ISSN 2522-6398 Vol. 3, Issue 7: 45-49, DOI: 10.25236/FER.2020.030713

The Teaching Strategy of Middle School Chemical Knowledge

Xiaohong Wu

College of Chemistry and Chemical Engineering, Yibin University, Yibin, 644007, China

ABSTRACT.*By taking part in all kinds of chemistry learning and problem solving activities, students have accumulated abundant factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge, and those knowledge will have an effect on problem solving in chemistry. During the procedure of problem solving, students were limited by the immediate memory span, and as a result, perceptual system selectively recognizes information in a problem situation. What's more, differences in recognition of problem solving were depended on students' type and degree of knowledge, which vary from students to students because of different learning level, and at the same time, offer a new perspective for the study on problem solving. Basing on the interpretation of result and discussion, we hold the view that for students in different learning level and different kinds of chemistry knowledge, we should adopt different instructional strategies: adopting practice strategies of positive and negative examples, and fine machining strategies to facilitate the meaning understanding and schematization of conceptual knowledge in chemistry. Strengthening the connection and positioning processing system of generative rules, and using exercise and feedback strategies to improve the level of generative connection and automation of procedural knowledge. Training students in general problem solving strategies and creating supportive social environment to improve students' metacognition level.*

KEYWORDS: *Factual, Knowledge conceptual, Knowledge metacognition, Knowledge problem solving, Instructional strategies*

1. Introduction

There is an inherent correlation between the processing stage of knowledge and teaching conditions, and the internal processing of knowledge can be divided into three stages: declarative, procedural and transfer. Usually, the knowledge cognition of students with learning difficulties, intermediate students and excellent students stays in the three different stages of knowledge declarative, programmed and automated, respectively. Different types of knowledge states have different cognitive processing characteristics and corresponding teaching strategies. Anderson points out in the revised edition that there is evidence that different teaching strategies should be used for different types of knowledge.

2. Teaching Strategies of Factual and Conceptual Knowledge

Factual knowledge and conceptual knowledge belong to declarative knowledge and both involve "what" knowledge, but conceptual knowledge is deeper, more organized, more integrated and systematic than knowledge of terms and isolated facts. According to the analysis of the research results, the fundamental reason for the ambiguity and confusion of students' concept understanding in the learning process lies in the replacement of the understanding and refinement of concepts with the excessive memory of rote memorization.

2.1 Teaching Strategies of Factual Knowledge

Factual knowledge teaching has accumulated rich experience, these experiences include: first, the factual knowledge teaching only need to periodically remind students to remember the details, for students to help students to remember the knowledge strategy (e.g. retention retelling and fine plural) and technology (e.g., mnemonics), provide students with opportunities to practice these strategies and techniques (Pressley, M., Yokoi, L., Meter, P.V., Etten, S.V., & Freebern, G.,1997) . Secondly,, in the process of teaching but also regularly have to learn the factual knowledge of induction, such as the color of common chemical substances, smell, solubility, oxidation and reduction, valence, ionization and hydrolysis of substances and so on, so as to find the law and commonality between each kind of knowledge, that is, the formation of conceptual knowledge.

ISSN 2522-6398 Vol. 3, Issue 7: 45-49, DOI: 10.25236/FER.2020.030713

2.2 Teaching Strategies for Conceptual Knowledge

2.2.1 Practice Positive and Negative Examples to Promote the Understanding of the Meaning of Chemical Concepts

The main reason why students can't solve problems smoothly is that they memorize concepts by rote and lack of meaningful understanding. Conceptual knowledge combined with deep understanding can help individuals transfer the knowledge they have learned to new situations and thus solve certain problems.Pennington&Rehder (1995) further pointed out in his research on knowledge transfer that the result of rote learning is that transfer can only occur between highly similar problems, while "understanding" learning can occur between low-degree similar or completely unfamiliar problems. To promote the understanding of the concept, the teacher can provide appropriate about new study chemistry are patients and the practice of the concept of positive cases help concept generalization, counterexample is helpful to distinguish, changing nature and the nature of the concept of contextualized conditions, conversion of form or content, profound understanding the connotation and extension of the concept of, teach students to distinguish between the definition of the concept of sexual characteristics and characteristics of specificity and get the thorough understanding of the nature of the concept of forming chemical concepts of prototype. Through the classification of positive examples to deepen the understanding of the concept, by providing practical practice to apply the concept, can further enrich, deepen the concept, more comprehensive understanding of the concept. The counterexample exercise can enable students to eliminate the irrelevant features of concepts in the continuous process, and improve students' ability to identify, adapt, transform and apply concepts. Without proper analysis and comparison of positive and negative examples, the process of generalization and differentiation cannot be completed, and it is difficult to achieve accurate discrimination and differentiation of homogeneous and heterogeneous stimulus patterns. The essential function of positive and negative example exercises is to show and strengthen the essential characteristics of rules between concepts and linking concepts. Students gradually improve and science the conditional domain of concepts and promote the transformation of conceptual knowledge into procedural knowledge represented by generative (conditional-behavioral) rules or systems. For example, when explaining the composition of "galvanic battery", we can understand the basic concept of galvanic battery through positive and negative example teaching. It is a general rule of thumb that the more we practice, the easier things become, but it is also a general rule of thumb that the number of times we practice should follow the law of power functions.

2.2.2 Exquisite Processing Promotes Schematization of Chemical Conceptual Knowledge

From the results of the relative researches, students in the chemical principle and general knowledge of chemistry theory, model and structure of knowledge learning is difficult, and this part of knowledge is the important factors that affect student understanding and characterization of the question, the main reason is this part of the students' conceptual knowledge is fragmentary isolated, no connection between concepts in the formation of significance, not in a larger network concept formed in the system concept, the teaching of chemistry conceptual knowledge can use fine encoding strategy. Fine coding strategy refers to the new knowledge and existing knowledge through certain significance to establish connection "clue", such as causality, belong to, containing, semantically related relations, through assimilation, to promote chemical structured and conditions of the conceptual knowledge, help to understand the relationship between the concept and provide problem solving in the process of knowledge search and extract "clue". In the process of chemistry teaching, can make use of mind maps, analogy, hierarchy chart, tree diagram, concept map and other methods to organize conceptual knowledge, make the concept through chunking, template to achieve knowledge schema, reduce students cognitive load in the problem solving process, promote the students in the process of problem solving structural characterization, and solution to the problem to correct the search.

3. Procedural Knowledge Teaching Strategies

The procedural knowledge level of middle school students has a direct impact on their problem-solving strategies. In Anderson ACT-R model, there are two memory systems: declarative memory system and procedural memory system. Generative follows the cognitive operation rules of "conditional-action". The generative rules used by different students in working memory during problem solving will generate different "condition" domains and "action" judgment mechanisms due to the types and levels of knowledge stored in long-term memory. In cognitive psychology, there are two typical types of "actions". Anderson calls them pattern recognition and action sequence of procedural knowledge, and Gagne considers them as intellectual skills and action skills of procedural knowledge. These two kinds of "actions" are manifested in the different paths of

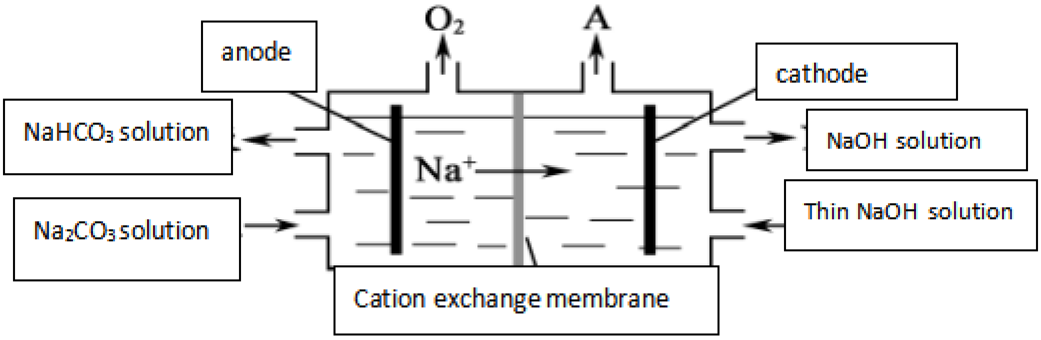
ISSN 2522-6398 Vol. 3, Issue 7: 45-49, DOI: 10.25236/FER.2020.030713

students' cognitive process of problem solving: different cognitive paths for students' problem solving correspond to different teaching strategies.

3.1 Contact Localization Processing, Promote the Generation of Procedural Knowledge Connection

Contact localization processing is the process of connecting all small programs acquired in the learning process as a whole to form the connection between stimulation and reaction of fixed programs. In this process, the combination of the small generation forms the large generation. Through the mastery of the generative “conditional-action” rules, the action direction and steps of a condition will be known.Such as follow problem.

Question:”electrolytic Ⅱ” is electrolytic solution, and we can know its principle in the following picture. The electrode reaction formula of the anode is _________, and the chemical formula of substance A produced by cathode is_________.



The procedure of problem solving:

(1)Recognition of problem information:Na_2CO_3 solution;cation exchange membrane;add Na_2CO_3 solution into the anode of electrolytic cell;the solution obtained from the anode is $NaHCO_3$ solution;the anode has formed O_2;dilute NaOH solution is added into the cathode of electrolytic cell;hydroelectricity generate $H^+$and OH^-(hidden information)

Recognition of key information:add Na_2CO_3 solution into the anode of electrolytic cell;the solution obtained from the anode is $NaHCO_3$ solution;the anode has formed O_2;

(2)Generative rule analysis and generative system building:

Generative rule r1:the more the anode material loses electrons--the more it loses electrons

Generative rule r2:cation exchange membrane--cations can pass through, but anions can not.

Generative rule r3:water and electricity leave the same quantity of mole $H^+$and OH^-

Generative rule r4:the product of the anode material losing electrons interacts with the substance in solution--anode electron equation

(3)Contact positioning, production rules are formed into production systems, and try to answer it.

(4)write the equation with the help of electrode reaction rule(knowledge of skills in procedural knowledge)

anode electron equation :$4CO_3^{2-}+2H_2O-4e^-=4HCO_3^-+O_2\uparrow$

3.2 Practice Feedback to Improve the Level of Automatic Knowledge Generation

Exercise strategy refers to examples of new knowledge in different situations to achieve the purpose of guiding when, what conditions and how to use knowledge, namely, to generate procedural knowledge. The content, frequency and form of practice should take into account the relationship between smart skills and operational skills, dispersion and concentration, and part and whole. Generally, a single generation rule and local skills should be practiced first, followed by a series of generation rules or generation systems, and the practice of overall skills should be carried out. For example, chemistry teachers adopt the practice and feedback strategies in the form of “problem-solution Maps”, “Examples”, “Schemas”, “Prototypes”, and “flow-process diagrams” to improve the automation of students’ procedural knowledge. Knowledge to automatic processing stage. The realization of automation level cannot be generated automatically and needs to be strengthened repeatedly. Practice and feedback are two very important teaching stages, because each practice and feedback give two related production forms the opportunity to be activated simultaneously in working memory, and the accuracy of procedural knowledge is obtained through practice and feedback. It is characterized by unconsciousness, fast execution, slow acquisition, slow forgetting and lack of flexibility. As Heyworth (1999) pointed out, it takes a long time for procedural knowledge to reach the automation stage, and a lot of exercises should be provided to encode and access it in long-term memory, migrate the application through variant exercises, and finally achieve the

ISSN 2522-6398 Vol. 3, Issue 7: 45-49, DOI: 10.25236/FER.2020.030713

automatic generation system of the program.Heyworth suggests teachers to enhance the consciousness of procedural teaching, master the basic application of procedural knowledge teaching, as well as the factual and conceptual knowledge to procedural knowledge transformation strategy, grasp typical examples, analysis and discussion, help students to answer questions relating to deep understanding of factual and conceptual knowledge (facts, definitions, procedures, rules, etc.), for students to learn in the form of conceptual knowledge to describe and explain the problem solving process.

4. Teaching Strategies of Metacognitive Knowledge

In recent years, research has pointed out that the metacognitive knowledge can be taught, but training, teachers can through A variety of ways and methods to improve students' learning motivation, perception of tasks and cognitive strategy control(Veloo, A. Rani, M. A. and Hariharan, K.,2015.Harandi, V. Eslami, S. H. Ahmadi, D. M. Darehkordi, A.,2013.), such as Veloo, A. Rani, M.A. and Hariharan, K. (2015) study on high school students' metacognition after six months of training the students' ability of problem solving performance and social skills. The content of metacognitive training includes: identification, planning, management, evaluation and wrong diagnosis of problem objectives. It is found that the experimental group performs significantly better than the control group in problem solving skills and social skills. These studies also pointed out some useful metacognitive training approaches and strategies, such as learning metacognitive skills through direct training or guidance. At present, there are two main metacognitive training approaches (Lin, 2001): strategy training AND create a supportive social environment.

Strategy training mainly focuses on two kinds of content: knowledge about specific fields and knowledge about oneself as a learner (knowledge about oneself). In addition, training can be provided on error recognition, attention and energy allocation, elaboration, self-questioning, self-explanation, reflection on the content and form of diaries, construction of visual representations, activation of previous knowledge, rereading difficult text chapters and modification strategies .Lin Lin also mentioned that teaching methods for domain-specific strategies include demonstration metacognitive strategies (such as various heuristic strategies and domain-specific cognitive strategies), prompt actions and reflection on oneself as a learner. In addition, the most common metacognitive method to support the learning problem-solving process is to insert question prompts in the learning process, which is one of the most common and effective forms of metacognitive strategy counseling. Have you ever solved a similar problem? What kind of problem is this? Have you identified the main problem? What strategies can you use to solve these problems? What steps have you taken to solve these problems? Are you sure your question is correct? Is there a more convenient way to solve the problem? What is the best way to solve the problem and so on.

References

[1] Pressley, M., Yokoi, L., Meter, P.V., Etten, S.V., Freebern, G (1997). Some of the reasons why preparing for exams is so hard: what can be done to make it easier?. Educational Psychology Review, vol.9, no.1, pp.1-38.

[2] Staver, J. R., Lumpe, A.T (2010). Two investigations of students' understanding of the mole concept and its use in problem solving. Journal of Research in Science Teaching, vol.32, no.2, pp.177-193.

[3] Pennington, N., Rehder, B (1995). Looking for transfer and interference. Psychology of Learning & Motivation, vol.33, no.8, pp.223-289.

[4] Selvaratnam, M., Canagaratna, S. G. (2008). Using problem-solution maps to improve students' problem-solving skills. Journal of Chemical Education, vol.85, no.3, pp.381-385.

[5] Atkinson, R. K., Derry, S. J., Renkl, A., Wortham, D (2000). Learning from examples: instructional principles from the worked examples research. Review of Educational Research, vol.70, no.2, pp.181-214.

[6] Taconis, R, Ferguson Hessler, M. G. M, Broekkamp, H (2001). Teaching science problem solving: an overview of experimental work. Journal of Research in Science Teaching, vol.38, no.4, pp.442-468.

[7] Heyworth, & Rex, M (1999). Procedural and conceptual knowledge of expert and novice students for the solving of a basic problem in chemistry. International Journal of Science Education, vol.21, no.2, pp.195-211.

[8] Veloo, A. Rani, M. A. and Hariharan, K (2015). The role of gender in the use of Metacognitive Awareness Reading Strategies among Biology students. Asian Social Science, vol. 11, no.1, pp. 67-73

[9] Harandi, V. Eslami, S. H. Ahmadi, D. M. Darehkordi, A (2013). The effect of metacognitive strategy training on social skills and problem - solving performance. Psychology & Psychotherapy, vol.3, nol.4, pp.1-4.

[10] Lin, X. (2001). Designing metacognitive activities. Educational Technology Research and

ISSN 2522-6398 Vol. 3, Issue 7: 45-49, DOI: 10.25236/FER.2020.030713

Development, vol.49, no.2, pp.23-40.