Enhancing Students’ Interest through Mathematics Learning

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Abstract. A number of previous researchers indicated that students' mathematics interest still low because most of them have perceived that mathematics is very difficult, boring, not very practical, and have many abstract theorems that were very hard to understand. Another cause is the teaching and learning process used, which is mechanistic without considering students’ needs. Learning is more known as the process of transferring the knowledge to the students. Let students construct their own knowledge with the physical and mental reflection that is done by activity in the new knowledge. This article is literature study. The purpose of this article is to examine the Concrete-Pictorial-Abstract approach in theoretically to improve students’ mathematics interest. The conclusion of this literature study is the Concrete-Pictorial-Abstract approach can be used as an alternative to improve students' mathematics interest.

1. Introduction

Students’ interest is one of the internal factor that influence students’ learning achievement. Interest known as a condition or situation was related to individual wishes or necessities. It’s can also define as the preference in someone’s soul together with happiness. Interest does not appear by spontaneous, but it’s turn up because of participation, experience, and habit when studying or working. Because of interest always related to wishes or necessities, it’s important to make certain condition so that students always need and want to study. In relation to the mathematics learning, interest is something important. Someone with high interest, she/he will have high motivation too. The higher learning interest will make students’ positive attitude toward mathematics.

The fact shows that students' interest toward mathematics still low. In Jerman, there is a downward trend of students’ mathematics interest that increases in later years [1]. Learning interest of elementary and middle school students’ decrease year by year especially in mathematics and others sciences [2]. Very few or almost none of the students in high school fancy taking up a course in mathematics in the University, and less than 9% of these students enjoyed lessons in mathematics [3]. Mathematics learning interest just visible at student with high ability in mathematics [4].

One of the reasons that cause students’ interest toward mathematics learning still low is almost students think that mathematics only contain numbers, formula, and the abstract theorem that were very hard to understand. Another reason is frustration since feeling so difficult to understand the material. Students get frustration in learning when the teacher show the problems in abstract only [5]. Besides that, monotone learning process that only controlled by the teacher, the learning process is only a transfer of knowledge from teacher to student, the student is not actively involved in the learning process as well as the lack of communication between teacher and students, while learning is
an active process of constructing understanding and knowledge, especially through social interaction [6]. Learning is not just accepting the matter alone, learning must be meaningful, knowledge must be received actively, knowledge is constructed by reflection physical actions and mentally performed with activity in the new knowledge obtained by the students, learning is a social process that is obtained through discussions between students and teachers or by peers in the classroom.

One of the ways that can be used to increase students’ learning interest toward mathematics is choosing precise learning approach. Guess, one of the learning approaches that can increase students’ learning mathematics interest is the Concrete-Pictorial-Abstract approach. The aim of this paper is to examine in theoretically the connection between the Concrete-Pictorial-Abstract approach and students’ mathematics interest especially on students in the middle school.

2. Research Method
This study was literature study to examine the Concrete-Pictorial-Abstract approach in theoretically to improve students’ mathematics interest. This study uses five theories of interest [8], [9], [11], [12], [13] and five research article using the Concrete-Pictorial-Abstract approach [5], [14], [15], [16], [17].

3. Results dan Discussions
3.1. Results
3.1.1. Learning interest
Interest is a feeling that accompanies or causes special object, and can also be regarded as a caring, positive feelings, or prefer the pure flavor comes from the heart about something. It’s a form of engagement, fun, and entered wholeheartedly an activity, the object or topic [7]. Interest is closely associated with learning as it allows improving and complementing the introduction of an object, to guide meaningful learning, to improve their long-term memory as well as a source of knowledge and orientation of motivation for further learning [8], greatly affects motivation and cognitive activity of students [9]. Interest in studying is the impulses of the student psychologically in learning something mindfully, serenity and discipline, causing students actively and happy to do so [10]. Students tend to engage themselves in deeper learning on a particular subject when they have an interest [11].

Interest divide into two categories, namely situational interest and personal interest [12]. Situational interest is an interest that is produced mainly by a number of conditions or concrete objects in the environment. Personal interest is an interest that is formed of interest in the long-term on a topic or activity. Students with personal interest characterized by their massive effort in looking for new information and have more positive attitude towards learning [13]. The benefits of having a personal interest are students will be more focused on activities or learning activities, able to learn and work on a job in the long term, using appropriate learning strategies and enjoys what she or he does to achieve. The rate or level of a person’s interest to give a great influence on learning especially attentive, objectives and levels of learning [12].

Some aspects of students interest that are, a sense of excitement, interest in learning, show concern when studying and engagement in learning: a) Students with a high mathematics learning interest will give more attention to the learning process, mathematics materials, assignments and math exams; b) Students with a high mathematics learning interest will show their interest in learning mathematics process, materials, mathematical tasks and mathematics exams; c) Students with a high mathematics learning interest, tend to have a high curiosity of the content and process of learning mathematics; and d) Students with a high interest in mathematics learning will participate actively in the process of learning mathematics, materials mathematics, mathematical tasks, and math exams [10].

3.1.2. The concrete-pictorial-abstract approach
The Concrete-Pictorial-Abstract (CPA) or the Concrete-Semiconcrete-Abstract is an approach based on heuristic Bruner’s conception of the enactive, iconic, and symbolic modes of representation is a well-known instructional advocated by the Singapore Ministry of Education since early 1980’s [14]. The Concrete-Pictorial-Abstract approach support the understanding mathematical concept before
learning rules, that is moving from the concrete or manipulative model of block or chips for multiplication toward the abstract representation such as $4 \times 3 = 12$ [15]. Learning by the Concrete-Pictorial-Abstract approach give beneficial to students with difficulties in mathematics learning because this approach is started by using the concrete materials, followed by learning through pictorial or representations and ending with using the abstract notation [5].

In the Concrete-Pictorial-Abstract approach, students learning begin from using a concrete object, pictorial representations, and then abstract numerals. The Concrete-Pictorial-Abstract approach is a three-stage learning process where students learn through physical manipulation of the concrete object, followed by learning through pictorial representations of the concrete materials or concrete manipulations and ending with solving the problem using abstract notation [16]. The third stage is a unified whole that in practice interrelated and mutually support one another. Concrete components include manipulation (such as red and yellow pieces, cubes, and beams), the use of tools, or other objects that can be touched during the learning process. Pictorial component involves drawings, paintings, diagrams, or graphics created or provided for students to read and interpret. While the abstract refers to symbols, numbers or letters used to solve mathematical tasks. The steps of learning at each stage of the approach outlined as follows:

a) Concrete Phase
   - Students are provided or create their own manipulative objects associated with the concept to be studied
   - Teachers give verbal explanations and questions with demonstrations
   - Students began tinkering with manipulative object

b) Pictorial Phase
   - Students make representations involving geometric drawings, graphs, charts or stake that could represent a previously used manipulative object
   - Students are given a series questions relating to the form of representation of objects manipulative

c) Abstract Phase
   - Students find a rule form a concept learned using symbols or abstract mathematical language
   - Students are given the questions exercises to practice their math skills using abstract symbols in solving problems.

Steps of learning by the Concrete-Pictorial-Abstract approach as follows [17]:

a) Choose manipulative object will be used to introduce conceptual understanding
b) The instructor then guides the students by participating the using of manipulative, providing prompts and cues, and the students independently use manipulative object to demonstrate the skill
c) Replace the manipulative object by pictures and/or drawings
d) Teachers use various strategies that can help students for remembering the steps involved in the mathematical skill or process. This serves as a transition from the use of pictures or drawings to the use of numbers only, that is, the abstract step.

e) Students use numbers only in completing a mathematical duty, and instruction focuses on fluency

Some studies support the effectiveness of this approach. Students in grade IX and VII identified having difficulties in algebra’s learning, obtained the higher result when learning how to solve algebra’s equations transformation use the Concrete-Pictorial-Abstract approach than the students who learn using traditional instruction [16]. In addition, students who learn by using the Concrete-Pictorial-Abstract approach sequence of procedures performed few errors when solving the algebra problems [5]. The purpose of learning mathematics by the Concrete-Pictorial-Abstract approach are students (a) can develop a real understand of the math concepts or skills they learn (b) are able to use this foundation and add their conceptual understanding to abstract problems and learning (c) Having deeper understanding of mathematical concept and idea, and provide an excellent foundational strategy for problem-solving in other areas in the future [18].

The Concrete-Pictorial-Abstract approach is a framework that facilitates students to make meaningful connections between the concrete object, the level of understanding by using the pictorial
and the abstract thinking. This is because students begin learning the visual experience, real and kinesthetic to build a basic understanding, then students can expand their knowledge through pictorial representation and finally can move to the level of abstract thinking, where students exclusively can use mathematics symbols for representation and modelling the problems.

3.2. Discussions

Interest is one of the internal factors which influence on learning and student learning outcomes. Interest is very crucial. Someone with a high interest, it will certainly have a high motivation also toward mathematics. The higher learning interest will also lead to a positive attitude of students towards mathematics. Students’ interest towards mathematics is strongly influenced by the teacher and the approach used in teaching [11].

The chosen an approach should be adjusted to the development of the students’ thinking stages so that learning more meaningful, fun and make students actively involved in reconstructing the understand and knowledge. There are four stages in the hierarchical learning, namely: (1) concrete phase (2) semi-concrete phase (3) semi-abstract phase (4) abstract phase. This is in line with the Piaget’s cognitive development theory which suggests four stages of thinking of each individual in receiving knowledge, namely (1) sensorimotor stage (2) pre-operation (3) concrete operational stage (4) formal operational stage [6]. One of the alternatives learning which refers to the students’ thinking stages and involving students actively in reconstructing the understanding and knowledge is learning by using the Concrete-Pictorial-Abstract approach.

Based on the description above, known that the Concrete-Pictorial-Abstract approach is an approach that can build understanding in deeper learning begins with using the concrete objects. The activity of manipulating the concrete objects in mathematics will provide the opportunity for students to understand that mathematics is very closely to their daily lives and feel the benefit when solving the mathematical problems related to daily life. In this stage, students can learn while playing by using the concrete objects related to material being studied, this will certainly make students happy to learn because it does not have to be monotonous. Furthermore, it will help students to build their mathematical confidence by giving them a way to examine and confirm their reasoning. The second stage is pictorial. The activities at this stage require students solving the problems presented by using or creating the image. This stage is a bridge that would connect students’ early knowledge who still need the concrete objects, going to mathematics learning stage which loading many notations, numbers, and symbols. The last stage in this Concrete-Pictorial-Abstract approach is an abstract stage. This stage focuses on the fluency to solve the mathematical problems by using symbols, notations, or numbers only.

These three stages learning presented a whole unity, which supports each other. This agrees with Riccomini’s opinion [19] who states the three stages in the Concrete-Pictorial-Abstract approach build the previous learning to improve the conceptual knowledge and retention in mathematics learning. Learning by using the Concrete-Pictorial-Abstract approach creates the learning that can make students’ interest.

This approach watches students’ level development of thinking too, especially on secondary class students whose age between 11-14 years range. According to Piaget’s Cognitive theory, this age has entered the formal operational stage, where students begin to think abstractly, logically, and ideally although not yet run optimally because they are in the transition stage between the concrete thinking stages to the abstract thinking stages. Therefore, the Concrete-Pictorial-Abstract approach was instrumental in bridging that thinking stage.

By this approach, students are invited actively discover and understand the knowledge with good. Using the concrete object that can be found in around environment can build up the students’ understand that mathematics learning is much related to our daily and surrounding. Students’ experience during learning will help them to remember the materials and the concepts learned along with understanding the materials interrelatedness. Moreover, learning by the Concrete-Pictorial-Abstract approach which doing step by step can reduce students’ frustration because the learning
started from the simple phase that is the concrete phase. Learning without frustration will certainly appear students’ interest. So, learning by the Concrete-Pictorial-Abstract approach gives more occasions for students to have and to improve their interest toward mathematics.

4. Conclusion
Interest as one of the success factors in learning mathematics can be improved by using the Concrete Pictorial Abstract approach. This approach can reduce students’ frustration, discouragement and anxiety level in learning mathematics because it’s done in gradually. Since concrete experiences are needed, teachers could use manipulative objects to explore students’ concepts such as arithmetical operations. Nevertheless, teachers are not limited to commercial materials, they can also use convenient materials in activities such as paper folding and cutting. When using the manipulative, students will obtain many experiences that help lay the foundation for more advanced mathematical thinking.

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