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Inductive Thinking: Learning Mathematics Constructtivistic for Elementary School Students

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Abstract

The learning paradigm used as a math learning for many years is a teaching paradigm that influenced by behavioral psychology, not the learning paradigm. It needs a paradigm shift from the teaching paradigm to the learning paradigm. In learning paradigm is not enough students just learn with teacher instruction in transferring knowledge to students, but students need to construct the mathematical knowledge they learn. In studying mathematics students are always involved with mathematical reasoning. One of the characteristics of mathematics is deductive thinking. In this mathematics learning deductive mindset is one of the objectives of a formal nature, the goal that emphasizes the arrangement of students' reasoning and personal formation. Although the deductive mindset is very important, but in learning mathematics, especially in elementary school is still indispensable use of inductive mindset.

Keywords: constructivism, Mathematic learning in elementary school, inductive thinking.

INTRODUCTION

Mathematics is one of the subjects taught in all levels of education, including in elementary school. The purpose of studying mathematics is to give learners analytical, logical, critical, creative thinking skills. However, the fact that mathematics is assumed to be a frightening subject, so that the impact of mathematics learning seems to be boring and result in low mathematics learning achievement. Another problem as revealed by Marpaung (2003) that the paradigm of learning used as a mathematics learning for many years is a teaching paradigm and is much influenced by behavioral psychology, not the learning paradigm. In the learning activities of mathematics teachers dominate the class and students are less involved in constructing concepts, ideas, or principles in their own way. Teachers do not demand from students reasoning ability, see the interrelationship between concepts or materials, communicate, and solve problems. Students are not trained to interact and negotiate well, not given the opportunity to reflect, nor be given the opportunity to develop their own strategies.

According to Hudojo (2005) who needs to get attention for the mathematic teacher today is a paradigm shifting from teaching to learning. In learning paradigm is not enough students learn with teacher instruction in transferring knowledge to students, but students need to construct the mathematical knowledge they learn. The learning paradigm is characterized by the presence of student activities so that students learn how to learn it and even feel how to learn it. This can be done if in teaching can "invite" students involved construct mathematical concepts or procedures.

In studying mathematics students are always involved with mathematical reasoning. Copeland (1974) classifies mathematical reasoning in inductive and deductive reasoning. Inductive reasoning is used when the truth of some special cases is then summarized or generalized to be true for all cases. Deductive reasoning is used on the basis of the general to the more specific.

Regarding to reasoning in mathematics learning, Soedjadi (2000) states that one of the characteristics of mathematics is a deductive mindset. In this mathematics learning deductive mindset is one of the objectives of a formal nature, the goal that emphasizes the arrangement of students' thinking and personal formation. Although the deductive mindset is very important, but in learning mathematics, especially in elementary school is still indispensable use of inductive mindset. Therefore, learning mathematics needs to include learning activities that involve students using inductive thinking. Based on the experience of mathematicians this can be done. That learning mathematics with inductive or deductive approach can be implemented at all levels of education, allegedly from NCTM (2000) as follows.

At all levels, students will reason inductively from patterns and specific cases. Increasingly over the grades, they should also learn to make effective deductive arguments based on the mathematical truths they are establishing in class (NCTM, 2000:59).

At all levels of education students are reasonably inductive based on patterns and special cases. Increased with the level of education, students also need to learn to make effective deductive arguments based on mathematical truths set in the classroom. Mathematics has a characteristic that is deductive which is it does not accept generalizations based on observations, but in the elementary stage of inductive reasoning where in the process students construct their own knowledge is necessary because it adjusts the level of thinking.

DISCUSSION

Learning Mathematic Construtivistic

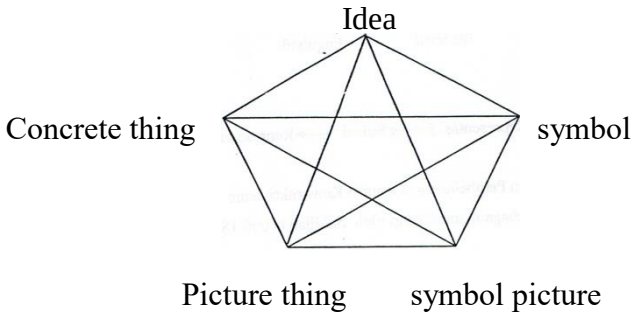
Constructivism which refers to Piaget's cognitive theory and constructivism epistemology said by von Glasersfeld includes the type of individual constructivism. Although the mathematical lesson of constructivism referring to Piaget's cognitive psychology that categorized in individual constructivism, but according to Slavin (2000: 256) and Copeland (1974: 32), Piaget does not neglect the importance of social interaction in constructing mathematics. Therefore, mathematics learning is constructivism in this research emphasizes individual students' activities in constructing mathematical knowledge, but also provides opportunities for students to interact socially. Social interactions that occur in the classroom are seen as activities that support student learning in constructing mathematics. This social interaction can take the form of exchanging opinions or discussions among students, or other learning activities that make the oral and written communication between students or between teachers and students.

In the social interaction is likely occur students who have difficulty in learning helped by friends or teachers. Through discussions with friends, allowing students who are less clever to learn from the more intelligent. Forman and McPhail as quoted Slavin (2000: 46) declared tutor by a friend who is more intelligent most

effective in improving the development of ZPD (Zone of Proximal Development). With regard to aid in learning, Slavin (2000) states that Vygotsky's approach emphasizes scaffolding. Wood, Bruner, and Ross (Slavin: 2000: 47) states: Scaffolding is a tactic for helping the child in his or her zone of proximal development in which the adult provide hint and prompt at different levels.

Scaffolding is a way to help a student in his or her ZPD by adult people by giving advice and instructions at different levels. In social interaction in the classroom, when there is mutual exchange between students in solving a problem and when teachers or students who more clever to provide assistance to students who have difficulty in the form of instructions how to solve the problem, then the scaffolding happen, students who have difficulty assisted by teachers or friends who are smarter.

According to Hudojo (2005) learning based constructivism is to help students to build the concepts or principles of mathematics with its own ability through the process of internalization, so that the concept or principle built. In order to embed mathematical ideas into student schematics, an integrated set of learning between ideas (presented in oral or written language as words or sentences), concrete objects, drawings of objects and symbols of images (semi-semi-abstract concrete), and symbol.



Picture 2.1. Web in Understanding mathematic Concept

(Source: Hudojo, 2005: 21)

Related to mathematics learning, Hudojo (2003) argues that learning mathematics is building understanding, the process of building that understanding is more important than learning outcomes, because understanding will be meaningful to the material being studied. Mathematics learning should emphasize the understanding of mathematical concepts and structures and their learning through problem solving.

According to Tadao as quoted by Sa'dijah (2006) there are five principles of learning mathematics according to the view of constructivism, as follows:

a. Mathematical knowledge obtained by children constructivistically.
b. Basically knowledge is constructed and obtained by the child through a process of awareness, operational, mediative, reflective, and agreement formulation.
c. In the process of constructing mathematical knowledge, operational activities, and reflective reasoning play a big role.
d. The child constructs, criticizes, and reconstructs mathematical knowledge through constructive abstraction with his friend or teacher.
e. When the child constructs

mathematical knowledge, five kinds of representations are: realistic, manipulative illustrative linguistic, and symbolic play an important role.

Inductive Reasoning

Copeland (1974) classifies reasoning into inductive and deductive reasoning. Soedjadi (2000) states: "deductive and inductive thinking are very important in learning." Related to mathematics learning, Soedjadi (2000: 45) argues as follows:

One of the mathematics characteristics is deductive thinking. In learning mathematic, the deductive mindset is important and objectives of a formal nature, which puts emphasis on the arrangement of reason. Although deductive mindset is very important, but in learning mathematics, especially in elementary and junior high school, it is still indispensable use of inductive mindset.

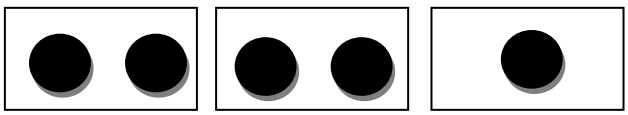
During this time, in preparing the steps of learning mathematics, the mathematic teachers mostly use a deductive approach. The characteristics in teaching learning process, teachers dominate the class, transfer knowledge, and start the learning in general things toward more specific things. Prince and Felder (2006) state traditional learning is a deductive learning approach, starting with theories and increasing to the application of theory. In the field of science and technology encountered attempts at learning and new topics that present a framework of knowledge, presenting theories and formulas with little regard for students' primary knowledge, and less or less to relate to their experiences.

In inductive reasoning, for example a student observes objects, attempts to classify or relate in various ways, for example: heavier, wider, and of the same color. In geometry, students classify objects with relations, such as "flat waves having three sides," "flat waves having four sides," and "flat waves having four equal sides of length."

By classifying objects in the environment, students can obtain a definition. As Copeland (1974: 53) has pointed out: *such classification will later come definition such as "a triangle is ...," "a family is ...,"a mother is ...," and "a river is* .... it means that, from such a classification finally becomes a definition like:" triangle is ..., "" family is ..., "" mother is ..., "and" river is .... ". Thus inductive reasoning encourages students to think from the particular to the general through finding definitions, formulas, patterns, etc.

Learning Construtivistic Mathematic with Inductive Reasoning

As an example, we will learn a mixed count operation that contains the addition and multiplication operations, in this operation will get different results; when the sum or multiplication is done first. The teacher prepares the ball as media.



Students are given a series of questions as follows:

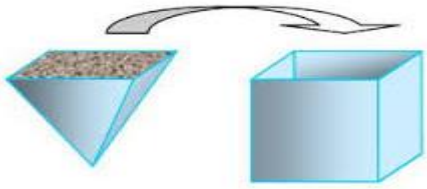
A. How many balls above? (Correct answer: 2 + 2 + 1 = 5)
B. Is the sum can be changed in multiplication? (2 + 2) + 1 = 2 x 2 + 1 = 5
C. Which is done first in 2 x 2 + 1? Students analyze and use their intuition to experiment with!
D. If multiplication is done first, then (2 x 2) + 1 = 5 (true)

E. If the sum is done first, then 2 x (2 + 1) = 6 (less true)

From above demonstration, students can conclude by themselves that in a mixed count operation which contains multiplication and addition, multiplication operations are done first than addition. In geometry scope, learning in subject of volume space begins with giving formula first, then the students are given examples of problems that must be done using the formula, then the teacher gives the exercise a similar problem with example problem. Students do not know the process of formula is obtained.

Constructivism math learning involves students actively in finding formulas. As an example on the rectangular pyramid volume material, students are invited to find the formula first. Tools and materials that must be prepared are: building blocks, and quadrilateral pyramids or nearby objects that resemble it. With the condition the size of base, the height of the quadrilateral are same. The other ingredient is the rice used for the experiment. After the tools and materials are prepared, students are required to do the experiment with the following steps:

1. Enter the rice fully into the quadrangle
2. Put the rice into the building blocks
3. Fill up a full block with rice



From the experiment, students are asked to conclude the results of the experiment. Whereas the block is fully loaded after three times put the rice into, it can be concluded that the volume of pyramid is 1/3 of the block volume, where the block volume: the base is multiplied by height. So the pyramid volume is 1/3 of the base is multiplied by height.

Based on experiment we can find the formulas, students have valuable experience and it will be meaningful learning. Also, with that experience, students will remember in his memory without memorizing. Math teachers should always create meaningful learning so that students realize that mathematics is important and fun, so that students will gradually love mathematics.

CONCLUSION

Based on the description in the discussion above, It can be formulated some conclusions as follows:

1) Mathematics has a deductive characteristic, meaning mathematics does not accept generalizations based on observations, but at the elementary stage still needed inductive reasoning in the acquisition of mathematical concepts, because it has function to adjust into level of thinking.

2) Inductive reasoning is based on the philosophy of constructivism, in which students are enabled to construct their own knowledge based on experience and use reasoning that starts from the specifics of the generalization of mathematics.

3) The learning paradigm used as a math learning for many years is a teaching paradigm and is much influenced by behavioral psychology, not the learning paradigm. It needs a paradigm shift from the teaching paradigm to the learning paradigm. Learning paradigm is not enough students just learn with teacher instruction in transferring knowledge to students, but students need to construct the mathematical

knowledge they learn suitable with the constructivism.

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