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IMPROVING ACHIEVEMENT AND ATTITUDES TOWARDS MATHEMATICS USING PROBLEM-BASED LEARNING SETTING TEAM ACCELERATED INSTRUCTION

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Abstract

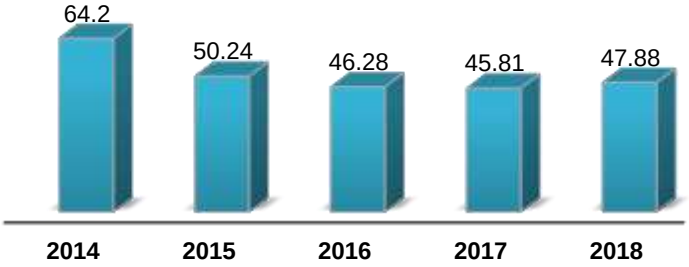
Learning achievement and attitude towards mathematics are two of the indicators of student success in learning mathematics. Problems related to these two things that occur in classrooms where the author teaches encourage the author to make improvements in learning through a classroom action research to improve student achievement and attitudes toward mathematics. Classroom Action Research (CAR) is carried out by applying Problem-Based Learning (PBL) with Team Accelerated Instruction (TAI) arrangements. Data were collected using two types of instruments, namely mathematics achievement test, and students' attitude toward mathematics questionnaire. The results showed that the average attitude of students towards mathematics there were 81% of students had good attitude categories to the top (59% good categories and 22% of very good categories), student achievement as much as 87.50% had been completed with an average student completeness is 81.75 while the implementation of learning activities has exceeded the specified target that is equal to 92.11% has been implemented. It can be concluded that the application of the PBL setting TAI model has succeeded in improving student achievement and student attitudes towards mathematics.

Keywords: achievement, attitude towards mathematics, *problem-based learning*, *team accelerated instruction*, classroom action research

A. Introduction

Education, especially mathematics, should equip students to think creatively, critically and have initiatives to prepare themselves in their lives. In fact, current educational practice only refers to the final results of the learning process. Whereas achievement is not only related to knowledge, but also skills, and abilities that students have developed as a result of instruction(Nitko & Brookhart, 2011), as well as affective aspects (Djidu & Retnawati, 2018) which can become a provision for students to face various future challenges. In other words, educational outcomes are not only about knowledge, but also about the skills and attitudes of students.

Aiken (Gable, 1986) states that the tendency to respond positively or negatively to objects, situations, concepts or personal is the concept of attitude. The tendency will give effect to cognitive components (what is believed or known), affective (emotion and motivation) and performance / conative (treatment or tendency to act). Teachers always dominate the learning process while students are only as learning objects. This is what actually makes student achievement is weak. The pressure that is always dominated by the teacher has a negative effect on students' attitudes because they feel they are not facilitated in learning.



Data sources: Balitbang Kemdikbud RI (2014, 2015, 2016, 2017, 2018)

Figure. 1 Mathematics National Exam Results of SMP Negeri 2 Karangnongko 2014-2018

Observations on class VIII.C students at SMP Negeri 2 Karangnongko indicate problems related to students' attitudes towards mathematics. The implication is that there is no significant increase in student learning achievement from year to year, and even tends to decrease. One proof can be seen from the results of the national mathematics exam achieved by students of SMP Negeri 2 Karangnongko from 2014 – 2018 which tends to be in the low category when compared to other schools (see Figure 1).

As a teacher, the low attitudes and mathematics learning achievement of students in class VIII.C at SMP Negeri 2 Karangnongko encouraged me to evaluate the learning process that had been carried out so far. After evaluating and reading the results of research related to mathematics learning, I found that improvements were needed in the learning process. One of the results of research in learning mathematics shows that to make improvements to the achievements and attitudes of students towards mathematics can be done by applying innovative learning models (Retnawati, Djidu, Kartianom, Apino, & Anazifa, 2018).

One innovative learning model that is highly recommended for mathematics learning today is Problem Based Learning (PBL) (Djidu & Jailani, 2017, 2018). The learning process in PBL places more emphasis on presenting problems at the beginning of the learning process, as well as student activities to gain understanding through the process of solving a problem (Jailani, Sugiman, & Apino, 2017; Widyatiningtyas, Kusumah, Sumarmo, & Sabandar, 2015). This is in line with the opinion of Delisle (1997: 1) that PBL provides a structure for discovery that helps students internalize learning and leads to greater comprehension. Furthermore, to support the implementation of mathematics learning, PBL can be implemented using the Team Accelerated Instruction (TAI) learning setting which is one of the settings in cooperative learning. In the TAI setting, students learn to use worksheets that are used in groups. They also discuss to find or understand concepts. Each group member can work on one problem (questions) as a shared responsibility. TAI can be used to complete the PBL model because the learning steps with PBL and TAI complement one another.

Improvement of the implementation of learning in class VIII.C SMP Negeri 2 Karangnongko needs to be carried out on a research-based basis. Author's efforts in making improvements in the implementation of mathematics learning can be a reference for teachers / practitioners of other mathematics educators who also encounter the same problems as those experienced by the author. The author conducted a Classroom Action Research (CAR) by applying the PBL model with TAI arrangements for students of class VIII C of SMP Negeri 2 Karangnongko to improve student achievement and attitudes towards mathematics.

B. Literature Review

1. Problem Based Learning (PBL)

PBL is a learning approach that emphasizes problems as a starting point in learning. This is in line with Arrends (2012: 396) that the tessence of PBLconsists of presenting students with authentic and meaningful problem situation that can serve as springboards for investigations and inquiri". Similarly what was stated by Duch, Groh, and Allen (2001: 6) that in the problem-based

approach, complex, real-world problems are used to motivate students to identify and research the concept and principles they need to know to work through those problems.

In general, PBL characteristics are characterized by problems as a starting point for learning. Krulick and Rudnick (1995: 4) defines a problem as a situation that requires a solution, and requires a clear way to obtain a solution. The learning process in PBL emphasizes problem solving activities, student activeness, and makes students construct their own knowledge. According to Delisle (1997: 1) PBL provides a structure for discovery that helps students internalize learning and leads to greater comprehension. Also supported by Tan (2003: 21) which states that in PBL, student understanding is obtained through interaction with problems and learning.

PBL stages according to Sears (2002: 12-13) are engagement, inquiry and investigation, performance, and debriefing. Engagement includes several things such as: 1) preparing students to act as self directed problem solvers who can collaborate with other parties, 2) identifying students' knowledge, and 3) exposing students to situations that encourage them to find their problems. Based on the description above, it can be concluded that PBL is a learning model that exposes students to real and ill-structured problems. In this study PBL steps are carried out through stages: 1) orienting students to the problem, 2) organizing students to learn, 3) guiding the investigation, 4) developing and presenting the work, and 5) analyzing and evaluating the problem solving process, as mentioned by Arends (2010)

2. Team Accelerated Instruction (TAI)

Cooperative learning model is one of the learning models that are widely used in learning activities. According to Arends (2010, p. 306), cooperative learning is a teaching model or strategy that is characterized by cooperative task, goal, and reward structures, and requires students to be actively engaged in discussion, debate, tutoring, and teamwork. furthermore, according to Slavin (2006, p.188) the Team Accelerated Instruction (TAI) type of cooperative learning model is student centered learning. Students learn by using student worksheets in groups. They then discuss to find or understand mathematical concepts. Each group member can work on one problem (questions) as a form of shared responsibility.

TAI cooperative learning places more emphasis on group appreciation, individual accountability and equal opportunities to share results for each group member. The syntax of TAI cooperative learning is: 1) placement test, 2) teams, 3) teaching groups, 4) student creative, 5) team studies, 6) fact tests, 7) team scores and team recognition, 8) whole-class units.

3. Student Attitudes Toward Mathematics

According to Nitko (2011, p.448), attitude can be defined as negative or positive feelings towards a physical object, a certain person, some people, government or other social institutions. Meanwhile, Romberg and Wilson (Kulm, 1980, p.357) states that attitudes are described as a person's tendency towards an object that exists in an environment that is recognized (mathematics, self, school, teacher, etc.). The tendency is related to the perception of the object shown by students' responses to the object. The measurement is usually done by asking for a response to one or several statements using a sequence of numbers (questionnaire). The sequences of numbers indicate the strength of their feelings towards the object or position described in the statement.

Based on the opinion of the experts above, it can be concluded that the attitude towards mathematics and mathematics learning can be defined as positive / negative expressions / responses of students towards mathematics and mathematics learning. Its aspects include cognitive, affective and conative aspects.

4. Learning Achievement

Student achievement is very closely related to learning activities. Skemp (1971, p.16) states that intelligence is the total cumulative of the schemata or mental plans built up through the individual's interaction with his environment, insofar as his constitutional equipment allow. Learning achievement is more related to cognitive aspects. This was revealed by Algrabel and Dasi (2001, p.46) who argued that achievement is the competence of a person in relation to a domain of knowledge. This is also supported by Joyce and Weil (2004, p. 7) which states that "… we measure the effects of various methods of teaching not only by how well they achieve the specific objectives towards which they are directed (for example, self, social skills, information, ideas, creativity), but also by how well they increase the ability to learn, which is their fundamental purpose".

To determine the level of student learning achievement, we need a measuring instrument in the form of a test. Ebel and Frisbie (1986, p.20) stated that the major function of a classroom test is to measure student achievement and thus to contribute to the evaluation of educational progress and attainments. According to Muijs and Reynold (2005, p.268) achievement tests measure student work in one subject in a given time. Furthermore, Brown and McNamara (2005, p.16) stated that mathematical achievement is more understood in terms of performance of prescribed mathematical procedures. This is quantifiable through diagnostic testing, and broader understanding is anchored around test indicators is in a statistically defined environment..

Based on the description above, it can be said that mathematics learning achievement is the level of mastery of mathematical material that has been achieved by students. The level of achievement is in the form of scores or scores obtained after participating in the mathematics learning process. In this study, learning achievement is measured using a multiple choice test that measures the basic competencies of learning in accordance with the objectives of mathematics learning.

C. Method

This is a Classroom Action Research (CAR). As a teacher who teaches class VIII. C SMP Negeri 2 Karangnongko, CAR is conducted to get improvements, improvements in the learning process and practice. This CAR consists of four basic stages that are interrelated and sustainable: plan, act, observe, and reflect. Before the four CAR stages are carried out, the study begins with a pre-research stage which includes problem identification, problem analysis, problem formulation, and hypothesis formulation of action.

Table 1. Target CAR Results in Each Cycle

Variable	Interval	Criteria	Target
Student attitudes toward mathematics	126 < X	Very good	16%
	102 < X ≤ 126	Good	50%
	78 < X ≤ 102	Moderate	34%
	54 < X ≤ 78	Bad	0%
	X ≤ 54	Very bad	0%
Learning achievement	Average		Good
	Pass the cut of score ≥ 85 %	Cut of score achieved	81,25%
	Average		75
Learning Process		learning has succeeded	90%

The subjects in this CAR are 32 students of class VIII.C SMP Negeri 2 Karangnongko, Klaten Regency with heterogeneous abilities. Data is collected in two ways: using tests and non-tests. The test instrument in the form of multiple choice questions is used to measure student achievement. Meanwhile, non-test in the form of a questionnaire is used to measure students' attitudes towards mathematics, while the observation sheet is used to measure performance based on PBL syntax with the TAI setting.

The success of CAR in is determined by three criteria. The first relates to students' attitudes towards mathematics that reach the average category at a good level. Second, the proportion of students who exceed the cut of score reaches 85% or more. Third, 90% of learning activities are in accordance with the PBL syntax setting of TAI. Details about the targets to be achieved in this CAR can be seen in Table 1.

D. Findings and Discussion

1. Findings

Before CAR was carried out, the teacher implemented mathematics learning activities in class VIII C of SMP Negeri 2 Karangnongko Klaten using direct / traditional learning, also the learning process in the classroom tended to be teacher-centered. With these learning activities, the quality of learning mathematics in class is not optimal. The results of the pretest and initial questionnaire obtained scores in Table 2.

From the results of the students' pretest and initial questionnaire, it was found that student learning outcomes were still not optimal. Student pretest scores indicate students completeness both classically and individually are still incomplete. It is shown that the percentage of students completeness is only 0%, or none of the students is complete. Likewise, the average pretest score was only 27.63. Similar conditions were also reflected in the scores of students' attitudes towards mathematics obtained from the initial questionnaire. Table 2 shows that 88% of students do not

have a good attitude towards mathematics (13% in the moderate category and 75% in the very bad category). The low learning outcomes of these students have a strong relationship with learning activities that are still teacher-centered, and use direct / traditional learning.

Table 2. Pretest and Initial Questionnaire Results

Variable	Interval	Criteria	Pre-research
Student attitudes toward mathematics	126 < X	Very good	3%
	102 < X ≤ 126	Good	9%
	78 < X ≤ 102	Moderate	13%
	54 < X ≤ 78	Bad	75%
	X ≤ 54	Very bad	0%
Learning achievement	Average		Kurang Baik
	pass the cut of score ≥ 85 %	Cut of score achieved	0%
	Average		27,63

The action that the researchers planned to improve the quality of learning was to carry out the first cycle of action by applying PBL with the TAI setting in mathematics learning. Observations were also made from the beginning to the end of the first cycle learning activities to observe the suitability of learning activities with PBL syntax with the TAI setting. At the end of cycle 1 students are given posttests and questionnaires to measure student achievement and attitudes toward mathematics. After observation, data were obtained regarding the implementation of PBL learning activities with the TAI setting, students' attitudes toward mathematics, and mathematics learning achievement (see Table 3).

Table 3. Implementation of Learning Activities in First Cycle

Variable	Interval	Criteria	End of First Cycle
Student attitudes toward mathematics	126 < X	Very good	6%
	102 < X ≤ 126	Good	69%
	78 < X ≤ 102	Moderate	25%
	54 < X ≤ 78	Bad	0%
	X ≤ 54	Very bad	0%
Learning achievement	Average		Baik
	pass cut of score s ≥ 85 %	Cut of score achieved	59,38%
	Average		73,88
Learning Process	done ≥ 90 %	learning has succeeded	76,32%

After carrying out the first cycle, researchers do reflection. The results of reflection are used to make an action plan in the second cycle which is basically the same as an action plan in the first cycle. However, there are additional actions in this second cycle, which is to provide solutions to obstacles in the implementation of PBL learning TAI settings in the first cycle. With planned solutions, it is expected to improve student learning outcomes.

Student learning outcomes in the second cycle are expected to meet the planned targets. After the second cycle, data about the implementation of PBL learning activities using the TAI setting, data on students 'attitudes toward mathematics, and data on students' mathematics learning achievement (see Table 4).

Table 4. Implementation of Learning Activities in Second Cycle

Variable	Interval	Criteria	End of Second Cycle
Student attitudes toward mathematics	126 < X	Very good	22%
	102 < X ≤ 126	Good	59%
	78 < X ≤ 102	Moderate	19%
	54 < X ≤ 78	Bad	0%
	X ≤ 54	Very bad	0%
Learning achievement	Average		Baik
	pass cut of score ≥ 85 %	Cut of score achieved	87,50%
	Average		81,75
Learning Process	done ≥ 90 %	learning has succeeded	92,11%

Data on the implementation of PBL learning activities in the TAI setting, students' attitudes towards mathematics and learning achievement starting from pre-research, the first cycle, to the second cycle can be seen in Table 5.

Table 5. The Implementation of Learning Activities

Variable	Interval	Criteria	Target	Pre-research	End of First Cycle	End of Second Cycle
Student attitudes toward mathematics	126 < X	Very good	16%	3%	6%	22%
	102 < X ≤ 126	Good	50%	9%	69%	59%
	78 < X ≤ 102	Moderate	34%	13%	25%	19%
	54 < X ≤ 78	Bad	0%	75%	0%	0%
	X ≤ 54	Very bad	0%	0%	0%	0%
Learning achievement	Average		Good	Bad	Good	Good
	pass cut of score ≥ 85 %	Cut of score achieved	81,25%	0%	59,38%	87,50%
	Average		75	27,63	73,88	81,75
Learning Process	done ≥ 90 %	learning has succeeded	90%	-	76,32%	92,11%

Based on Table 5, it is known that the average attitude of students towards mathematics before research is still in the bad category (13% in the moderate category and 75% in the bad category). After participating in learning in the first cycle, the average attitude of students towards mathematics increased to a good category but the percentage of very good categories was still less than the expected target (6% of the 16% expected target). At the end of the second cycle, students' attitudes towards mathematics had reached the good category and all criteria had exceeded the expected target (59% of the good category and 22% of the very good category).

Student mathematics learning achievement before the study was still 27.63 and 0% of students achieved the cut of score. After the first cycle of learning activities, the average student learning achievement increased to 73.88 and 59.38% achieved the cut of score. Both are still below the expected target (the average student score of 75 and 81.25% reaches the cut of score). At the end of the second cycle, the average student learning achievement had exceeded the target of 81.75 and the percentage of students who reached the cut of score was 87.50%.

Furthermore, the implementation of the learning process has also reached the target. In the first cycle 76.32% was carried out, but still below the expected target, which is 90%. Meanwhile, in the second cycle the implementation of the PBL learning process in the TAI setting had exceeded the target determined by the implementation of 92.11%. Thus, the implementation of learning using the PBL TAI setting model has been carried out to the maximum and in accordance with the specified achievement targets.

2. Discussion

The implementation of the PBL model with the TAI setting in mathematics learning that has been carried out in the CAR has succeeded in increasing mathematics learning achievement for students of class VIII C of SMP Negeri 2 Karangnongko. There are several reasons why PBL models with TAI settings can improve student learning achievement. *First*, PBL learning activities emphasize the active role of students in the learning process (Arends, 2012; Savin-baden & Major, 2004; Wardono, Waluya, Mariani, & Candra D, 2016). *Second*, the active role of students in this learning process is also supported by investigative activities on problems that are carried out independently or in groups by students. *Third*, the activity of presenting the results of discussions by students is also one that can train students' communication skills that also support their achievements. In a number of research results, it is stated that PBL can not only improve achievement, but can also improve others student skills, such as creativity (Apino & Retnawati, 2017), mathematical communication skills (Ningrum, 2017), and even higher-order thinking skills (Djidu & Jailani, 2016, 2017; Retnawati et al., 2018).

Furthermore, the improvement of students' attitudes towards mathematics after the implementation of the PBL model with the TAI setting also cannot be separated by the existence of learning activities that are not monotonous, not dominated by the teacher, and are not abstract. Other researchers, who also applied the PBL model to junior high school mathematics learning in one of the private schools in Yogyakarta (Mashuri, Djidu, & Ningrum, 2019) also found the same results as the results of this study. They found that PBL applied to mathematics learning had increased students' interest in learning mathematics. One of the interests in learning mathematics is shown by an interest in mathematics (Tiurma & Retnawati, 2014).

The success of mathematics learning that applies the PBL model with the TAI setting certainly cannot be separated from the consistency and commitment of the teacher in carrying out his role as a facilitator in learning. There is no more dominance of the teacher in the learning process. What the teacher does is trying to encourage students to play an active role in the learning process.

E. Conclusion

Based on the results and discussion of the CAR results on efforts to improve students' attitudes towards mathematics with the PBL model setting TAI in class VIII C students at SMP Negeri 2 Karangnongko, the following conclusions are obtained. First, mathematics learning activities using the PBL setting TAI model can be carried out well after learning for two cycles. Second, the application of the PBL setting TAI model has succeeded in increasing student achievement and student attitudes towards mathematics.

Based on the results of this CAR, the author recommends the following. *First*, for mathematics learning to work effectively, teachers need to use innovative student-centered learning models, as has been done in this action research. *Second*, the group investigation process in applying the PBL model can be arranged using several types of cooperative learning so that the investigation/group discussion activities in PBL are carried out with various variations. *Third*, teachers need to routinely conduct evaluations, and improve research-based mathematics learning as was done in this study.

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