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Using the Concrete-Representational-Abstract Approach to Enhance Students' Interest in Mathematics Refers to the Primer Mathematical Skills

Azmidar[1*], Putri Nur Malasari[2]

[1]Department of Mathematics Education, Institut Agama Islam Negeri Parepare, Indonesia

[2]Department of Mathematics Education, Institut Agama Islam Negeri Kudus, Indonesia

Abstract: Students' interest in mathematics is very influential to the achievement of learning outcomes, so the teacher is recommended to utilize the precise approach to enhance students' mathematics interest. This study aims to analyze the achievement of mathematics students' interest using the Concrete-Representation-Abstract (CRA) approach refers to primer mathematical skills. The study uses a quasi-experimental and a post-test design. The students in grade VII are the population in this study and use two groups were purposely selected, an experimental group that receives CRA and a control group that gets common learning (CL). The result shows that the mathematics interest' of students who received the CRA approach is higher than students who only received CL. Refers to the indicator of students' mathematics interest, the interaction with a teacher or friend to discuss the material scale gets the high score, and the lower score at the indicator diligently solving the assignment.

Keywords: The Concrete-Representation-Abstract approach, mathematics interest.

Abstrak: *Minat belajar siswa terhadap matematika adalah hal yang sangat krusial dalam peningkatan hasil belajar matematika siswa. Oleh sebab itu, pengajar dituntut menggunakan pendekatan yang tepat untuk meningkatkan minat belajar matematika siswa. Penelitian ini bertujuan untuk menganalisis pencapaian minat belajar matematika siswa menggunakan pendekatan Concrete-Representational-Abstract (CRA) berdasarkan pada kemampuan awal matematika siswa. Penelitian ini adalah penelitian kuasi dengan desain post-test. Siswa kelas VII adalah populasi dalam penelitian ini dan menggunakan du akelas yang dipilih secara random dengan pertimbangan keefektifan proses pembelajaran, yakni kelas perlakuan yang mendapatkan pendekatan CRA dalam proses pembelajaran dan kelas control yang mendapatkan pembelajaran biasa. Hasil penelitian menunjukkan bahwa minat belajar matematika siswa yang belajar menggunakan pendekatan CRA lebih tinggi daripada siswa yang belajar dengan pendekatan biasa. Berdasarkan indikator minat belajar matematika siswa, skor tertinggi diperoleh siswa pada indikator berinteraksi dengan guru atau teman untuk mendiskusikan masalah. Sementara skor terendah diperoleh pada indikator tekun mengerjakan tugas matematika.*

Kata kunci: *Pendekatan Concrete-Representation-Abstract, minat matematika.*

▪ INTRODUCTION

One of the internal aspects that predispose students' learning achievement is students' interest because it is the basic asset for students to learn (Collette & Chiapetta, 1994). Interest notable as a situation was connected to individual expectancy or necessity. It also could be determined as the preference in someone's soul and happiness. Interest does not arise spontaneously, it turns up due to fellowship, impression, and habits when studying or working (Azmidar et al., 2017). Interest is always associated with necessities or wishes; therefore, it is important to ensure the certain condition so that students always need and want to learn.

Azmidar & Putri Nur Malasari
*Email: azmidar@iainpare.ac.id

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The reality shows that students' interest in mathematics remains low. In Jerman, a downward trend in students' mathematics interest may increase in later years (Frenzel et al., 2010). The learning interests of elementary and middle school students decrease year by year, especially in mathematics and other sciences (Schukajlow, 2015). Only a few of the students in high school fancy taking up a course in mathematics at the University and less than 9% of these students enjoyed lessons in mathematics (Nwaocha, 2010). Mathematics learning interest is just seen by students with high ability in mathematics (Ediningrum, 2015). Based on observation of mathematics learning in SMP 7 Alla, the researcher sees that students tend to ignore the teacher when giving subject matter, also they were busy talking to others and try to avoid math class for various reasons. This indicates that students' interest in learning mathematics needs improvement.

One of the reasons that cause students' interest in mathematics learning is still low, almost students think that mathematics only includes numbers, formulas, and abstract theorem that were very hard to understand. Another reason is frustration because feeling so hard to understand the material (Abah et al., 2019). Students get frustrated in learning when the teacher only shows the problems in abstract (Sousa, 2007). Besides that, the monotone learning process that only managed by the teacher, and the student is not actively involved in the learning process as well as a lack of communication between teacher and students, while learning is an active process of constructing understanding and knowledge, especially through social interaction (Santrock, 2012). Learning is not only about receiving the problem, it is also a meaningful process, but knowledge should also be accepted actively, and reflection physical actions would build the knowledge, and mentally completed with activity in the new knowledge acquired through the students, learning is a social procedure that is acquired through discussions among students and teachers or through peers within around them.

Teachers can facilitate and foster the development of interest by inviting students to participate in meaningful tasks by connecting to the world around them, providing activities that require student involvement, and providing challenges adapted to mental development (Elliot et al., 2000). Therefore, students' interest in learning mathematics is expected to appear optimally, both with the emergence of feelings of pleasure, attention, and interest in learning mathematics (Zhang & Wang, 2020).

Efforts to achieve success in learning require meaningful learning that involves an appropriate learning approach to increase student interest in learning. (Arthur et al., 2014) and (Tella, 2007) in their research found that students' interest in mathematics was strongly influenced by the approach used by the teacher. Furthermore, we need a learning approach that can provide a chance for students for exploring their abilities, build up and dedicate their own representations connected to the subjects they have learned, and learn started by providing context related to the material before going up to things that are abstract. Thus, students can have a high interest in learning mathematics.

The approach selected must be customized with the students thought procedure development phase, thus the learning process is more significant, and fun and makes students actively interest in retrieving their knowledge and understanding. Piaget's principle of cognitive development (Santrock, 2012) suggests four phases of thinking for an individual in receiving knowledge: (1) the sensorimotor phase (2) the pre-

operation phase (3) the concrete operational phase (4) the formal operational phase. Another preferred approaches in learning that indicate to the thinking phase of student and reflects the students' entanglement actively in retrieving knowledge and understanding is using the Concrete-Representation-Abstract (CRA) approach in clusters in the learning process.

The Concrete-Representation-Abstract (CRA) approach is an approach refers to the Bruner's heuristic idea of "enactive-iconic-symbol." Representation was introduced in Singapore in 1980 (Yew Hoong et al., 2015). Learning using the CRA approach is very useful for them who've mathematics adversity learning because this approach starts by the use of evident objects, through pictures then use of symbols at the last (Sousa, 2007). The CRA approach includes three learning process stages: the concrete stage (doing), where students learn through the manipulation of concrete objects; the pictorial stage (seeing), students learn to transform concrete objects into the form of a drawing or painting model; and the end stage, namely abstract (symbolic), students learn to solve problems using abstract symbols (Witzel, 2005) (Yuliyanto et al., 2019). Manipulatives are highly vulnerable because it has a concrete nature, so students can reach them. This genuine trait seems to make manipulative 'visible,' related to the one's personal self that is intuitively meaningful and therefore helpful (Clemen, 1999).

Learning mathematics through the CRA approach in clusters enables students to make a significant relationship among concrete, pictorial, and more understanding and thinking in the level abstract. This is because students begin studying using visible, real, and kinesthetic impression to build a primer perspectivity. Afterwards, they should find out their knowledge use pictures, diagrams, or sketches and at the end, switch to the abstract thinking stage, in which students could complete using mathematical signs in representing and modelling the problems associated with the material being studied.

A few research espouse the potency of this approach. Students in grades VII and IXI indicated having adversity in Algebra and receive the higher output when learning the way in solving algebra's equations transformation using the Concrete-Representation-Abstract approach than the students who learn by conventional instruction (Witzel, 2005). Besides that, research by Azmidar found that the Concrete-Pictorial-Abstract approach can enhance students' representational mathematical ability (Azmidar et al., 2021). Similarly, students who learn using the Concrete-Representation-Abstract approach sequence of manner carried out less mistake when solving algebra problems (Sousa, 2007). The benefit of learning mathematics by the Concrete-Representation-Abstract approach is students (a) may expand an obvious understanding to the math concepts or ability they learn (b) may use this basic and append their deep understanding of the concept to abstract problems and learn (c) Having a deep understanding about the mathematical concept and thought (Flores, 2010), and offer an brilliant strategy to solve the problem in different areas within the destiny (Lee et al., 2014).

The theory of constructivism learning assert that learning is an actively action to build knowledge and perceptivity by social relation. This social relation is within the format of intercourse among students and teachers, peers, or other in around them. Abdurrahim (2015) mention that the experts suggested one of the learning methods that help students in the learning process is the cooperative learning method. Using cluster learning may be ideal if the participants are variety in competences and characteristics,

resulting in proper teamwork among students in high, middle, and low-level capabilities (Suherman et al., 2003).

This study would integrate the CRA approach and the cooperative learning, so it will be called the Concrete-Representational-Abstract in a clusters approach. The cooperative learning allow to effectively contribute to the role of activating the educational manner more than other conventional instructional methods (Gubbad, 2010). Learning by the CRA in cluster approach which is held step by step may enhance students' interest because learning begins from the easy level, that is the concrete level (Salingay & Tan, 2018). At this phase, the context problems would be provided by the teacher in the manipulative form associated with the material currently studied (Williams, 2018). The CRA cluster (CRA-C) approach offers substantial benefits for students in having and improving their mathematics interests.

▪ METHOD

Research design

The study was quasi-experimental with a post-test only. This study uses a non-equivalent control-cluster design, where the experimental group and the control group were not randomly selected. This design has an experimental group that learns using the CRA in clusters approach, and a control group that learns by Common Learning. The study classes will be given a post-test at the end of the meeting.

Population and sample

This investigation was established in SMPN 7 Alla, Enrekang Regency. The population in this investigation was students in the 7th grade which separate into four group of classes. A purpose sampling method is used to pick the sample study. There were two groups were selected, an experimental group that accepts learning by the CRA-C approach and the control group that accept common learning (CL). Both classes were given a post-test at the end of the meeting.

Instrument

Scale as a non-test instrument was used in this research. The scale used is the mathematics interest scale which developed by the researcher based on the mathematics interest theory which consist six indicators which are: happy in learning mathematics, happy to learn about the square, diligently solving the assignments, trying to learn squares, actively participating in the learning process for square material, interacting with teachers or friends to discuss the material. The mathematics interest scale consists of 22 item statements which are shared into positive and negative statements.

Table 1. Indicators and spread out of the mathematics interest scales statements

Indicators	Statements Number		Total
	Positive	Negative	
Happy in learning mathematics	1,3,5	2, 4, 6	6
Happy to learn about the square	7, 8, 9	10	4
Diligently solving the assignments	11	12	2
Trying to learn squares	13, 14	15, 16	4
Actively participating in the learning	17, 18, 19,20	-	4

process for square material			
Interacting with teacher or friend to discuss the material	-	21, 22	2
Total of statements	13	9	22

Scoring the interest scale instrument using a Likert Scale with four scale value for each the positive and the negative statement. For the positive statements, the scales are: four for always, three for often, two for rarely, and one for hardly ever. And for the negative statements, the scales are: one for always, two for often, three for rarely, and four for hardly ever. Before used, the mathematics interest scale instrument was tested for the validity and reliability. Validity analysis uses the Spearman rank correlation test with criteria if the value $t_{count} > t_{critical}$ then the iinterpretation of scale statement is valid, on the contrary is not valid.

Table 2. Validitas of mathematics interest's scale

Number statement	r_{xy}	Criteria	t_{count}	$t_{critical}$	Interpretation
1	0.368	Low	2.168	2.042	Valid
2	0.612	Middle	4.239		Valid
3	0.555	Middle	3.654		Valid
4	0.674	Middle	4.997		Valid
5	0.555	Middle	3.654		Valid
6	0.627	Middle	4.408		Valid
7	0.505	Middle	3.205		Valid
8	0.350	Low	2.040		Valid
9	0.633	Middle	4.479		Valid
10	0.374	Middle	2.209		Valid
11	0.303	Low	1.741		Valid
12	0.258	Low	1.463		Valid
13	0.555	Middle	3.654		Valid
14	0.480	Middle	2.997		Valid
15	0.516	Middle	3.299		Valid
16	0.599	Middle	4.097		Valid
17	0.719	High	5.666		Valid
18	0.472	Middle	2.932		Valid
19	0.390	Middle	2.320		Valid
20	0.480	Middle	2.997		Valid
21	0.500	Middle	3.162		Valid
22	0.627	Middle	4.408		Valid

The reliability instrument using the Croanbach's Alpa by criteria if the value of $t_{count} > t_{critical}$ then the instrument of scale is reliable. Refers to the reliability analysis, obtained 0.859 for Croanbach's Alpa test (high criteria) with t_{count} is 8.05 and $t_{critical}$ is 2.042. From the analysis, obtained the instrument is reliabel and may use in this study.

Data Analysis

Descriptive statistics will be used to provide an overview of the students' mathematics learning interests. Because the students' mathematics learning interest

scale is an ordinal form, the statistical test used is a nonparametric statistical test, Mann-Whitney U.

▪ RESULT AND DISSCUSSION

Students' mathematics learning interest scale was given once in two classes after treatment, in the experimental group which learns by the Concrete-Representation-Abstract approach, and in the control, group using Common Learning. The scale was given to see how the students' interest after the learning treatment of the two research classes. This scale consists of 22 statement items with four answer choices using a Likert Scale.

Table 3. Descriptive achievement of students' mathematics learning interest

No	Indicators	Approach	
		CPA-G (%)	CL (%)
1	Happy in learning mathematics	89.03	85.33
2	Happy to learn about the square	73.25	59.00
3	Diligently solving the assignments	65.50	68.00
4	Trying to learn squares	85.33	70.00
5	Actively participating in the learning process for square material	82.75	81.00
6	Interacting with teacher or friend to discuss the material	94.80	86.00

Overall, we can conclude that the students' interest achievement who learn through the Concrete-Representation-Abstract approach is maximum than students who learn through common learning. Refers to indicators, we can see the highest difference in achievement is in the indicator of trying to learn square. In this indicator, the group that receive lesson by the Concrete-Representation-Abstract approach gets 15.33% higher than the group that learns through common learning. This shows high student interest in learning mathematics, especially because the approach given is able to stimulate students' interest to explore the material being studied. The second higher indicator is happy to learn about the square. In this indicator, the group that learns through the Concrete-Representation-Abstract gets 14.25% higher than the group that learns through common learning. This is because learning by the Concrete-Representation-Abstract approach started from the simple stage, using the concrete object. This stage helps the student to find and understand the concept before moving to the abstract level. At the table 2, we conclude that the highest percentage in both CRA and CL groups is in the indicator of interacting with teachers or friends to discuss the material. This indicates that the achievement of students' interest in learning mathematics is strongly caused by their involvement in learning mathematics, especially when interacting with teachers or friends to discuss the material being studied.

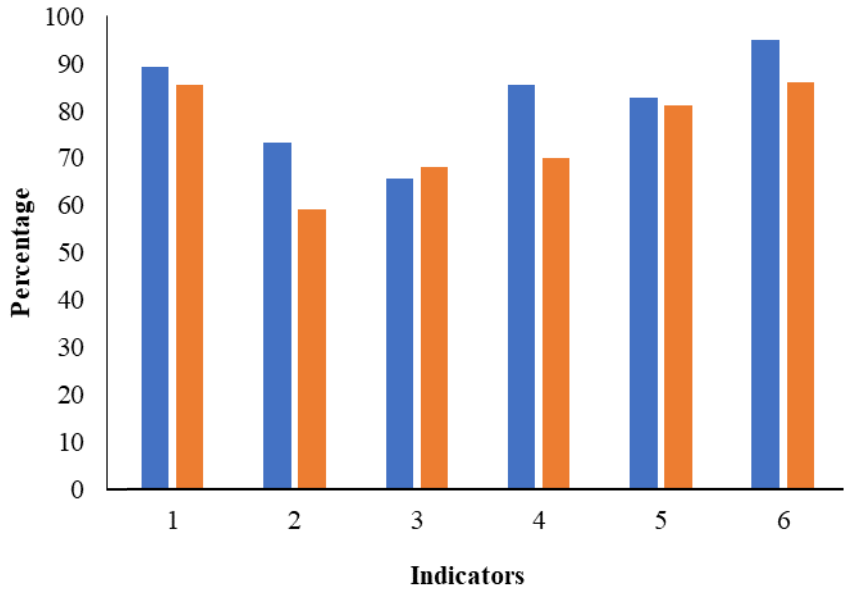

Figure 1. Achievement of students' interest in CPA (blue) and RL (red) class

Specifically, this research provided answers to a hypothesis, that is "The achievement of mathematics students' interest who learning by the Concrete-Representation-Abstract approach in clusters was higher than students who learn by the Common Learning". Based on Mann-Whitney U obtained 145336.500 with asymp < 0.05, which means at the 5% significance level, the student's mathematics interest who learn by the Concrete-Representation-Abstract approach in clusters was maximum than students who learn by the common learning. Thus, the hypothesis of this research is accepted.

Despite this approach being new for students, it works well. We can see from the result of the statistical analysis that achieving the mathematics interest of students who learn by the Concrete-Representation-Abstract approach in clusters is maximum than students who get Common Learning. It is establishing the Concrete-Representation-Abstract approach can inspire the students' interest, especially in learning mathematics. According to Abarantes (2007) discover that the learning approach more influences the learning process. The proper learning approach may enhance students' interest. Students lean to select the approach that is supply learning experience and interactive, encourages understanding, emphasizes application, integrates theoretical and practical knowledge, and produces more transferable knowledge. When teachers use the approach that is in line with students' thinking stage, students develop a more favourable attitude toward their teachers' pedagogical attributes. A positive interest in the learning approach leads to maximum achievement and learning performance (Young et al., 2003).

These three phases of learning present a whole unity, which helps each other. In line with Riccomini et al (2008) who reveals that the phases in the Concrete-Representation-Abstract approach construct the previously learning to enhance the primarily knowledge and memory in mathematics learning. Studying by the Concrete-

Representation-Abstract approach establish the learning that will carry out the students' interest.

Learning with the Concrete-Representation-Abstract approach in clusters is accomplished by giving the manipulative object connected to the topics studied to advice and help students bring out activities independently from the beginning until making a conclusion. At the beginning stage of this approach, students are requested to find their concept about the material being studied so that learning is meaningfully. Students divide into clusters before implementing the Concrete-Representation-Abstract approach in the experimental class and common learning at the control class. Every cluster includes four or five students with various capabilities and gender. It meant that students may assist each other and work team to solve the worksheet are given. Abdullah (2010) and Sottie et, al (2013) state that students who divided in a teamwork increase the accomplishment and productiveness of students' accomplishment, emphasize the positive relationships between the team member, and improve their self-esteem and mental health.

▪ CONCLUSION

The mathematics interest of students who learn using the Concrete-Representation-Abstract approach in the cluster is maximum than students who learn using the common learning. Based on an indicator, students' interest is a maximum indicator of interacting with teachers or friends to discuss the material. Based on this research result, we can conclude that the Concrete-Representational-Abstract approach can use to enhance the mathematics students' interest especially for students who still need the concrete object in learning process to represent their understand about the subject. However, in applying this approach, the teacher should regard to the time management because students are sometimes too engrossed in the concrete stage when fiddling with the manipulative objects.

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