Instructional Design of Students' Cognitive Development Based on Driving Problem Chain —— Taking "Hydrolysis of Salts" as an Example

Xiaoyu Zhong[1,2]

{18761929729@163.com}

Cardiff High School Pinghu School, Jiaxing City, Zhejiang Province 314000, China[1]
Beijing Normal University, Beijing 100875, China[2]

Abstract. Problem-driven Deep teaching can guide students' autonomous learning and cultivate their core literacy and higher-order thinking. Teaching practice shows that by exploring interaction and problem-driven, guiding students to study independently and think deeply, and understanding the internal logic of knowledge points, the unity of knowledge learning, ability training and literacy improvement can be effectively realized. Taking the teaching of "Hydrolysis of Salts" as an example, this paper discusses how to guide students to build their own knowledge system about "Hydrolysis of Salts" through problem-driven, starting from the existing knowledge reserves of high school students.

Keywords: Deep Teaching; Problem-driven;Hydrolysis of Salts.

1 Introduction

China's education is gradually entering the "literacy era", aiming at cultivating students' essential character and key ability. In 2017, the Ministry of Education promulgated the Chemistry Curriculum Standard for Ordinary Senior High Schools (hereinafter referred to as the "New Curriculum Standard"), which clearly put forward the literacy requirements of chemistry education, and identified "evidence reasoning and model cognition" as one of the five core literacy of chemistry, and most scholars believe that this literacy is the thinking core of chemistry core literacy, focusing on cultivating students' chemistry thinking, that is, "being able to understand the relationship between chemical phenomena and models, Can use a variety of cognitive models to describe and explain the structure, nature and changes of matter, predict the possible results of matter and its changes, and construct models based on the information of matter and its changes." However, the teaching of chemical modeling requires us to dig deep into the value behind the literacy-based teaching, stop at the surface of knowledge, cultivate students' cognitive perspective and thinking model from the perspective of chemistry, and improve students' model cognitive ability[1-2]. In the process of constructing model, students' interest in learning chemistry is improved, and in the process of constructing model and modifying model, students' old and new thinking collides in communication and interaction, and finally a general idea to solve problems is formed[3-4]. Based on the existing research on modeling teaching, this study improved and perfected the teaching mode of chemical modeling, as shown in Figure 1. This teaching mode of modeling

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consists of six steps: teaching situation, initial model building, analysis model, model building, model application and model revision.

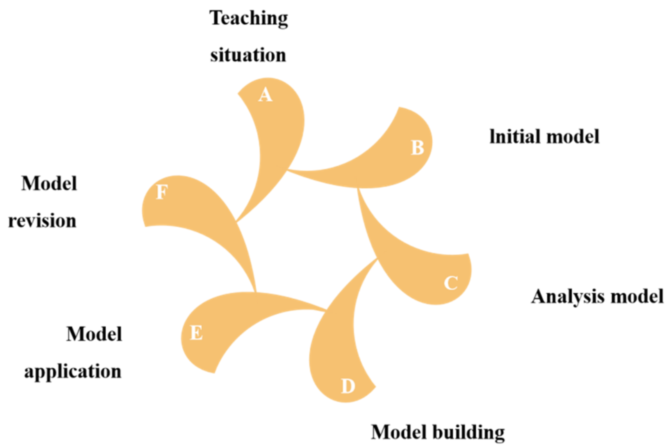

Fig. 1. Teaching flow chart of chemical modeling

2 Teaching objectives

2.1 Knowledge and ability objectives

(1) Explore the application examples of hydrolysis of salts through experiments, and master the operation methods.

(2) Examples of the application of hydrolysis of salts in actual production, life and scientific research can be cited to appreciate the value of chemistry.

(3) Explain the application principle of hydrolysis of salts by combining macro and micro methods, and gradually construct the concept of change and balance.

2.2 Evaluation objectives

(1) Diagnose and develop students' experimental operation ability and information processing ability through experimental operation and data recording.

(2) Diagnose and develop students' understanding of the social application value of chemical knowledge by understanding the application examples of hydrolysis of salts in production, life and scientific research.

(3) Diagnose and develop students' views of change and balance by combining macro and micro thinking methods.

3 Teaching record

Link 1: Review the old and learn the new.

Teacher: Looking back briefly, what are strong acid, weak acid, strong base and weak base? Guide students to think about the classification and acidity judgment of salts produced by different acid and alkali reactions[5].

Students: In order to clarify the definition of strong and weak electrolytes, illustrate common weak acids and bases, strong acids and strong bases, and then analyze the main sources of salts, and draw the following conclusions: salts mainly include strong acid and strong base salts, weak acid and weak base salts, strong acid and weak base salts and strong base and weak acid salts; The judgment of the acidity and alkalinity of salts is mainly based on the relative size of H+ and OH-.

Link 2: Put forward the concept and essence of hydrolysis of salts.

Teacher: Guide the students to find that Na2CO3 and NH4Cl will not ionize to produce H+ and OH-. Ask the students to think about where the H+ and OH- in the solution come from.

Students: They all come from water. The relative sizes of H+ and OH- make the salt appear acidic, alkaline or neutral.

Teacher: Guide students to analyze the reason why NH4Cl solution is acidic from a microscopic point of view; Explore the composition of the solution, ionization, particle composition and interaction between particles, the direction and result of ionization equilibrium movement[6].

Teacher: Introduce the process of hydrolysis of salts through animation demonstration, and guide students to summarize the concept and principle of hydrolysis of salts.

Students: Think about the essence of hydrolysis of salts and answer the questions raised by teachers in groups.

Summary: The essence of hydrolysis of salts is that salts ionize weak acid anions and combine with H+ ionized by water, or salts ionize with weak base cations and combine with OH- ionized by water to generate weak electrolyte, which destroys the ionization balance of water and promotes the ionization of water, thus making c(H+) ≠ c(H-), so the salt solution presents different acidity and alkalinity.

Link 3: The characteristics of hydrolysis of salts and the writing of equations

Teacher: According to the law of hydrolysis of salts"Who is weak and who is hydrolyzed", instruct students to find out the ions that hydrolyze in FeCl3, and write the ionic equation and chemical equations of AlCl3 hydrolysis according to the hydrolysis essence of salts.

Students: Write the chemical equation and ionic equation of the hydrolysis reaction of AlCl3.

Teacher: Through the chemical equation of hydrolysis of AlCl3, let students find that hydrolysis of salts is actually the reverse reaction of acid-base neutralization reaction, and summarize that hydrolysis is reversible, endothermic and weak, and deepen students' understanding of hydrolysis of salts by using intuitive experimental phenomena. Using the properties of hydrolysis of salts, combined with the knowledge of chemical equilibrium and ionization equilibrium of weak electrolyte, this paper helps students summarize the matters needing attention in writing the equation of hydrolysis of salts[7].

Students: According to the characteristics of hydrolysis of salts, summarize the matters that should be paid attention to when writing the chemistry or ionic equation of hydrolysis of salts, including: ① reversibility; ② No gas or precipitation symbol; ③ The ionic hydrolysis of polybasic weak acid radical is step by step, and the cationic hydrolysis of polybasic weak base is one step.

4 Experimental results

In this study, the students in the science class of Grade Two in a senior high school are selected as the research object. In the early stage, a questionnaire survey was conducted on the current situation of modeling teaching for the students in the science class of Grade Two in senior high school, and a preliminary understanding of the current model cognition level and modeling ability of the students in Grade Two in senior high school was obtained. Then, two classes with the same level were randomly selected from the science class of Senior Two, and the data were analyzed based on the entrance examination scores of Senior Two. After confirming that there was no significant difference in chemistry scores between the two classes, the two classes were taken as the control group and the experimental group respectively[8]. Before the implementation of teaching, a preliminary investigation has been made on the present situation of chemical modeling teaching in two classes. In order to ensure the influence of chemical modeling teaching on students' cognitive level and modeling ability before and after the implementation, this paper takes the chemical scores of the entrance examination of the experimental class and the control class as the pre-test data of this experiment, which is used to determine the differences of chemical learning between the two classes, and uses SPSS24.0 software to carry out independent sample T-test on the chemical scores of the entrance examination of the two classes. The statistical results are shown in Table 1.

Table 1. Difference detection of chemical scores between control class and experimental class

Testing period	Classes	N	Average score	Standard deviation s	t	P
Senior two entrance examination	Control class	61	73.2685	9.6083	-2.415	0.9581
	Experimental class	63	75.1738	9.3918		

From Table 1, it can be seen that the average scores of the entrance examination of the two classes are not much different. Through the independent sample T test, $P>0.05$, it shows that there is no significant difference in the chemistry scores of the two classes, indicating that the chemistry level of the two classes is equivalent before the teaching practice, so it is feasible to select these two classes as the control group and the experimental group for teaching implementation. According to the students' answers, the scores are counted, and the after-school test scores are tested by SPSS24.0, as shown in Table 2.

Table 2. Differentiated Test of Chemistry scores in Control Class and Experimental Class after Class

Subject	score	Average score		Standard deviation		Independent T test		SOLO thinking level
		Experimental class	Control class	Experimental class	Control class	t value	P value	
1	3	2.7319	2.0483	0.5849	0.6284	-0.243	0.691	Single-point structure hierarchy (u)
2	5	4.5131	3.974	0.9428	0.8624	-0.261	0.039	Multi-point structure hierarchy (M)
3	8	6.8524	5.7539	1.0736	1.2851	-0.9523	0.043	Association structure hierarchy (R)
4	10	8.7428	6.5318	1.4936	2.0731	-1.852	0.028	Abstract extension hierarchy(E)
Total	26	24.9572	20.3174	3.9973	4.5297	-2.7964	0.041	

From the analysis of after-school test scores, it can be found that the average difference between the experimental class and the control class is also relatively large, and the average difference between the experimental class and the control class is 4.6398, which also intuitively shows that chemical modeling teaching is also helpful to improve students' chemical scores. On the level of single-point thinking, there is no significant difference between the experimental class and the control class ($P>0.05$), which shows that the teaching method has no influence on students' understanding of basic concepts[9]. However, there are significant differences between the experimental class and the control class in three aspects: multi-point structure level, association structure level and abstract extension level ($P<0.05$). This shows that the teaching mode of chemical modeling can develop students' thinking depth, which has a positive role in promoting students' learning. It is speculated that the teaching mode of chemical modeling is likely to stimulate students' learning interest and improve their learning motivation in a certain teaching process. In the learning process, students also have the independent consciousness to construct knowledge, which is helpful for students to spread abstract thinking and logical thinking ability. Therefore, the introduction of chemical modeling teaching has played a role in promoting learning to a certain extent, and has a positive impact on improving students' chemistry scores, greatly promoting teachers' teaching quality and having a positive impact on teachers' teaching[10].

5 Conclusion

This class is driven by problems and carries out deep teaching with students as the center. The design of the problem goes from shallow to deep, step by step. In each learning link, corresponding exercises are provided to test students' understanding and mastery of what they have learned, and give timely evaluation. According to students' existing knowledge and life practice, we can find the growth point of new knowledge, and promote the growth of students' knowledge experience and the construction of knowledge system. Under the combination of students' inquiry activities and group experiments, the microscopic process of NH4+ hydrolysis is displayed by Flash animation, so as to break through the teaching difficulties of this lesson. This teaching activity design can stimulate students' initiative in learning and achieve the effect of deep teaching. Classroom teaching practice shows that problem-driven teaching can help students further understand the essence of hydrolysis of salts, be familiar with and master the writing of the equation of hydrolysis of salts, and the classroom teaching effect is good, which can successfully achieve the classroom teaching objectives. However, there are still some problems in teaching, such as more student activities arranged and insufficient time left for students to think in some links, which may lead some students with weak foundation to fail to keep up with the teaching progress. Therefore, teachers should optimize teaching design, arrange time more reasonably and improve classroom efficiency.

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