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Mathematical Problem Solving Ability in Auditory, Intellectually, Repetition Learning with Ethnomathematics Nuanced Viewed From Self-Efficacy

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Abstract

Mathematical problem solving ability is an important ability in learning mathematics. This study aims to describe students' mathematical problem solving abilities through AIR learning with ethnomathematics nuanced. This research is descriptive research. The population in this study were all class X of Senior High School 5 Semarang in the academic year 2019/2020. The sampling technique used was cluster random sampling. The sample in this study were X MIPA 10 as the experimental class and X MIPA 7 as the control class. The research subjects were selected based on self-efficacy categories, namely high, moderate, and low. The data collection techniques used were questionnaires and tests. The data analysis used was descriptive data analysis and independent sample t-test. The results showed that the application of the AIR learning model with ethnomatematics nuanced can improve students' mathematical problem solving abilities. Students with high self-efficacy categories are able to achieve all four aspects of problem solving abilities, namely understanding problems, devising a plan, carrying the plan, and looking back correctly and completely, while students with moderate and low self-efficacy categories have not been able to achieve all four aspects of problem solving abilities.

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INTRODUCTION

Education is an effort to prepare a human through tutoring, teaching, and training activities that are expected to be useful for his or her future roles (Susandi & Widyawati, 2017). Quality education will produce human resources that have the potential as capital to make Indonesia a developed country. However, in reality the quality of education in Indonesia is still very poor (Vendiagrys, Junaedi, & Masrukan, 2015).

One of the abilities that need to be developed according to the National Council of Teachers of Mathematics (NCTM) in 2000 is problem solving skills. Problem solving is one of the most valuable aspects of mathematics education (Tzohar & Kramarski, 2014; Hendriana, Euis, & Soemarmo, 2017; Mushlihah & Sugeng, 2018). Polya (1985) suggests four steps of problem solving, namely (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) looking back.

Based on the results of PISA in 2015, Haryanti stated that Indonesia was ranked 63 out of 72 participating countries. In the five times participating, Indonesia is still ranked low in Treads in International Mathematics and Science Study (TIMSS) (Islamiah et al, 2018). From the results obtained in PISA and TIMSS, it can be seen that the mathematical problem solving abilities of students in Indonesia are still low. This is in accordance with the results of previous findings which state that students' mathematical problem solving abilities are still low (Maharani & Bernard, 2018; Akbar et al, 2018; Aisyah et al, 2018; and Tambychik, 2010).

Mathematical problem solving ability can be increased if there is an interaction in solving mathematical problems, so it is necessary to the learning model that can enhance students' mathematical problem solving ability. Learning that makes it possible to realize these conditions is cooperative learning. Cooperative learning has many positive effects in mathematics classrooms (Smith-Stoner & Molle, 2010). One of the cooperative learning is Auditory Intellectual Repetition (AIR). AIR learning is suitable for use in mathematics learning because it is able to practice students' courage to express opinions (Auditory), solve the problems (intellectually), remember the material that students have learned (Repetition), and make students active and creative in learning mathematics (Wahyuni & Mushaddi , 2019).

Utami and Wutsqa (2017) state that teachers rarely give problem-based questions. Teaching mathematics for everyone should be adapted to the culture (D 'Ambrosio, 2003). In mathematics learning, it is necessary to have a content that connects mathematics in real life based on local culture with school mathematics known as ethnomatematics. Through ethnomathematics based learning, students can learn mathematics and recognize their culture. Characteristics and culture will be interesting to develop (Geni & Isti, 2017).

Success also depends on the factor from students in the process of learning Mathematics. Self-efficacy is a psychological aspect that has an influence on a person's success in completing tasks and problems properly. Bandura (2006) uses the term self-efficacy which refers to beliefs about a person's ability to organize and carry out an action in order to achieve certain goals.

The purpose of this study was to describe the improvement of students' mathematical problem solving abilities through AIR learning with ethnomathematical nuances.

METHOD

This type of research is descriptive research. The population in this study were all 10^{th} grade students at SMA Negeri 5 Semarang in the even semester of academic year 2019/2020. Samples were taken using cluster random sampling. The sample in this study were class X MIPA 10 as an experimental class which is taught by using AIR learning model with ethnomathematical nuances and class X MIPA 7 as a control class which is taught using expository learning. The determination of the research subject was selected based on the student's self-efficacy category. The total research subjects were 6 students where 2 students were selected from the high self-efficacy level, 2 students were selected from the medium self-efficacy level, and 2 students were selected from the low self-efficacy level. The data collection techniques used were test of mathematical problem solving ability, interview, and self-efficacy questionnaire. Data analysis was performed by descriptive analysis and independent t-test.

RESULTS AND DISCUSSIONS

Based on the results of preliminary data analysis (prerequisite test), it was found that the two sample classes came from populations that were normally distributed, had the same variance (homogeneous), and there was no average difference in problem-solving abilities between two samples. This means that the samples come from the same conditions. Students were still confused when they were asked about solving problems with ethnomathematics nuances at the first meeting. From the data on the test scores of students' mathematical problem-solving abilities in the experimental class, the average score of the students' mathematical problem solving abilities test was 63. 30% of the total students achieved the minimum completeness criteria, where the minimum completeness criteria was 70. Students obtained an average score of 58 in the control class. 17% of the total students reached the minimum completeness criteria. Students are still confused in presenting the results of their discussion at the second meeting. But students have been able to complete worksheets better than previous meetings. Students also exchange opinions well. Besides that, students are a little more active in asking questions. From the results of the problem solving ability test, students in the experimental class, the average score obtained by the students was 67. 47% of the total students achieved the minimum completeness criteria. From these data, it appears that the value of students' mathematical problem solving abilities has increased, but it has not reached the predetermined minimum target where 75% of the total students who take part in the learning have been said to have reached the minimum completeness criteria. The average score obtained by students was 60 in the control class. 27% of the total students achieved the minimum completeness criteria. Students completed worksheets and mathematical problems with ethnomathematical nuances well at the third meeting. Students are able to present the results of their discussion in front of the class so that learning at the third meeting occurs well. In addition, students are also active in exchanging opinions between groups. From the test results of students' mathematical problem-solving abilities in the experimental class, the average score of the students was 72. 73% of the students achieved scores above the minimum completeness criteria. From these data, it can be seen that the test scores of students' mathematical problem solving abilities in the experimental class increased. The average score obtained by the students was 60 in the control class. 27% of the students achieved a score above the minimum completeness criteria. Mathematics learning occurs well at the fourth meeting. Students are accustomed to solving worksheets and mathematical problems with ethnomathematical nuances. Students are also used to exchanging opinions with other groups and are accustomed to presenting the results of their discussions with other groups. From the test of students' mathematical problem-solving abilities in the experimental class, it was found that the average value of students' mathematical problem-solving abilities was 79. 87% of the students scored above the minimum completeness criteria. From these data, it can be seen that there is an increase in the test scores of students' mathematical problem solving abilities in the experimental class. There was classical completeness at the fourth meeting. 87% of the students scored above the minimum completeness criteria. In the control class, the student's average score was 66. 57% of the students scored above the minimum completeness criteria.

Based on the test of students' mathematical problem solving abilities, it was found that the test scores of students' mathematical problem solving abilities in the experimental class taught with ethnomatematic nuanced AIR learning and students in the control class taught by expository learning from the first meeting to the fourth meeting are presented in Table 1.

Table 1. The Recapitulation of Test Results

No	Attainment	X MIPA 10				X MIPA 7			
		M1	M2	M3	M4	M1	M2	M3	M4
1.	The average score	63	67	72	79	58	60	63	66
2.	Complete (%)	30	47	73	87	17	27	37	57
3.	Incomplete (%)	70	53	27	13	83	73	63	43

The results of hypothesis testing from the test scores of mathematical problem solving ability in the experimental class and control class are presented in Table 2

Tabel 2. Independent t-test Results

Meeting	t_{count}	t_{table}	Criteria	Inference
I	2.202	1.67	$t_{count} > t_{table}$	H_1 was accepted
II	2.710	1.67	$t_{count} > t_{table}$	H_1 was accepted
III	3.680	1.67	$t_{count} > t_{table}$	H_1 was accepted
IV	4.267	1.67	$t_{count} > t_{table}$	H_1 was accepted

Based on the results of calculations with $\alpha = 5\%$ and $dk = 30 + 30 - 2 = 58$, it was found that $t_{table} = 1.67$. Based on the results of hypothesis testing using the independent t-test at the first meeting to the fourth meeting, it was found that H_1 was accepted. This means that the students' mathematical problem solving abilities in the experimental class who were taught by using AIR learning with ethnomathematics nuance were better than that of the control class students who were taught using expository learning. For more detailed data, the results of the students' mathematical problem solving abilities test results in the experimental class and control class are presented in Figure 1.

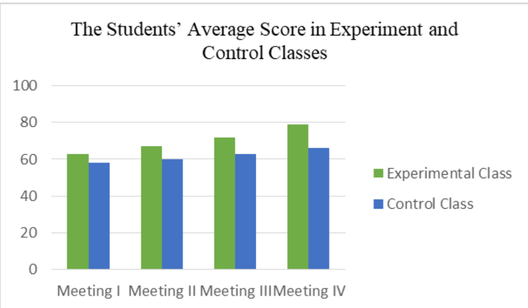

Figure 1. The Students' Average Score

From the data on the test scores of mathematical problem solving abilities in Table 1, it was found that the test scores of students' mathematical problem solving abilities in the experimental class, X MIPA 10, which were taught using AIR learning with ethno-mathematical nuances increased. The results of the test scores for the students' mathematical problem solving abilities in class X MIPA 10 are presented in Figure 2.

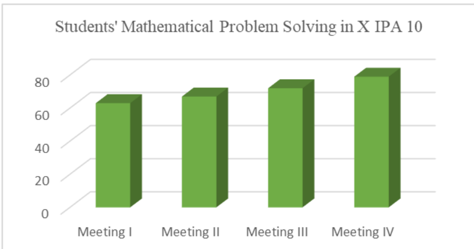

Figure 2. Students' Test Score at X MIPA 10

From the data on the results of the test of students' mathematical problem solving abilities in table 1 above, it was found that from the first meeting to the fourth meeting there was an increase in students who achieved the minimum completeness criteria. These results can be seen in Figure 3.

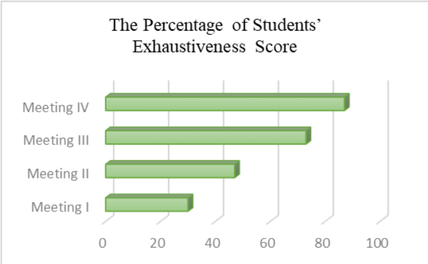

Figure 3. Percentage of Exhaustiveness Score

Giving self-efficacy questionnaire aims to group students based on their self-efficacy. The determination of the research subject was selected based on the results of the student's self-efficacy questionnaire. The results of the self-efficacy questionnaire for students in class X MIPA 10 can be seen in Table 3.

Table 3. Students' Self-Efficacy Category

Category	Frequency	Percentage
High Self-efficacy	5	16.67
Medium Self-efficacy	19	63.33
Low self-efficacy	6	20.00
Total	30	100

From each of these categories of self-efficacy, two students from each category were taken to be analyzed their problem solving abilities. The selection of students with low self-efficacy was obtained from 2 students who had the lowest score on the self-efficacy questionnaire. Selection of students with moderate self-efficacy was selected from 2 students with self-efficacy questionnaire score in the middle. While the selection of students with high self-efficacy was obtained from 2 students with the highest self-efficacy score. Selected research subjects were given the codes SE 01 and SE 02 for students with high self-efficacy categories, SE 03 and SE 04 for students with moderate self-efficacy categories, and SE 05 and SE 06 for students with low self-efficacy categories.

The results of problem solving abilities based on the student's self-efficacy category show that students with high self-efficacy are able to understand the problem well, they are able to write what is known and draw sketches of the problems given completely and correctly. Students are able to write the complete formula and reveal the steps to work properly and correctly in the step of devising a plan. At the step of carrying out the plan, students with high self-efficacy are able to carry out the problem solving plan that has been made and they are able to calculate properly. Students with high self-efficacy are able to check again by counting backwards and checking again that the answers obtained are correct answers at the step of looking back. The example of student work with high self-efficacy in carrying out the plan are presented in Figure 4.

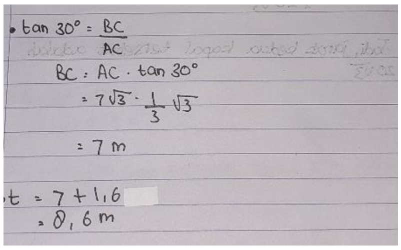

Figure 4. The Example of Student's Work with High Self-Efficacy in Carrying Out the Plan

Students' mathematical problem solving abilities with moderate self-efficacy are in the step of understanding the problem, students are able to understand the problem well. Students are able to explain what is known and draw a complete and correct sketch of the problem given. In the step of devising a plan, students are able to write the complete formula and describe the steps to solve the problem properly. Students with moderate self-efficacy are able to carry out the plan quite correctly. Students are not conscientious in calculations. Students with moderate self-efficacy are able to look back, but are incomplete. The example of student's work with moderate self-efficacy in carrying out the plan is presented in Figure 5.

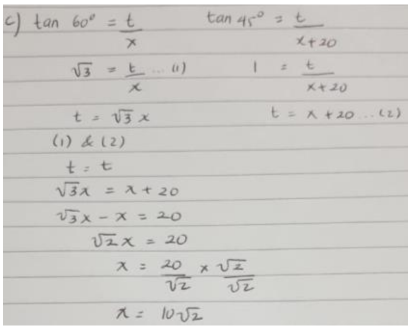

Figure 5. The Example of Student's Work with Moderate Self-Efficacy in Carrying Out the Plan

Students with low self-efficacy at the step of understanding the problem, students are able to write and explain what is asked and known, and can make sketches correctly but incompletely. At the step of devising a plan, students with low self-efficacy are able to plan problem solving but are incorrect and incomplete. Students with low self-efficacy are able to carry out the problem-solving plan that has been made, but it is incorrect and incomplete at the step of carrying out the plan. Students with low self-efficacy have not been able to check the answers that have been obtained at the step of looking back. The example of student's work results with low self-efficacy in carrying out the plan are presented in Figure 6.

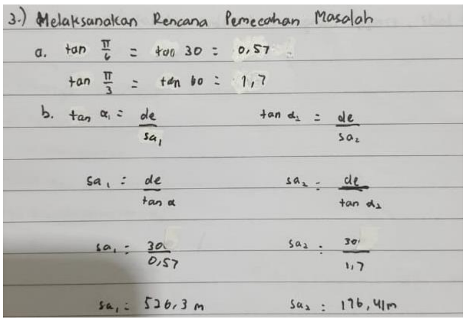

Figure 6. The Example of Student's Work with Low Self-Efficacy in Carrying Out the Plan

Self-efficacy in the academic field refers to a person's belief that the person is capable of performing certain actions. Self-efficacy plays an important role in achievement motivation, is interconnected with self-regulating learning processes, and mediates academic achievement. Someone who has high self-efficacy will have great confidence and effort in solving problems. Likewise, someone who has low self-efficacy is unsure and easily gives up in solving problems. Based on the results of the study, it shows that there are differences in students' mathematical problem solving abilities based on self-efficacy (high, medium, low) (Somakim et al, 2019). This is in line with research conducted by Novianti, Darminto, & Purwoko (2018).

Cooperative learning is useful for increasing student participation in understanding the material and developing students' general abilities (Smith-Stoner & Molle, 2010). AIR is a learning model that includes the Auditory process which means that learning must be through listening; Intellectually which means that learning must use thinking skills; and Repetition which means that learning must repeat the material that has been taught. AIR learning model has several advantages including the students have more opportunities to utilize their knowledge and skills, and students have a lot of experience to find something in a problem. So, mathematical problem solving ability increased with AIR learning model (Shoimin, 2016)

The AIR learning model with ethno-mathematical nuances requires students to learn and complete tasks that are related to the existing culture in the student's environment. Students become more enthusiastic because of the problems presented oriented culture and daily life of the students so that they have high enthusiasm to resolve the problems that exist in every student worksheet. The ethnomatematics teaching materials developed encourage students to explore the information in accordance with their cognitive structures to be constructed with new information in order to produce more meaningful learning as described in Ausubel's theory. Learning that relates to real life will make students interpret it more.

The results of this study are in line with several previous studies, including research conducted by Hutagulung & Harahap (2018) which stated that the AIR model can improve the spatial abilities of students at SMP Negeri 1 Pinongsari; Tri, Destiniar, & Anggria (2018) stated that AIR learning can improve students' ability to understand mathematical concepts. Likewise, the results of research conducted by Ayu, L, S., Supriadi ,. & Aristyawan, A. (2016) stated that there are differences in results between classes using Sundanese ethnomathematics learning and classes that do not use Sundanese ethnomatics learning. Ethnomathematics is effective in learning mathematics (Zaenuri, 2020). Learning with ethnomathematics can also improve students' mathematical communication skills, student literacy skills, and make students actively involved in learning (Fathul, Zaenuri, & Sunyoto, 2020; Prabawa & Zaenuri, 2017; Pujianto & Masrukan, 2016).

CONCLUSION

Based on the results and discussion, it can be concluded that the application of the AIR learning model with ethnomathematical nuances can improve mathematical problem solving abilities on the subject of trigonometry. Students with high self-efficacy categories are able to understand the problem, devise a plan, carry out the plan, and look back correctly and completely. Students with moderate self-efficacy are able to understand the problem, devise a plan, carry out the plan quite correctly and look back but are still incomplete. Students with low self-efficacy are able to understand the problem and devise a plan correctly, they are less able to carry out the plan, and they are less able to check again. Thus, students with high self-efficacy were able to achieve all four aspects of problem-solving abilities, while students with moderate and low self-efficacy had not optimally achieved all four aspects of problem solving abilities.

The suggestion in this study is that the AIR learning model with ethnomathematical nuances can be used as an alternative learning by teachers in mathematics learning activities to improve students' mathematical problem solving abilities.

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