



The Application of Project-Based Teaching Based on Chinese Characteristics in High School Chemistry

Pengyun Wang

College of Chemistry and Chemical Engineering
Henan University, Kaifeng, China

Suyi Xu

Central Philippine University, Iloilo, Philippines

Ying Xu

College of Chemistry and Chemical Engineering Henan University,
Kaifeng, China, Central Philippine University, Iloilo, Philippines

Yanyan Tang

College of Chemistry and Chemical Engineering
Henan University, Kaifeng, China

ABSTRACT

China's basic education has undergone several reforms, and the new round of curriculum reform has vigorously promoted the policy of "core literacy" and cultivating high-quality talents in all aspects. Project-based teaching is a teaching mode that takes students as the main body and lets students practice in real problem situations. It plays a very important role in promoting students' problem-solving ability, developing innovative consciousness and implementing "subject core literacy". Based on Chinese characteristics, this paper takes "handmade ancient soap making" as the project theme, disassembles the task, design the teaching process, and briefly describes the application of Chinese project-based teaching in high school chemistry practice teaching.

Keywords: project-based teaching, manual soap making, core literacy

Project-based teaching is a student-centered learning method, which guides students to actively participate in the learning process in specific situations, achieves learning goals through interactive sharing, [1], and enables students to acquire basic knowledge and skills, key abilities and necessary characters to explore and solve problems in the process of real problem situation practice. Its remarkable characteristics are: real problem-driven, exploring problems in the context, learning in the form of group cooperation, using various tools and resources to promote problem solving, and producing results or products that can be shared openly.

Project-based teaching originated in the late 16th century when the European construction industry was reformed. In 1918, Kilpatrick redefined "project-based teaching" [2]. In 2000, John Thomas from the United States emphasized that the release of complex tasks is an important

prerequisite for project-based. [3] Solomon, a senior expert in project-based learning from the United States, made an analysis from the perspective of learning process in 2012 [4]. With the rapid development of project-based learning, more and more foreign educational research teams have applied project-based teaching mode to the teaching of basic disciplines, mainly represented by chemistry and biology.

China began to study project-based learning in the late 1990s, and the initial project-based learning mainly originated from vocational education. With the gradual development and improvement of project-based learning in China's educational environment, the application scope of this method has gradually expanded. The research on project-based learning in China mainly focuses on combining the knowledge of related disciplines, selecting appropriate project themes, and starting project practice after designing appropriate projects according to the actual situation.

THE APPLICATION BASIS OF PROJECT-BASED TEACHING WITH CHINESE CHARACTERISTICS

'China General High School Chemistry Curriculum Standards (revised in 2020) ' [5] emphasizes: The compilation of high school chemistry textbooks should pay attention to the systematic and structured organization of subject content, pay attention to the overall design of authentic scenarios, complex problems and diverse activities, and the transformation of experimental inquiry and practical activities to promote the learning mode, so as to achieve the goal of developing students' core literacy of chemistry.

In recent years, the study pressure of Chinese teenagers is relatively large, and there is a phenomenon of "teaching and learning for exams" in school education. Some students have poor psychological quality and lack of innovation consciousness and challenge spirit, which is not conducive to the requirements of quality education and social development characterized by cultivating innovation ability.

Project-based teaching can enable students to find out the essence of phenomena in learning activities, form their own views, and gradually form a certain attitude and behavior, motivation, interest, moral character, self-consciousness, world outlook and outlook on life.

The project-based teaching with Chinese characteristics [6] combines the goal of Chinese talent training with the characteristics of middle school students' mental development. By allowing each student to experience the process of solving problems, on the one hand, it can stimulate their interest in learning, improve their enthusiasm and enhance their learning initiative, and through the completion of tasks to achieve the collation of a large number of new knowledges, so that knowledge understanding and memory of knowledge becomes easier, and the retention time is longer, thereby improving the teaching rate. On the other hand, they can improve their thinking ability, problem-solving and other abilities, and develop their core qualities.

THE METHODS AND STRATEGIES OF HIGH SCHOOL CHEMISTRY PROJECT-BASED TEACHING DESIGN

Pre-Class Preparation Stage

Based on the characteristics of project-based teaching with Chinese characteristics, in the teaching preparation stage, teachers conduct a comprehensive and systematic study of the

"micro-project" taught, carefully study the curriculum standards of Chinese high school chemistry, and organize corresponding teaching content. Chinese high school chemistry teaching content should not only be related to the classroom content, but also take into account the extracurricular content, which requires Chinese teachers to have high requirements, not only professional theoretical knowledge, but also a certain ability to control the classroom. Before carrying out project-based teaching, students are divided into groups according to the principle of "inter-group homogeneity and intra-group heterogeneity", that is, group members have certain differences and complementarity in academic performance, expression ability and hands-on operation ability, and the differences between groups are minimized so that each group is at the same level and the fairness of the group is guaranteed.

Clarify the Theme of ' Micro Project:

The theme of the project generally comes from the hot issues in the society, the problems to be solved around, social science issues, etc. "Knowledge can only have meaning in the context in which it is produced and applied, and it must not be separated from the environment in which it is located, and the best way to learn knowledge is in the context" [7]. Therefore, the topic chosen by the teacher should be reasonable and well-founded. First of all, it is necessary to create situations based on curriculum standards, teaching content and students' characteristics, and propose inspiring questions according to their own teaching topics. Secondly, it is necessary to combine students' interests and relate them to daily life, so that students can use the knowledge and ability they have learned to solve problems they often encounter in real life.

Analysis of Learning Situation:

The analysis and accurate grasp of the learning situation is very helpful to the smooth development of project-based teaching. It is not only necessary to consider the real situation of students, but also to find suitable projects when selecting projects. Also pay attention to the individual differences of students, each student's existing knowledge and experience and the latest development area will be different to a certain extent, teachers should

pay attention to teach students according to their aptitude. Because "micro-projects" are at the end of each chapter and have a certain generalization and sublimation effect on the content of each chapter, there is a certain degree of difficulty and comprehensiveness, so the teacher's requirements for students cannot be completely consistent, according to the specific situation of students, they should formulate standards that are in line with their own development.

Classroom Teaching Stage

Change of Classroom Atmosphere:

In the project-based teaching classroom with Chinese characteristics, students experience the problem-solving process, communicate and discuss with the same group members, boldly express their thoughts on the problems, and improve their communication, expression and cooperation ability to a certain extent. The sense of classroom atmosphere has also greatly improved, it is no longer a quiet listening class, but a new type of classroom with expressions and questioning.

Change of Classroom Subject:

Socratic teaching method points out that in the teaching process, teachers should not directly tell students knowledge, but let students take the initiative to think [8]. In recent years,

China has been emphasizing the implementation of curriculum reform to return the initiative to students in the classroom, but the specific implementation is not perfect. The new curriculum standard of Chemistry in Chinese high school points out that chemistry teaching is the key path to practice the philosophy of chemistry curriculum and guide students to achieve the quality standard of chemistry study, including "teaching" and "learning", and the relationship between the two is intrinsically unified. The purpose of teaching in the classroom should be to teach students how to learn knowledge, not just to impart knowledge itself. Students are the main body in the classroom, what teachers should do is to guide students to learn, give students a certain degree of guidance, students under the guidance of the teacher to communicate and cooperate with classmates, bravely express their ideas, and build their own knowledge system.

After-School Evaluation Stage

Project-based teaching emphasizes students' internalization of knowledge in real situations [9] and cultivates students' ability to solve practical problems. Only by studying its evaluation system can valuable judgment be made on students' learning. At present, the evaluation method unanimously recognized by Chinese educators is the organic combination of formative evaluation and terminal evaluation to reflect students' learning performance comprehensively and truly. And the source of evaluation is not limited to teachers, can be parents, classmates and even students themselves.

THE IMPLEMENTATION PROCESS OF PROJECT-BASED TEACHING IN HIGH SCHOOL CHEMISTRY

In the early stage of the project, teachers make plans, define tasks and provide technical guidance; Students collect information, understand the task, and determine the division of labor.

Middle stage of the project: teachers create situations, raise questions and provide technical guidance; Student group cooperation, investigation and research, effect test.

In the later stage of the project, teachers organize communication, make comprehensive evaluation and give suggestions; Student self-evaluation, inter-group evaluation, self-summary.

This paper takes the "Handmade soap making" micro-project as an example to illustrate the development and implementation of project-based teaching cases based on China's national curriculum.

Theme Analysis of Project Content

The making of soap is the content of the first part of the oil part in Chapter 4 of the Chinese High School Chemistry Human Education Edition Elective 5, and it is also the experimental content of the chemical production process of Theme 3 of the elective course Series 1 of the Chinese Chemistry Curriculum Standards for General High School (2017 edition). The process of making handmade soap is more interesting and easier to stimulate students' interest in chemical experiments; In this project-based study, students can better understand the scientific process of soap making, and deepen the principle of soap making by hand compared with industrial soap making methods.

This paper designs three main activities [10]. By completing a series of learning tasks, Chinese high school students can realize the important role of control variable thought in scientific inquiry in the process of solving practical problems, so as to develop core qualities such as concept change, evidential reasoning and scientific inquiry.

Project Teaching Objectives

Through access to information for soap production, master the principle of saponification reaction.

The specific experimental operation is carried out according to the principle of saponification reaction to improve the understanding and application ability of knowledge.

Try to see life from the perspective of chemistry, and use chemical knowledge to solve problems in production and life, develop scientific inquiry, innovation consciousness, social responsibility and other aspects of literacy.

Project Tasks and Teaching Process

In conjunction with the project theme "Handmade Soap Making", the teachers asked the driving question: how to make beautiful and practical soap at home [11]. The project learning process of the project consists of three parts: (1) understanding the principle of soap making; (2) Explore how to make handmade soap at home; (3) Design the soap making scheme. The teaching time of this project is 3 class hours, and the learning duration of the whole project is about 1 month.

Project Implementation Process and Student Learning Outcomes

[Consult before class] Students consult the methods and principles of handmade soap through materials, networks and other means before class.

[Introduction of situation]: Introduce common cleaning supplies in daily life, show you a variety of soap, and ask how soap is made?

[Teachers propose to drive the general task] How to make handmade soap at home?

Project activity 1 Share the main ingredients of soap and understand the experimental principle

[Pre-class task] Students consult materials and guide students to understand the principle of soap making.

[Student activities] Watch videos on making soap by hand in ancient ways and making soap by industry.

[Teachersupplement] The production of soap in the factory is to first saponify the refined oil and alkali, and then salt out the soap base, so that glycerol, excessive lye, water and soap base are separated. Finally reprocessed into different forms of products [12].

[Teacher guidance] Each group sends a student as a representative to try to explain the principle of soap making and conduct group mutual evaluation [13].

[Students ' summary] In fact, the soap reaction principle is the saponification reaction mentioned in our textbook. $(C_{17}H_{35}COO)_3C_3H_5 + 3NaOH \rightarrow 3C_{17}H_{35}COONa + C_3H_5(OH)_3$

Project Activity 2 Explores How to Make Handmade Soap at Home

[Teacher guidance] By collecting information, what raw materials are used in making handmade soap?

[Student 1] According to the principle of saponification reaction, grease and lye are needed.

[Student 2] We make soap at home, and the grease can be lard, olive oil, palm oil, etc.

[Student 3] We use materials at home to make lye, which can be made from burnt paper shell powder and plant ash.

[Teacher guidance] So What factors should we consider when making handmade soap?

[Student 1] When we make handmade soap, we should consider the effects of temperature, stirring, etc.

[Student 2] When making handmade soap at home, keep it at room temperature, but stir as much as possible when stirring, so that the soap will be more delicate.

[Student 3] Regarding the dosage, we can prepare about 2 pairs of shell powder and plant ash, and take the supernatant after the reaction between the two. Prepare about 1 kg of fat, stir while pouring lye, stir as much as possible for a while, add 1 teaspoon of salt, stir until paste.

Project Activity 3 Design A Soap Making Scheme

[Teacher guidance] After understanding the principle and influencing factors of soap making, the students were asked to design the implementation plan of handmade soap making.

[Student show] Each group discussed and finally came up with the production plan.

Raw materials: seashell wood ash oil salt Steps:

- 1) weighing shell 2-3 two, burning, grinding into powder; burn grass ash 2-3 two, add water to boil, filter, take the clear liquid; pour into the shell powder to stir, filter again, and place overnight.
- 2) Weigh about 0.5 kilo of oil, pour into the upper lye, pour into a spoonful of salt, and slowly stir in one direction until it becomes paste.
- 3) Pour the reaction finished soap solution into the mold, slightly shake, so that the surface is smooth and uniform. Placed at room temperature for 48 hours, demoulded after solidification.

[Teacher's comments] The students' plans from the raw materials to the precautions of the reaction are more detailed. Please work in groups according to the above experimental plan and make handmade soap at home.

Project Review

[Teacher guidance] By making handmade soap at home, from failure to success, how do you feel? [Student] express different feelings.

[Teacher summary] Through the study of this project, we not only made handmade soap with different shapes, but also understood the use of chemical methods to solve practical problems. I believe that every student has a benefit.

INSPIRATION FROM PROJECT-BASED TEACHING

The project-based teaching of handmade soap making can create real situations [14], and students can participate in exploration, solve real problems, consolidate relevant knowledge points, and improve students' innovative knowledge and practical ability. Students not only learn chemical knowledge, but also have a strong interest and desire to explore the chemistry subject. Chemistry comes from life, and the integration of boring chemical knowledge into activities closely related to life enables students to fully feel the charm of chemistry, cultivate their ability to use chemical knowledge to solve practical problems, feel the close connection between chemistry and production and life, feel the convenience brought by chemistry for production and life, and appreciate the discipline value of chemistry.

This section of design allows students to take on more responsibility and develop their experimental design skills and literacy competencies autonomously. This kind of teaching method, which focuses on cultivating students' active learning, can scientifically and effectively

cultivate students' participation, and significantly improve students' ability to learn knowledge and solve practical problems. Students solve practical problems through independent cooperation and analysis, and finally achieve project success [15].

References

- [1] Kokotsaki Dimitra, Menzies Victoria, Wiggins Andy. Project-based learning: A Review of the Literature[J]. *Improving Schools*, 2016, 19(03): 267-277.
- [2] Kilpatrick WH. The Project Method[J]. *Teachers College Record*, 1918(19):319-335.
- [3] Du X.M., & Han J. A Literature Review on the Definition and Process of Project-Based Learning and Other Relative Studies[J]. *Creative Education*, 2016, (7): 1079-1083.
- [4] Gwen Solomon. Project-Based Learning: A Primer[J]. *Technology & Learning*, 2003, (1): 1-3.
- [5] Ministry of Education of the People's Republic of China, Chemistry Curriculum Standards for Senior High Schools (2017 edition), Beijing: People's Education Press, 2018
- [6] Chen Ying, Wang Lei, Xu Min, et al. *Chemical Education (Chinese and English)*, 2018, 39 (19): 8-14
- [7] Zhao Yuquan, Yu Naijia, Practical Teaching of high school Chemistry based on "project Teaching" [J]. *Reference for Middle School Chemistry Teaching*, 2019 (03): 12-14 [8] Brown J, Collin A, Duguid P. *Educational Research*, 1989, 18(1): 32-34.
- [9] James J. Dillon. *Teaching Psychology and the Socratic Method*[M]. Palgrave Macmillan, New York 2016.
- [10] Lin Xiuqing. Research on project-based chemistry teaching in senior high school from the perspective of Deep Learning [J]. *Fujian Basic Education Research*, 2021(11):122-123. (In Chinese)
- [11] Li LAN, Lin Hongyan, Yan Ruyue, Liu Weihua. Project-based learning of "Substance Transformation and Reaction Regulation" in senior high school chemistry [J]. *Chemical Education (Chinese & English)*, 2023, 44 (3) :46-53. (In Chinese)

-
- [12] Li Jiajia. The implementation path of project-based learning in high school chemistry classroom [J]. Mathematical and Physical Problem-Solving Research, 2021(33):82-83. (In Chinese)
- [13] Yang W. Improvement of oil saponification reaction experiment [J]. Chemical Education, 2012(2):64,67. (in Chinese)
- [14] Chen Qiao, Wang Xinyi, Jiang Danji. Project-based learning in senior high school Chemistry "Understanding substances around us from the perspective of composition and Change" [J]. Chemical Education (Chinese and English), 2019,44(1):63-69.
- [15] XING Ruibin, LIU Cui, Chen Ying, WANG Lei. Project learning of acetaldehyde Properties in senior high school chemistry [J]. Chemical Education (Chinese and English), 201,42(1):36-43. (in Chinese)