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Article

Concrete Representational Abstract Approach to Improve Students' Problem Solving Skills on Heat Material

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ABSTRACT

This study aimed to determine the implementation of physics learning with the Concrete Representational Abstract (CRA) approach on the heated material and the improvement of students' problem-solving skills using the CRA approach on the heated material after learning. The population of this research is all class VII in one Madrasah Tsanawiyah in the Majalengka District. the research sample is class VII-B with 20 students. The sample used a simple random sampling determination technique. The research method used is a pre-experimental design with one group pretest-posttest design. The data on the results of the implementation of learning with the CRA approach were obtained using an observation sheet, while the data for improving the problem-solving skill was obtained through an essay test of five questions. The study results for three meetings showed that the activities of teachers and students using the CRA approach had increased, with an average teacher activity of 81.37% in the excellent category and student activities of 77.15% in the excellent category. There is an increase in the student's problem-solving skills on heat material with an average N-Gain value of 0.71, which is in the high category. The normality test results showed that the pretest and posttest data were normally distributed, so the t-test was used to test the hypothesis. The results obtained are tcount (25.58) > ttable (1.73), which means Ho is rejected, and Ha is accepted. Thus, the student's problem-solving skill increases using the CRA approach to the heated material. The CRA model can improve the problem-solving skills student and be implemented in other materials.

INTRODUCTION

Natural sciences are related to how to find out about natural phenomena systematically. Hence, science is the mastery of a collection of knowledge in the form of facts, concepts, or principles and a process of discovery. The learning process is an activity where a person produces aspects of behavioral changes that exist in him regarding knowledge, attitudes, and skills. Learning is often interpreted as the acquisition of skills and knowledge. The essence of science learning is to teach students to be involved in the investigation process (Kurniawan et al., 2019). Building knowledge and skills must take place continuously by involving as much

as possible physically and mentally students. This ability has important implications for learning, especially science or science lessons. The knowledge already possessed by a person dramatically affects his ability to learn new knowledge and skills (Jufri, 2013).

The results of observations and interviews conducted at one of the Madrasah Tsanawiyah in the Majalengka District showed that lectures dominated learning, students were less active in finding their problems because the learning that took place in the classroom was still teacher-centered, physics lessons were challenging and finally, students did not motivate to follow the learning. After the material was delivered, there were no students asking questions; this showed that students lacked great curiosity; not many students answered rationally when the teacher asked questions, and there were still students who copied the results of their friends' work when the teacher gave questions.

Apart from interviews and observing the learning process in the classroom, the researchers also looked at the results of students' problem-solving tests on the heated material obtained from the students at one Madrasah Tsanawiyah in the Majalengka District from classes who had studied heat material. The result stated that students' problem-solving ability on heat material was still lacking. From a total of 25 respondents given a problem-solving ability test, as many as six questions presented in the form of description questions with three different materials obtained the following data.

Table 1. Value of problem solving skills of students at one madrasah tsanawiyah in the majalengka district

No	Content	Minimum Completeness Criteria	Average value
1	Measurement	70	72.5
2	Temperature	70	62.5
3	Heat	70	60.0

Most of the respondents could not answer the problem-solving questions, and the preliminary study results showed that students answered not all the questions presented by the researchers. It is sufficient to see that when students are given problems in the form of problem-solving, they have not been able to solve them. Therefore, it is necessary to use appropriate models, strategies, and approaches in the learning process. Using appropriate learning models, strategies and approaches can encourage the growth of students' enjoyment of a lesson; it will increase motivation in doing assignments, provide convenience for students in solving physics problems, and ultimately achieve good learning outcomes (Aunurrahman, 2009). Efforts to improve problem-solving skills can be made by giving meaning to the concepts that students learn (Ningrum et al., 2022). Problem-solving ability in science learning is a learning goal that is expected to apply knowledge to the real world in a meaningful way (Syukri et al., 2018).

One learning approach that involves students directly and actively to improve students' problem-solving skills is the Concrete Representational Abstract (CRA) approach. When teachers teach using the CRA approach, they first exemplify the physics concept and provide instructions and support for solving problems (Al-Salahat, 2022). The CRA approach is an approach that directs students to play an active role in every stage of the learning process. This CRA approach teaches students through three stages of learning (Nugroho & Jailani, 2019), starting with the concrete stage, namely the stage where physics material is presented in the form of concrete that is applied through the experimental method. Then the next stage of learning through image representation from manipulation of concrete objects resulting from experiments (representational stage), ends with solving problems using notation (abstract stage), namely the stage of abstract understanding that is taken through understanding in the form of symbols, or calculations in concepts. Physics so that students can explain physics concepts at a symbolic level. These three stages will guide students to be active and focused in solving problems. The stages in the CRA approach focus on conceptual understanding and teacher involvement in learning (Bouck et al., 2018).

The results of research conducted by Arvianto (2011) showed the success of applying the CRA approach to students' mastery of mathematical concepts by applying conventional learning. The research conducted by Fauziah (2014) stated that students' mathematical problem-solving abilities on cube and block material could be improved more optimally by using a modified CRA approach compared to conventional learning. In addition, research by Nursifah (2014) states that the CRA approach can develop students' representational abilities on the reaction rate material.

The CRA approach is an approach through the use of concrete objects or materials; explanations back based on the results of learning at the concrete stage can either be in the form of pictures, graphs, tables, or with a series of sentences that are made by themselves, then abstract in the form of symbols (Witzel, 2005). This approach has three stages in the implementation of learning, namely concrete; at this stage, the teacher provides material through tangible objects. Children are invited to learn through representational images or animations at this stage. An abstract is the last stage, where students learn abstract concepts through notation and symbols. Learning using the CRA approach is very beneficial for students who have difficulties in learning.

Students' physics problem-solving ability is a form of ability that requires thinking by using and connecting previously known physics concepts (Nuryantini et al., 2020). The concepts or principles of physics that have been possessed are applied appropriately to solve problems (Good et al., 2019). Problem-solving skills train students to observe, reason, analyze, and think creatively to solve everyday problems (Prahani et al., 2022). The improvement of students' problem-solving ability was obtained from the students' scores which were measured through the pretest and posttest of the instrument in the form of a description of five questions that described indicators of problem-solving skills.

METHODS

This study used the pre-experimental with one group pre-test and post-test design. The research procedures are shown in Figure 1. The types of data taken from this research are qualitative and quantitative data. The data obtained in this study include:

a. Qualitative data, in the form of a description or narrative about the implementation of the CRA approach obtained from observer comments. Observations were carried out by observers to observe the activities of teachers and students for three meetings.
b. Quantitative data, in the form of student problem solving ability test data and percentage data on the implementation of the CRA approach on heat material. The data obtained from the normal gain of the results of the pretest, posttest, and the implementation of teacher and student activities which were measured during the learning process were filled in by the observer by marking (x) and check list (√) in the appropriate column with the observed activity.

The population of this study was all class VII at one of the Madrasah Tsanawiyah in the Majalengka District, which totaled three classes, while the sample was class VII-B. Sampling was done by simple random sampling technique, namely, randomly taking samples from the population without regard to the existing strata in the population (Sugiyono, 2013). The method used in this study is the pre-experimental method. The research was carried out on one group of students (experimental group) without a comparison group (control group). The design used in this study is a one-group pretest-posttest design. According to the statement describes, the hipothesis of these reseacrh are follow:

H_0 : There is no significant improvement of student problem solving ability where use the CRA approach.

H_a : There is significant improvement of student problem solving ability where use the CRA approach.

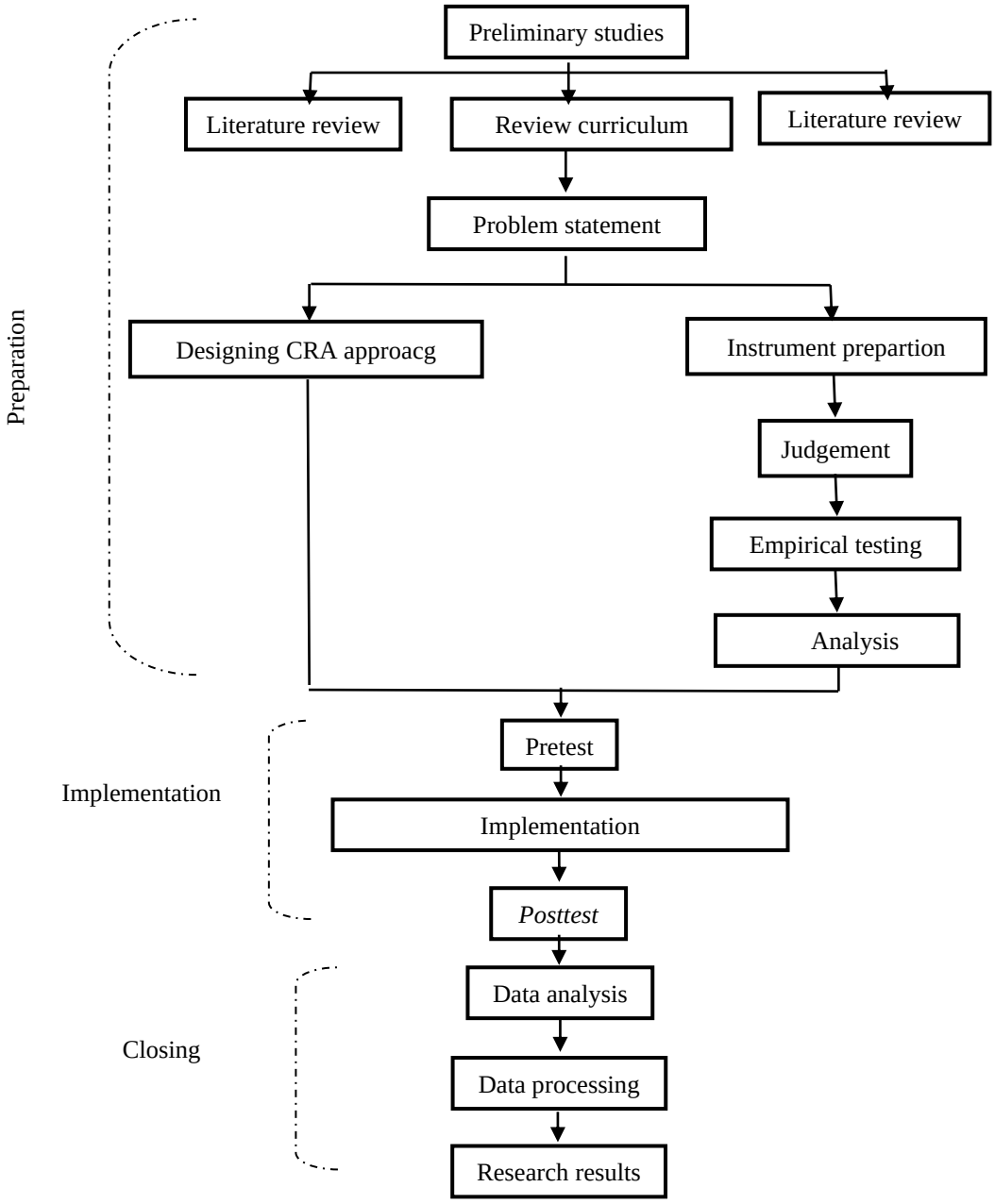

Figure 1. Reseacrh Procedures

RESULTS AND DISCUSSION

Implementation of the CRA Approach

Based on the results of the implementation analysis using the CRA approach, each meeting experienced an increase. Based on the observation data, the implementation of teacher and student activities at each meeting was carried out well. The interpretation of the implementation of teacher and student activities as a whole can be seen in table 2.

Table 2. Interpretation of the Implementation of Teacher and Student Activities

No	Meeting	Activity Implementation Value		Information
		Teacher	Student	
1	1st	68.78	63..92	Enough
2	2nd	80.62	76.26	Well
3	3rd	94.70	91.27	Very good
	Avarage	**81.37**	**77.15**	**Well**

The activity of teachers and students at each meeting has increased. The average activity of teachers and students when implementing the CRA model is in the excellent category. In accordance with the research of Oglu & Avcioglu (2022) which states that the use of the CRA approach can increase student participation in learning voluntarily, this is reflected in the results of the implementation of learning.

Improved Problem-Solving Skills

a. N-Gain Score Analysis

The improvement of students' problem-solving abilities obtained from the average pretest, posttest, and N-Gain scores on heat material is shown in table 3.

Table 3. Average Value of Pretest, Posttest, and N-Gain of sSudents

	Score		*N-Gain*	Interpretation
	Pretest	***Posttest***		
Amount	540,00	1580,00	14,22	
Average	27,00	79,00	0,71	High

The improvement of each problem-solving skills indicator can be seen in table 4.

Table 4. Scores average pretest, posttest, and n-gain of each problem solving skills indicator

No	Indicator	Score average			Interpretation
		Pretest	***Posttest***	***N-Gain***	
1	Understand the problem	3.35	9.45	0.92	High
2	Collect data	3.25	7.70	0.66	High
3	Formulate hypotheses	2.25	8.00	0.74	High
4	Assess the hypothesis	2.22	7.25	0.65	Medium
5	Conclude	1.75	7.00	0.64	Medium
Average		**2.56**	**7.88**	**0.71**	**High**

The overall average increase in students' problem-solving abilities for each indicator is in the high category. The understanding of the problem indicator experienced the highest increase, including the high category. The lowest increase occurred in the concluding indicator, including the moderate category. This shows that using the CRA approach in learning heat material can improve students' problem-solving skills (Citra et al., 2019). The CRA approach allows students to digest concepts more meaningfully and contextually (Flores & Hinton, 2022). Problem-solving ability is important to improve because this ability is directly related to physics subject matter (Hidayatullah et al., 2021). The details of the number of students who experienced an increase in each category of increasing problem-solving abilities are presented in table 5.

Table 5. Percentage of Number of Students in Each Category Improving Problem Solving Skills

No	Category	Number of Students	Presentation (%)
1	Low	0	0
2	Medium	8	40
3	High	12	60

Students experienced an increase in problem-solving abilities in the high category by 60% and 40% of other students in the medium category. No students experienced an increase in problem ability in the low category. Theasy et al's research (2017) reveals that among the factors influencing students' problem-solving abilities are determination, perseverance, and self-confidence in finding problem-solving.

To find out whether the data is normal or not, a normality test is carried out. Based on the recapitulation of the results of the normality test, it can be seen in the following table 6.

Table 6. Pretest and Posttest Normality Test Results

Description	*Pretest*	*Posttest*
Number of students	20	20
Avarage	27.7	82
x^2_{count}	7.48	7.72
x^2_{table} $(dk = 3; \alpha = 0.05)$	7.81	7.81
Results	$x^2_{count} < x^2_{table}$	$x^2_{count} < x^2_{table}$
Criteria of data	Normally distributed	Normally distributed

The results of the analysis of the normality test show that the pretest and posttest data are normally distributed, namely $x^2_{count} < x^2_{table}$. Therefore, a hypothesis test was conducted using the t-test. The data is normally distributed, then the hypothesis test is carried out using parametric test (t test) with a confidence level of 5%. The results of the t test analysis can be seen in table 7.

Table 7. Hypothesis Test Results (t-test)

Description	Value
Number of student (*N*)	20
Maximum gain score criteria (*dmaks*)	88
t_{count}	25.58
t_{table} $(dk = 19; \alpha = 0.05)$	1.73
Results	$t_{count} > t_{table}$
Criteria	There are significant differences

The value of tcount = 25.58 while ttable = 1.73. From these data it shows that the value of $t_{count} > t_{table}$, thus there is an increase in students' problem solving abilities after the application of the CRA approach. From this data, it can be concluded that Ho is rejected and Ha is accepted, indicating that applying the CRA approach can improve the problem-solving ability of class VII students at one Madrasah Tsanawiyah in the Majalengka District on heat material.

Based on several previous studies and the results of research conducted by the author, it can be concluded that the CRA approach can be used as an alternative learning that can be used to improve students' problem solving abilities. in line with research conducted by Nursifah (2014) stating that the CRA approach can develop students' representation abilities in the material on reaction rates. Hanifahtusholihah (2013) states that learning using the CRA approach shows an increase in students' generic science abilities in electrolysis material. Then research conducted by Fauziah (2014) states that students' mathematical problem solving abilities in cube and block material can be improved more optimally by using a modified CRA approach compared to conventional learning.

CONCLUSION

The implementation CRA approach on heat material from each meeting was entirely carried out with a percentage of 100%. Meanwhile, for the meeting, the percentage of teacher activity implementation scores was 81.37% in the excellent category, and the student activity implementation value with a percentage of 77.15% in the excellent category. Then there is an increase in students' problem-solving abilities on heat material using the CRA approach, which is applied to class VII B at one Madrasah Tsanawiyah in the Majalengka District, the average N-Gain value is 0.71 as a whole, including the high category.

Suggestion

The CRA approach's learning process requires much time and more stringent guidance. Teachers should pay more attention to students at the Concrete stage when preparing tools in experimental activities to avoid students talking outside of the material discussion. The teacher must also continue to supervise and condition students when their groupmates prepare tools and materials for experiments. Before the experimental activity, the teacher must explain the

steps in more detail. This is intended so that students understand and do not ask questions again when conducting experiments so that learning using the CRA approach can run well. The students' problem-solving ability on the indicator concluded that they got the lowest N-gain value compared to the other four indicators. Because students do not pay attention when their friends inform them in front of the class. Teachers should pay more attention to student activity in each stage of their learning activities and be better able to guide students in concluding learning, not just concluding the results of experimental activities.

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