Application of Cognitive Psychology Theory on Mathematical Concept Teaching

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Abstract. With the wide application of mathematics and the development of modern information technology and computer technology, people gradually realized the psychology was closed with the mathematical study of the cognitive factors, non-cognitive factors and mathematics learning. From the perspective of cognitive psychology to research mathematics teaching, this paper discussed the formation of students' knowledge, the obtain of mathematics concept, the solution of students' cognitive problems and the design of concept teaching activities, in order to optimize mathematics concept teaching.

Keywords: Cognitive Psychology Theory, Mathematical Concept Definition.

1. Mathematical Concept Definition

Lexicon explained the mathematical concept definition as reflect of characteristics of the general and nature of things in people's mind. In psychology, the concept was generally defined as symbols represented similar things with common features of material. According to this definition, the words or other symbols used in daily life and work. As long as it correctly represented a category, content or attribute, the symbol could represented a concept. And mathematical concept referred to the reflection form for essential characteristics of quantity relation and space relation of realistic things in human mind, namely the form of mathematical thinking.

2. Mathematical Concepts of Psychology Analysis Process

Obtain of the concept was from different conclusion of different psychological school. Cognitive behavioral psychology research was from the internal factors of the individual factors, that concept formation and concept assimilation was a concept of two kinds of basic forms.

2.1 The Formation of Concept

Concept formation referred to the perception, analysis, comparison and abstract from a lot of actual cases. Then this study extracted the common nature of properties, and form a concept. D Þ ·AtlStbel described the formation of the concept of psychological process was as follows: 1. To identify various stimulus mode analysis; 2. To put forwarder presumption of abstract common ingredients; 3. To detect the presumption in the following particular situation; 4. To select attribute from assumptions, in order to include all property scope; 5. To set attribute related to cognitive structure of the notion of a fixed role; 6. To separate the new concept from the old concept; 7. To extend the new concept into the field with same category; 8. To apply specific mathematical language symbol to mark the new content.

2.2 Concept Assimilation

D Þ ·AtlStbel analyzed the formation of concept from another perspective, and considered that students learned the concept under teaching-learning condition, which was totally different from that under the condition of natural environment or the concept scientists invented or created. Concept assimilation was the most basic method to obtain the concept. Concept assimilation referred to new concept incorporating into the original concept of student cognitive structure, so that students could obtain the concept. The obtained concept could play a role in the cognitive activities. The psychological process of concept assimilation included the following aspects: 1. Identify. To identify

the new concept which was the existed concept, including the recall and reproduce of knowledge. As in the study of the concept of quadratic equations, students shall recall and be familiar with equation, linear equation and fractional equation; 2. Assimilation. To establish the connection between the old and new concept, and add the new concept into the original cognitive structure, and then reconstruct the original cognitive structure to become a new cognitive structure. For example: when students learn the quadratic equations, he shall discuss the nature of the quadratic equations, and expand the original cognitive structure; 3. Strengthening. To give some of the new concept of positive and negative examples in able to further identify and understand the significance.

3. Application of Cognitive Psychology Learning Theory in Teaching

Below were the basic factors of combined with cognitive psychology analytical concept.

3.1 Background introduction.

Mathematical concept was abstract and boring sometimes. It shall make full use of psychology in the introduction of the concept of the principle of empathy principle, namely, under the action of students emotional implication got evoked, and easy to own feelings into the perceived education teaching content. Good concept was introduced, which could help students did not have the pressure of the outside environment, with a positive emotional experience actively, freely imagination, thinking and exploration. There were different methods for concept introduction, such as beginning with a interesting story, activity, a question, acquaintance, connecting to actual factors, and so on. For example: on teaching the merger of similar items, the teacher first took out a bag of coins, and ask the students to assist teacher to help the teacher to count how much money it was. The enthusiasm of students was aroused, be vied with one and another went to the platform to assist teacher a few coins. Teacher asked other students to help the timing at the same time. Student A took out the coin one by one and counted it. Student B took out the coin, and calculated as group, 10 coins as one group; Student C classified the coin per value,1 RMB as a group, 0.5 RMB as a group, 0.1 RMB as a group, and quickly calculated the total accounts. According to the method of these three students, teacher asked which method will be the best option to calculate the coins. The answer was the method of Student C, as the classification. Teachers took the opportunity to introduce the concept, in mathematics, there was a similar classification for integral expression, like similar terms.

3.2 Through specific examples, typical examples, teacher guided students to carry our the analysis, comparison and comprehensive activities.

Sum up the essential attribute of the nature and get a concept. The famous American cognitive psychologist bruner believed that learning was not a passive form of stimulus and response, but the formation of the active process of cognitive structure. In our learning process, it shall consider the past for existing cognitive structure of the influence of the learning process, to form of knowledge structure in students mind. This structure consisted of the basic concepts of the subject knowledge, basic idea or principle, adopt the discovery learning mode to let the students understand the basic structure of the discipline. This is Mr. Bruner's discovery of learning theory, discovery learning model was divided into four stages: a. with the questioning consciousness to observe specific facts concept; b. put forward the assumption; c. Updated into concept; d. to apply. For example: during the interpretation of arithmetic progression, first give a few numbers: 1, 3, 5, 7, 9, 11……11, 6, 1,-4,-9, -14,-19……, then guide the students to observe, the above sequence in a common. After careful thinking, students summarized each with a difference which was a constant. Based on the answer from students, teacher would answer further guide: the minus of the number and the previous number was a constant. Then it could be concluded that student’s complete concept of arithmetic progression, the minus of one and previous one was a constant.

3.3 Definition

In the Piaget’s theory of cognitive development, to understand and form a mathematical concept correctly, the connotation of the mathematical concept must be clear, which is the characteristics of the “quality” and the extension, the scope of the “quantity”. Generally, the mathematical concept is to

reveal the essential feature by applying the definition. But before that, there was a phase which must be understood by example, practice and verbal description. For example, children understanding of natural numbers, the results of sum, difference, product and quotient is just like this. In the senior school, a mathematical concept starts to be expressed by text that is to say by definition, such as fraction and scale. Some mathematical concepts only can be expressed by definition after a long period of brewing, such as functions and limits. The definition is to express the mathematical concepts accurately.

Many mathematical concepts are expressed in mathematical symbols. For stance, y =f (x) says that the x is argument and the law is the function of f. Mathematical symbol is a unique way to express mathematical definition and it plays a great role in the students' understanding and formation of mathematical concept. It simplifies and explicit the thinking process of mastering the concept. Many mathematical concepts are defined by mathematical symbols, which enhance its scientificity. This process demands accurate mathematical symbols to express, which can proceed by teachers' guidance and students' summary. It also can be completed by autonomous reading and learning in textbook by students.

3.4 Concept discrimination

That is to say, for instance (positive and reverse) as the carrier, guides the student to analyze the meaning of key words, including the investigation of the special concept; Famous mathematician Mr Dianzhou Zhang once said, "a good example is betterthan a dozen quotes". In the process of learning positive and negative concepts, it is hard to avoid occurrence of cognitive bias, and the student is often difficult to detect. So in order to clarify the fuzzy cognition, it not only need positive examples to clarify concepts profoundly, but also need appropriate reverse examples to highlight the kernel and the essence of the concept. And in there peated speculation process of self-denial and self-identity, it can clear the concepts and achieve the purpose of a deep understanding and elaborate the concepts, so as to optimize the minds of students. For example, in the teaching of odd function concept, teachers can provide students the following example to identify:

$(1).f(x)=1.(2).f(x)=|2x+1|-|2x-1|..(3).f(x)=\sqrt{4-x^2}+\sqrt{x^2-4}$

$(4).f(x)=g(x)-g(-x)..(5)\,f(x)=\sin x, x\in[0,2\pi].(6).f(x)=\sqrt{\frac{x+1}{x-1}}\bullet\frac{x-1}{4}$

In the analysis of the above question, positive cases highlight the connotation of the concept and reverse example reveals the extension of concepts, the combination of both deepens students' cognition and understanding of concepts.

3.5 Through various forms to apply concepts, to strengthen the understanding of the concept, in order to improve the ability to solve the problem.

Gestalt psychologist supposed learning was to detect the key elements of the specific situation to know how these elements link, identified the underlying structure. Learning can through to the intrinsic nature of the problem situation conscious way to solve the problem, the insight for understanding, not only helped the migration, but also not easy to forget. Insight would become our permanent part of the knowledge and skills. With the modern cognitive information processing psychology terms, epiphany was the long-term memory and the content that will forever keep in learner's mind.

The use of mathematical concept was the key to enlightenment problem situation. For example, in the teaching of the concept of plural, apart from identify the plural figure, teachers could also make students solve the following problems:

The real component and abstract component of $(1+\sqrt{3})i$ was respective:

A 1, $\sqrt{3}$ B. 1+ $\sqrt{3}$ C. -$\sqrt{2}$ +$\sqrt{2}$ i D. $\sqrt{2}$ +$\sqrt{2}$ i

Please check whether the below was correct:

If z $\in$C, z2 $\geq$0.

If a $\in$R, (a +1) i is pure abstract figure.

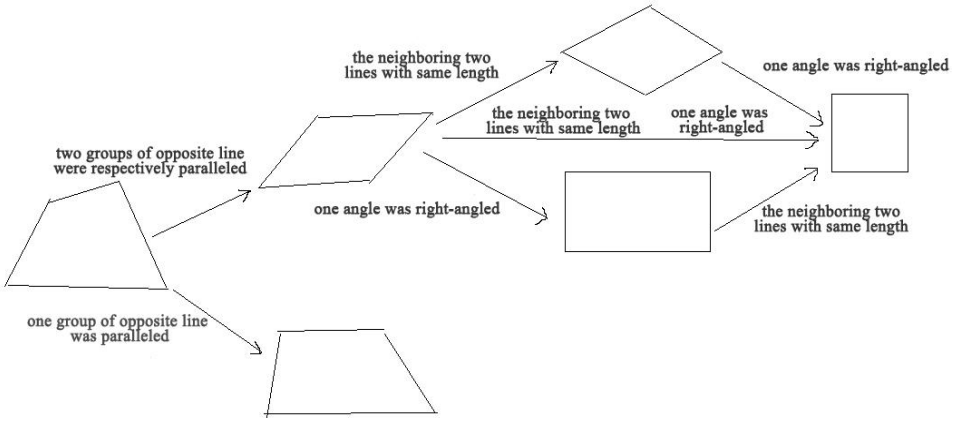
If a> b, a+i > b + i

Complex number $z = \frac{m^2 + m - 6}{m} + (m^2 - 2m)i$, if m was below:

A. Real number B. imaginary number C. Pure imaginary number.

To deal with these problems, students shall define the concept repeatedly of the real number, imaginary number and pure imaginary number, in order to strengthen the concept of complex number in the application

Concept of "delicate" was mainly to establish links with the related concepts, the formation of good math cognitive structure, making concept map. AtlStbel education psychology was the most important part was the description of the significance to study. He argued, the learning of knowledge for students shall be as meaningful as possible. When students related the teaching contents and their cognitive structure. Cognitive structure was an organized system of class, students must know high-level scientific concept in advance. Then learned less scientific concept, definition, law, property, etc., finally learn bits and pieces of special things or scientific facts. Meaningful learning was not the result of the expansion of knowledge, but the new concept of knowledge and the existing old mutual assimilation and, then changed the learner's cognitive structure, the formation of hierarchy, system of organization. This is the concept map. AtlStbel supposed the new study of the relationship between the thesis and student's thesis had the following three types: lower relationship, upper relationship, combination relationship. Combining these relationships, it could be related to content of concept map, deepen the understanding of concepts and analysis of relevant knowledge. Below the concept map could clearly reflected the concept of the quadrangle, differences and relations.



4. Conclusion

In mathematics, as the general form of thinking, the judgment and reasoning were expressed in the forms of theorems, laws and formulas. The mathematical concept was basis of the constitute. Proper understanding and skillfully use of mathematical concept was the basic to master knowledge of mathematics and computing skills, and to develop logical argumentation and the premise of spatial ability.

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