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Mathematical representation ability based on learning styles of students on Anchored Instruction assisted Problem Card

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Abstract

Learning outcomes and abilities of class VIII students of SMP Negeri 1 Banyubiru on the aspects of mathematical representation are not optimal. Each student has a different learning style that influences the process of representing mathematical problem solving. In this study, the application of the *Anchored Instruction* model assisted by *Problem Card* aims to find out students 'classical completeness and describe the students' mathematical representation abilities for each type of learning style, namely Visual, Auditorial, and Kinesthetic (V-A-K). This research method is mixed methods or combination methods. The research design used was explanatory sequential design. The subjects of this study were 9 students of class VIII B of SMP Negeri 1 Banyubiru who were selected using the purposive sampling method. Data collection techniques in this study used the test method, questionnaire method, and interview method. The results showed (1) the learning outcomes on the aspect of mathematical representation ability in the *Anchored Instruction* model achieved classical; (2) learning outcomes on aspects of mathematical representation ability for classes using the *Anchored Instruction* learning model aided by *Problem Card* are better than classes that use the *Anchored Instruction* learning model; (3) description of students' mathematical representation abilities for each type of learning style, namely visual, auditorial and kinesthetic.

1. Introduction

Countries in facing the challenges of the globalization era now require reliable human resources who have critical, systematic, logical, creative thinking, and the willingness of effective cooperation. The state has the goal of making thoughtful human resources as mentioned, more likely to be produced from educational institutions. One of the subjects in school that can be used to achieve these goals is mathematics because mathematics has a relationship with daily life both present and future. The National Council of Teacher Mathematics (2000) stipulates that there are 5 process skills that students need to have through mathematics learning that are covered by the standard processes, namely: (1) Problem solving; (2) Reasoning and proof; (3) Communication; (4) Connection; and (5) Representations.

From the results of the preliminary study, it was found that only about 22.5% of students achieved the KKM of 70. Students could not write down what was known and was asked in full as stated in the problem. In addition students are also not able to make equations or mathematical models of the problems or information provided. In terms of solving problems, students also have not been able to write steps to solve mathematical problems with words. From these results it can be said that the mathematical representation ability of eighth grade students of SMP Negeri 1 Banyubiru is still low.

The ability of representation is one of the important and fundamental components for developing students' thinking abilities, because in the process of learning mathematics we need to link the material being studied and represent ideas in a variety of ways. According to Jones (Hudojo, 2005), there are several reasons for the need for representation, namely: giving students fluency in developing concepts and mathematical thinking

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and to have strong and flexible abilities and understanding of concepts built by teachers through mathematical representation.

In addition to the importance of problem solving skills in the process of learning mathematics, learning styles also affect the learning process of mathematics. DePorter & Hernacki (1999) states that a person's learning style is a combination of how he absorbs and then organizes and processes information DePorter and Hernacki (2004), classifying a person's learning style types into three types of learning styles namely visual learning styles , auditory learning styles, and kinesthetic learning styles, or abbreviated as VAK. According to Aisyah (2017) each student has a different way of solving problems, this is thought to be influenced by his learning style.

The low ability of students to solve problems is also influenced by the lack of student interest when working on problems. Learning media has an important meaning in learning because it can help students explore knowledge, increase learning motivation and make learning more interesting. One of the learning media that can improve students' mathematical representation ability is the *Problem Card*. According to Hudojo (2005), mathematical ideas are learned by students through instructions, questions and exercises written on cards. By using these cards, students will absorb mathematical concepts, look for mathematical structures and solve problems. This *Problem Card* contains practice questions that are packaged in an interesting way. Usually students will be lazy if asked to do exercises. However, if the practice question is used as a *Problem Card* that looks interesting, it is hoped that students will be interested in reading and working on it.

In addition, the factor that affects students' mathematical representation ability is the learning model used by the teacher. Teachers are considered to be the main key as a problem solver with the ability to apply effective learning models in learning mathematics in school. According to Slameto (2013), mathematics learning is largely determined by the strategies used in teaching mathematics itself. In the learning strategy, it contains the learning model used. Learning that is assumed to be appropriate with this is learning using the *Anchored Instruction* model.

Anchored Instruction (AI) is a technology-based learning model developed by The Cognition and Technology Group at Vanderbilt University led by John Bransford. The *Anchored Instruction* learning model is developed with a special design based on an animation-based format called an "anchor" or "case" that provides a basis for exploration and association in solving problems (Rabinowitz in Ariyanto, 2011). AI learning model is considered to be more helpful to students in solving mathematical problems in class (Bottge, 2015). According to research conducted by Young (2004) states that the activities in the *Anchored Instruction* learning model provide a variety of problem solving experiences that are used to solve one problem so that it can be concluded that children who are given AI model learning have a higher problem solving power than problem solving in learning ordinary.

Based on the initial explanation, there are several formulations of this research problem, which are as follows (1) Are the learning outcomes on the aspects of mathematical representation ability in the *Anchored Instruction* learning model assisted by a *Problem Card* achieving classical completeness? (2) Are the learning outcomes on the aspect of mathematical representation ability for classes using the *Problem Card* assisted *Anchored Instruction* learning model better than classes using the *Anchored Instruction* learning model? (3) What is the description of the mathematical representation ability based on the learning styles of Grade VIII students using the *Problem Card* assisted *Anchored Instruction* learning model?

The purpose of this study is as follows (1) To find out the learning outcomes on the aspect of mathematical representation ability in the *Anchored Instruction* model to achieve classical completeness. (2) To find out the learning outcomes on the aspect of mathematical representation ability for classes using the *Problem Card* assisted Learning Model better than the class using the *Anchored Instruction* learning model? (3) To describe the ability of mathematical representation based on student learning styles with the *Anchored Instruction* learning model aided by *Problem Card*.

The hypotheses proposed in this study are as follows (1) the average test score of students' mathematical representation ability after attending the *Anchored Instruction* learning model with *Problem Card* reaches individual completeness (2) the mathematical representation ability of students in learning the *Anchored Instruction* model with *Problem Card* reaches completeness classical (3) learning outcomes on aspects of mathematical representation ability for classes using the

Anchored Instruction learning model aided by *Problem Card*s better than classes using the *Anchored Instruction* learning model.

2. Methods

This type of research used in this study is a mixed method or often called a combination research method. As for the research design used in this study is a sequential explanatory design, which is a research design that combines quantitative and qualitative methods. In the first stage, researchers collect and analyze quantitative data that refer to the figures from the value data obtained by students. This is to answer the first and second problem formulations. Then the second stage, researchers collected and analyzed qualitative data in the form of interview transcripts. This is to answer the formulation of the third problem.

The population used in this study were all students of class VIII of SMP Negeri 1 Banyubiru in the even semester of the 2018/2019 academic year, namely classes VIII A - VIII F. The technique used in sampling in this study was simple random sampling. Simple random sampling is done by randomly selecting two classes from the population without strata differences between each class. In this study, class VIII A and VIII B were selected as samples with class VIII A as the control class that was given treatment in the form of learning through the *Anchored Instruction* model and class VIII B as an experimental class that was treated in the form of mathematics learning through the *Anchored Instruction* model with *Problem Card*s. Determination of the subjects in this study used a purposive sampling technique, namely by selecting three research subjects from each student with visual, auditory, and kinesthetic learning styles.

The independent variable in this study is the learning style. While the dependent variable in this study is the mathematical representation ability of students. Data collection methods used in this study are (1) documentation method used to obtain data related to research; (2) the test delivery method used to obtain students' mathematical representation ability data; (3) students giving questionnaire methods in this study were used to obtain data on student learning styles; (4) and the interview method used to obtain in-depth information about mathematical representation capabilities in terms of student learning styles based on the tests provided.

Quantitative data analysis techniques are used to test whether learning outcomes on the aspect of mathematical representation ability in the *Anchored Instruction* learning model aided by *Problem Card* achieve classical completeness. While qualitative data analysis techniques are used to obtain a description of mathematical representation ability based on students' learning styles with the *Problem Card* assisted *Anchored Instruction* learning model. This qualitative data was obtained through interviews with nine research subjects in the experimental class. Where the subject is chosen based on the level of mathematical representation ability and student learning style.

3. Results & Discussions

Based on the analysis of the learning style questionnaire given to the experimental class students, it was found that each student has a different learning style. This is in accordance with the opinion expressed by Ramlah, et al (2014), which states that everyone has different learning styles tendencies. Besides DePorter (2005) also states that in reality we have all three learning styles, only one style dominates. From the results of the analysis of the learning style questionnaire, there are 7 students who have a type of visual learning style, 16 students have the type of auditory learning style, and 8 students have a type of kinesthetic learning style. This is consistent with the opinions expressed by Kartono (2019). dominates the types of student learning styles in research classes.

The results of this mathematical representation ability test are used for the final data analysis. Data on the mathematical representation ability of students from the two research classes is presented as follows.

Table 1. Data Value of Mathematical Representation Ability

Class	N	Average	Max	Min
Experiment	31	74,677	97	40
Control	31	80,645	97	47

Quantitative data analysis in this study includes the normality test, homogeneity test, hypothesis test 1, and hypothesis test 2. Based on calculations with SPSS 20.0 software, Sig = 0.115 is obtained. Clearly Sig. = 0.115 > 0.05 so H_0 is accepted. This means that the mathematical representation test value data comes from populations that are normally distributed. Based on this, for further analysis and calculation in this study using parametric statistics.

After the normality test, then proceed with the homogeneity test. Based on calculations with the help of SPSS 20.0 software obtained by Sig. Homogeneity test is Sig. = 0.465. Obviously Sig. = 0.465 > 0.05, so H_0 is accepted, which means that the data on the mathematical representation ability has the same or homogeneous variance.

Then hypothesis test 1 which is an average test and hypothesis test 2 which is a proportion test. Hypothesis 1 test is used to determine whether the average mathematical representation ability of students in the experimental class reaches individual completeness (actual completeness). Based on the results of calculations with ms.excel, obtained that t_{count}= 4.785894 and t_{table} with a probability of 0.95 and dk = 33, obtained t_{table} = 1.69552. Because t_{count} = 4.785894 > t_{table}= 1.69552, H_0 is rejected. In conclusion, the average test for students' mathematical representation ability is more than 60.5, so that it is declared complete.

Furthermore hypothesis 2 test is used to find out whether the average mathematical representation ability of students in the experimental class reaches the actual completeness of 60.5 and reaches the classical completeness of 75%. Based on the results of calculations using ms.excel, it was found that z_{count} = 2.021203and z_{table} with a significance level of 0.05 and probability = (0.5-0.05) = 0.45, obtained z_{table} = 1.64. Because z_{count} = 2.021203> z_{table} = 1.64, H_0 is rejected. In conclusion, the test results of students' mathematical representation ability by learning the *Anchored Instruction* model aided by *Problem Card*s achieve classical completeness. Based on the average test results and the one-party proportion test it can be said that the experimental class achieved mastery learning. This refers to the opinion of Masrukan (2014) which states that the criteria for mastery learning include individual completion and classical completion.

This average difference test is done to test the difference in the average value of the mathematical representation ability test in the experimental class and the control class. This average difference test is used to test the average mathematical representation ability in the experimental class is higher than the average mathematical representation ability in the control class.

Based on the results of calculations using ms.excel, it was found that t_{count} = 1.687261 and t_{table} with the degree of trust (α) = 0.05 and dk = 31 + 31-2 = 60, obtained t_{table} = 1.67065. Because t_{count} = 1.687261 > t_{table} = 1.67065, H_0 is rejected. In conclusion, students 'mathematical representation ability by learning *Anchored Instruction* models with *Problem Card*s is more than students' mathematical representation ability by learning *Anchored Instruction* models.

Based on this, it can be said that the *Anchored Instruction* model aided *Problem Card* is effective in achieving representation mathematics abilities. With the implementation of strategies that are in line with student learning styles, students with complete mathematical representation ability are obtained for all learning styles. Although in this study there are still indicators that are not yet fully mastered by students so further research is needed.

3.1. Mathematical Representation Ability in Visual Learning Styles

Students with a visual learning style with high mathematical representation ability in all three indicators, which consist of visual, symbolic, and verbal indicators are able to fulfill these indicators. They have no difficulty in the process of working because instructions on the questions are considered clear and easy to understand.

Students with visual learning styles with moderate mathematical representation ability are able to fulfill visual and symbolic indicators, but are less able to verbal indicators. In the process of working on the problem, students can not express the results of their thoughts in words. At the time of the interview, students can explain the steps of solving mathematical problems in their own words, but when working on the problem, students are confused in writing the steps of solving the problem in writing.

Whereas students with visual learning styles at low representation ability are able to meet visual indicators, namely drawing geometric shapes to explain problems and facilitate solving of 3 problem numbers correctly. Students do not experience difficulties in the drawing process because instructions on the questions are considered clear and easy to understand. For symbolic indicators, students are less able to fulfill. Students are correct in working on questions number 1 and 2, but make mistakes in working on problem number 3 because they do not understand the problem. In verbal indicators, students have not been able to meet the indicators on the number of questions given, namely number 4. Students have not been able to express the results of their thoughts with words. In addition, students also did not write down steps for solving problems in writing on the grounds they had run out of time in working on the questions. So students only write down what is known and what is asked in the problem.

Students with visual learning styles in interviews talk more quickly, often knowing what to say but not being able to choose words. Meanwhile, during the learning process, visual learning style students are more pleased if the objects related to learning are drawn on the board.

Based on this it can be concluded that the mathematical representation ability of students in the visual learning style of the *Anchored Instruction* learning model aided by *Problem Card*s is easier in making geometric shapes to explain problems and facilitate resolution.

3.2. Mathematical Representation Ability in Auditorial Learning Styles

Students with auditory learning style on high mathematical representation ability in all three indicators, which consist of visual, symbolic, and verbal indicators are able to fulfill these indicators. They have no difficulty in the process of working because instructions on the questions are considered clear and easy to understand.

Students with auditory learning style with moderate mathematical representation ability are already able to meet visual and verbal indicators, but are less able to symbolic indicators. There was an error in the process of working on the tests conducted by students on aspects of symbolic ability due to errors in determining the number of small boxes in the main gift box, determining the volume and conclusions.

While students with auditory learning styles with low representation ability are unable to meet the requirements of visual and symbolic indicators. As for verbal indicators, students have not been able to fulfill them. Students solve errors in block size images. While before, students really determine the size of the beam. The student also admitted that it was difficult to distinguish between lengths, widths, and heights. Then students are less able to fulfill the symbolic indicator in number 3, because there is no need for volume symbols and the number of small gift boxes in the prize box won, and in question number 2 do problems in entering numbers in calculations, for verbal indicators, students are not able to produce their results with words. In addition, students also cannot decide on the problem-solving steps that must be done. Can students only discuss what is recognized and what is asked in the problem.

Students with auditory learning style during the interview talk more. While learning, students are easily distracted by noise, move their lips when reading, and students learn by listening and remembering what was discussed rather than what they saw.

3.3. Mathematical Representation Ability in Kinestetic Learning Styles

Students with kinesthetic learning styles with high mathematical representation ability in all three indicators, which consist of visual, symbolic, and verbal indicators are able to fulfill these indicators. They have no difficulty in the process of working because instructions on the questions are considered clear and easy to understand.

Students with kinesthetic learning styles with moderate mathematical representation ability are able to meet visual and symbolic indicators, but have not been able to verbal indicators. Students have not been able to meet verbal indicators because students are only able to answer what is known and what is asked.

While students with kinesthetic learning styles with low representation ability are able to meet visual indicators, but are less able in symbolic indicators and have not been able to in verbal indicators. Students are less able to meet the symbolic indicators, because they do not understand the problems so they are wrong in working on the solution. While on verbal indicators, students do not write answers at all.

Students with kinesthetic learning styles during the interview speak slowly, and use their hands to explain. While during learning, students cannot be silent. They touch or make movements to get attention.

4. Conclusion

Based on the results of the analysis and discussion, it was concluded that (1) student learning outcomes in the aspect of mathematical representation ability in the *Anchored Instruction* learning model assisted by the *Problem Card* reached classical completeness; (2) learning outcomes on aspects of mathematical representation ability in the experimental class using the *Problem Card* assisted *Anchored*

Instruction learning model are better than the control class using the *Anchored Instruction* learning model, (3) students with high mathematical representation ability in visual, auditory learning styles, and kinesthetic has been able to meet all indicators, namely indicators 1, 2, and 3. Then students with mathematical representation ability are in the visual learning style, auditory, and kinesthetic able to meet indicator 1. For indicator 2, students with visual and kinesthetic learning styles have able to meet, but students with auditory learning styles are less able to meet indicator 2. Whereas for indicator 3, students with visual learning styles are less able to meet indicators, students with auditory learning style types are able to meet indicators, and students with kinesthetic learning styles have not been able to meet indicator 3. Students with a return Low mathematical representation ability on indicator 1 on visual and kinesthetic learning styles has been able to meet the indicators, while students with auditory learning styles are less able to meet the indicators. For indicator 2, students with visual, auditory and kinesthetic learning styles are less able to meet the indicators. Then for indicator 3, students with visual, auditory and kinesthetic learning styles have not been able to meet the indicators. In this case the indicators used are (1) drawing geometric shapes to explain problems and facilitate solving, (2) making equations or mathematical models of the problems or information provided, and (3) writing steps to solve mathematical problems with words.

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