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Auditory, intellectually, repetition with ethnomathematics nuance in improving students' mathematical problem solving ability

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Abstract. The objective was to analyze students' skill to solve mathematical problems in Auditory, Intellectually, Repetition (AIR) learning with ethnomathematics nuance. This research is an experimental quantitative study. The population in this study were all class X SMA Negeri 5 Semarang 2019/2020. The sampling technique in this study is cluster random sampling. The sample in this study were X MIPA 10 as an experimental class and X MIPA 7 as a control class. The techniques of collecting data in this study consisted of test, observation, and documentation. Data analysis in this research used independent t-tests and descriptive. The finding proved that AIR learning with ethnomathematics nuance was effective for students' problem solving ability. The problem solving ability of students who are taught with AIR learning with ethnomathematics are better than students who are taught with expository learning, and there is an increase in the ability of students who are taught with AIR learning with ethnomathematics nuance.

1. Introduction

Education is an effort to prepare quality people who will produce human resources that have the potential to advance a country. Mathematics has an important role in life, such as a role in efforts to master science and technology. Mathematics is also related to everyday life. Because of the importance of mathematics in life, a person needs to master mathematics well in order to support life in the future. One of the efforts to master mathematics is through learning at school.

The National Council of Teachers of Mathematics determines six important abilities that need to be developed in learning mathematics, namely (1) understanding concepts, (2) problem solving, (3) reasoning and proof, (4) communication, (5) connections, (6) representations [1]. The ability that must be possessed by students in mathematics is problem solving [2-3]. at higher education, problem solving is also important skills in teaching and learning process of mathematics. New answers are needed to create solutions in problem solving abilities. Each step is a precursor of the next step and the result of the previous step in problem solving ability [4]. The steps in solving problem consist of understanding the problem by mentioning the information that is known, asked and drawing a sketch, devising a plan to be worked on, carrying out the plan that has been prepared, and looking back by checking the answers and looking for alternatives answers [5].



In 2015, Indonesia ranks 63rd out of 72 countries participating in the Program for International Students Assessment (PISA). In five participation times, according to Trends in International Mathematics and Science Study (TIMSS), Indonesia is still at the lowest level [6]. The ability of students to solve mathematical problems in Indonesia, according to PISA and TIMSS, is still low. This is in line with the results of previous studies which stated that the students in Indonesia still have low abilities to solve mathematical problems [7]. In overcoming these problems, efforts are needed to enhance the ability of problem solving. One of them is by applying model that does not saturate students, can support interaction between students, and can enhance students' skills of mathematical problem solving.

The type of learning model that makes it possible to realize these conditions is a cooperative learning model. The cooperative learning model has many positive effects in mathematics classrooms [8]. One of the cooperative learning models is Auditory Intellectual Repetition (AIR). The AIR learning model includes aspects of listening (Auditory), thinking (Intellectually), and Repetition. Dave Meier states that creating, solving problems and constructing meaning is an intellectual property. One has to use the mind to turn experience into knowledge. Repetition also affects the student learning process, where the stimulus and response is a situation that must be repeated in mathematics learning in order to increase learning retention in students [9].

Not only the learning model, but also the questions given to students are not related to real life. Various problems in the student's culture can be used as problems in mathematics, so students can find solutions to solve them. The approach in teaching and learning that links mathematics in schools and the culture that exists in the environment around students is called ethnomathematics [10-11]. Because ethnomathematics has a relationship with multicultural views, students will more easily understand mathematics [12]. Students will also be more active in the learning process of mathematics with the application of ethnomathematics [13].

Based on the description above, one of the alternative solutions is the application of AIR learning with ethnomathematics nuance on the subject of trigonometry. The objective of this study is to analyze students' skill to solve mathematical problems in AIR learning with ethnomathematics nuance.

2. Methods

This research is an experimental quantitative study in which there are two classes with different treatments. The population in this study were all class X of SMA Negeri 5 Semarang academic year 2019/2020. The sampling technique in this study is cluster random sampling. The sample in this study were X MIPA 10 as an experimental class which is taught by using AIR learning with ethnomathematics nuance and X MIPA 7 as a control class which is taught using expository learning. The techniques of collecting data in this study consisted of test, observation, and documentation. Data analysis in this research used independent t-tests and descriptive.

3. Results and Discussion

The results of the tests of students' abilities in X MIPA 10 who were taught with AIR learning with ethnomathematics and students' ability in X MIPA 7 who were taught by expository learning from the first meeting to the fourth meeting are presented in Table 1.

Table 1. X MIPA 10 test results

No	Attainment	X MIPA 10				X MIPA 7			
		M.1	M.2	M.3	M.4	M.1	M.2	M.3	M.4
1.	Average score	63	67	72	79	58	60	63	66
2.	Maximum	80	80	90	100	70	80	80	90
3.	Minimum	40	50	50	60	40	40	40	40
4.	Complete (%)	30	47	73	87	17	27	37	57
5.	Incomplete (%)	70	53	27	13	83	73	63	43

Hypothesis testing using the independent t-test was carried out on the test scores obtained by students in X MIPA 10 and X MIPA 7. The results of hypothesis testing are presented in Table 2.

Table 2. Independent test results

Meeting	t_{count}	t_{table}	Criteria	Inference
I	2.102	1.67	$t_{count} > t_{table}$	H_1 is accepted
II	2,710	1.67	$t_{count} > t_{table}$	H_1 is accepted
III	3.680	1.67	$t_{count} > t_{table}$	H_1 is accepted
IV	4,267	1.67	$t_{count} > t_{table}$	H_1 is accepted

Based on the results of hypothesis testing with $\alpha = 5\%$ and $dk = 30 + 30 - 2 = 58$, the value of $t_{table} = 1.67$ is obtained. Obtained hypothesis testing criteria for the first meeting to the fourth meeting namely $t_{count} > t_{table}$, so H_1 is accepted. This means that the students' ability to solve the mathematical problem in X MIPA 10 who were taught by using AIR learning with ethnomathematics nuance were better than the students' ability in control class who were taught using expository learning. For more detailed data, the results of the students' ability to solve the problem in class X MIPA 10 and class X MIPA 7 are presented in Figure 1.

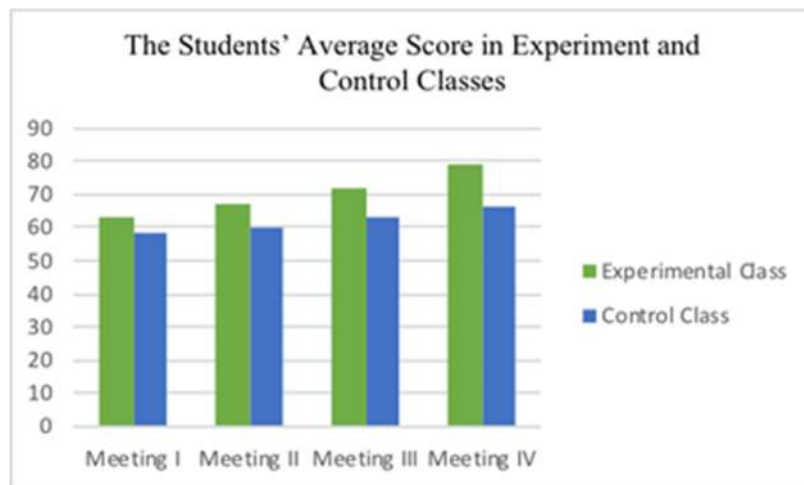


Figure 1. The average score in experimental and control classes

From the data in Table 1, the test scores of students' mathematical problem-solving skills in class X MIPA 10, the experimental class, who are taught using AIR learning model with ethno-mathematical nuance have increased. The results of class X MIPA 10 mathematical problem solving abilities are presented in the diagram in Figure 2.

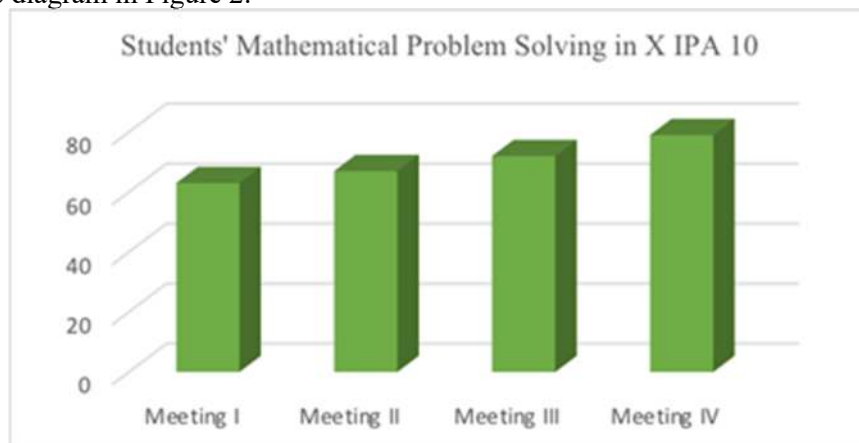


Figure 2 Students' test score at X MIPA 10

From the work of the students in class X MIPA 10 in table 1 above, it is known that there has been an increase in students who achieve minimum completeness. These results are presented in Figure 3.

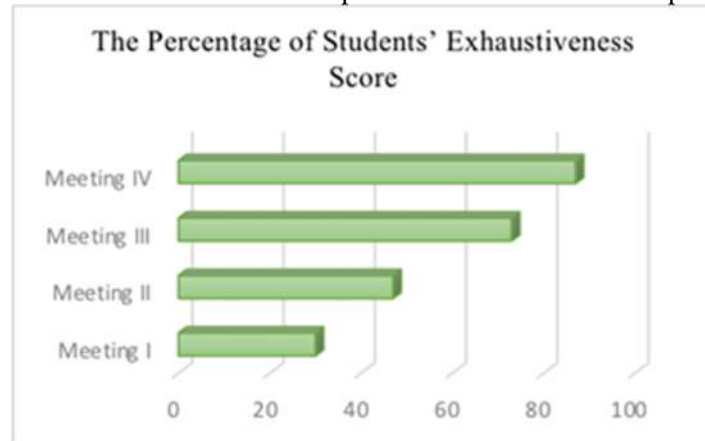


Figure 3 The percentage of students' exhaustiveness score

The cooperative learning is useful for increasing student participation in understanding the material and developing students' abilities [8]. By applying AIR learning to mathematics learning, students' problem solving abilities improve. This is because AIR learning creates a teaching and learning process which keeps students active. During the mathematics learning process, students enthusiastically listen to the subjects described, they discuss together with their groups, solve the given mathematical problems. Students also repeat what they have learned by doing assignments individually. So, the subjects studied will be easily understood and remembered by students. Students have more experience to find something in solving mathematical problems. The application of ethnomatematics also causes students to be interested and enthusiastic in the learning process. This is because the problems used are related to the student's own culture. AIR learning with ethno-mathematical nuance requires students to learn to solve mathematical problems that are adapted to the existing culture in the students' environment. Some of the Ethnomatematics objects in Semarang City that are used in learning are presented in Figure 4 to Figure 7.



Figure 4. Masjid Agung Jawa Tengah



Figure 5. Tugu Muda

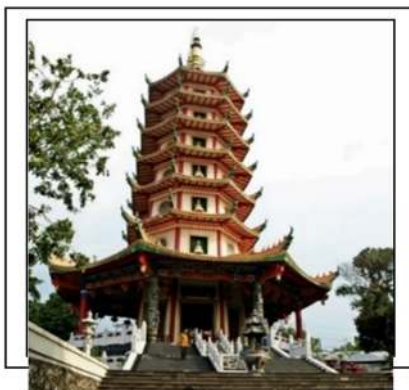


Figure 6. Vihara Buddhagaya Watugong



Figure 7. Gereja Blenduk

Students become more excited because the problems presented are culturally oriented and related to the daily lives of students so that they have high enthusiasm to solve the problems that exist on each student worksheet. The ethnomatematics teaching materials developed encourage students to explore 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 by linking to real life will make students interpret the learning more.

The results of this study are in line with several previous studies, including research conducted by Ni Made which states that the application AIR learning model effectively improves student learning outcomes on the subject of two-dimensional and three-dimensional shapes [14]. Zaenuri states that ethnomatematics is effective in learning mathematics [15]. Previous research stated that PjBL learning with ethnomatematics is effectively applied to two-dimensional material [16]. Previous findings also show that ARIAS-based ethnomatematics is effective for problem solving abilities. This also happened to peer tutorial learning [17-18].

4. Conclusion

Based on the findings and discussion explained, the students' ability of mathematical problem solving in X MIPA 10 which is taught by AIR learning with ethnomatematics are better than the students in X MIPA 7 which is taught by expository learning. The application of AIR with ethnomatematics can also enhance the ability of mathematical problem solving on trigonometry. Suggestion in this study is that the AIR learning with ethnomatematics nuance can be used as an alternative learning by teachers in mathematics learning activities to improve students' mathematical problem solving abilities.

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