better understand this knowledge and increase their motivation to learn. Second, chemistry is closely related to people's food, clothing, shelter, and transportation, and is widely used. The situational teaching method can cultivate students' innovative spirit and improve students' ability to use chemical knowledge to solve problems in practical situations. Third, chemistry teaching should keep up with the trend of The Times. Through situational teaching methods, supplement some recent chemistry

DOI: 10.54254/2753-7048/56/20241616

discoveries, outstanding scientists, and research achievements, which helps students to deeply realize the rapid development of society and broaden students' knowledge and horizons. This method can improve the problem of "do more exercises" thinking, improve students' learning abilities such as knowledge transfer, and cultivate students' core qualities of "scientific inquiry and innovation consciousness" and "scientific attitude and social responsibility". For example, in the "REDOX reaction" teaching, teachers can put the Mid-Autumn festival to eat moon cakes customs as a classroom introduction, for moon cake bag inside the preservatives of the substances. The exploration, gives the students in the inquiry a more concrete understanding of the principle of REDOX reaction, the feeling of chemical knowledge, and the inner connection of real life [11].

### 5.2. Experimental Research Method

The experimental research method means that teachers guide students to conduct experimental research for a certain problem or phenomenon in the teaching process. The process of experimental inquiry refers to finding problems, putting forward conjectures, designing experiments, conducting experiments, and drawing conclusions. In the classroom of experimental research, the idea of "students are the main body and teachers are the leading" is carried out, which lets the students as the explorers, conduct independent experimental research. This teaching method can not only enhance students' interest in learning but also make teachers and students pay attention to chemistry experiments. And then let students cultivate core qualities such as "macro identification and microanalysis", "evidence reasoning and model cognition" and "scientific inquiry and innovation consciousness" in experimental research. For example, in the teaching of "substitution reaction of halogenated hydrocarbons", teachers can guide the students to guess the substitution reaction principle of halogenated hydrocarbons by combining the knowledge they have learned, and then ask students to design an experiment to verify the conjecture and verify whether the conjecture is correct according to the experimental phenomenon.

### 5.3. Task-Driven Method

Task-driven method means that teachers set up a series of learning tasks in the teaching process, and these learning tasks are progressive so that students can think and discuss in the process of completing these tasks, and constantly deepen their understanding and mastery of knowledge [12]. In the task-driven classroom, the idea of "students are the main body and teachers are the leading" is carried out. Students carry out independent inquiry according to the learning tasks set by the teacher, and students ask questions by themselves and then build a model according to the knowledge they have learned to solve the problems. This teaching method is conducive to improving students' learning enthusiasm, conducive to cultivating students' inquiry spirit and critical thinking, and conducive to cultivating students' core qualities of "evidence reasoning and model cognition" and "scientific inquiry and innovation consciousness". This method can better solve the problem that the concept of "cultivating people by virtue" cannot be implemented. For example, in the teaching of "chemical reaction rate", teachers can set the learning task of "exploring the relationship between the rate of chemical reaction and temperature" [6]. In the process of completing this task, students need to collect, sort out, and analyze the experimental data, use scientific methods to reason and demonstrate, and build models to explain the observed phenomena.

## 6. Conclusion

By analyzing the characteristics of teaching and core qualities of chemistry teaching, and exploring the existing three problems, this paper gives three teaching methods that can be implemented, namely situational teaching method, experimental research method, and task-driven method. These teaching

DOI: 10.54254/2753-7048/56/20241616

methods can improve the existing three problems in high school chemistry teaching, which is conducive to cultivating students' core chemistry literacy and cultivating comprehensive, application-oriented, and innovative talents. The content of this paper is conducive to the goal of high school chemistry teaching and the new college entrance examination reform and aims to provide some inspiration for teachers to improve their teaching ideas. The current research still has problems such as insufficient research perspectives, which can be further improved in the future, and then conduct more in-depth research on this topic.

## References


[1] *Yellow Order. (2019). Grasp the Characteristics of Chemistry Discipline to Carry out Efficient Teaching. Middle School Chemistry Teaching Reference, (22), 12.*

[2] *Wang, T. Y. (2020). Grasp the Characteristics of the High School Chemistry Discipline to Master the Corresponding Chemistry Learning Methods. Scientific Consultation (Educational Research), (08), 170.*

[3] *Ministry of Education of PRC. (2020). Chemistry Curriculum Standards for General High Schools (2017, 2020). The People's Education Press. Retrieved from http://www.moe.gov.cn/srcsite/A26/s8001/202006/t20200603_462199.html*

[4] *Chen, X. Y. (2018). Interpretation of General High School Chemistry Curriculum Standard (2017 Edition). Arts and Sciences Navigation (Middle School), (07), 63-64.*

[5] *Wang, Y. (2023). Exploring the Theme Teaching of High School Chemistry from the Perspective of Core Literacy. Parent, (18), 177-179.*

[6] *Song, C. B. (2023). Explore the Effective Practice of High School Chemistry Teaching Method under the New Curriculum Standard. Proceedings of the Fifth Academic Conference on Innovative Education and Development, (I), 464-473*

[7] *Ma, Z. X. (2024). Research on the Optimization of Senior High School Chemistry Teaching Reform under the Background of "Three New Studies". Master Teacher Online, (03), 17-19.*

[8] *Jordan, H., Ellen, Y. (2016). Characterizing High School Chemistry Teachers' Use of Assessment Data via Latent Class Analysis. Chemistry Education Research and Practice, (2), 296-308.*

[9] *Li, X. J. (2023). Reform of Senior High School Chemistry Experiment Teaching Strategy under the Background of the New College Entrance Examination. Student Weekly, (32), 76-78.*

[10] *Zhu, Y. F., Zhao, Y. Z., Yao, R. J., Song, W. Q., He, Z. M. (2024). Practice and Exploration of Diversified Teaching Modes in Organic Chemistry. Curriculum Learning and Exploration, (2).*

[11] *Lu, Y. (2023). Research on the Teaching Strategy of High School Chemistry Curriculum Pointing to the Core Literacy. Teaching Management and Education Research, (22), 113-115.*

[12] *Zhao, F. Y. (2024). High School Chemistry Teaching Design Based on Project-Based Learning--Scientific Understanding of Iron Supplement. International Journal of Mathematics and Systems Science, (2).*