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Mathematics Literacy based on Visual-Spatial Intelligence 7th Grade Students on Discovery Learning with Performance Assessment

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Abstract

This study aims to determine the effectiveness of discovery learning with a performance assessment of students 'mathematical literacy and analyze students' mathematical literacy based on visual-spatial intelligence. This study used a mixed method with concurrent embedded. Subjects of this studi were 7th grade students of SMP An Nur Ungaran 2017/2018 school year. The results of the study show that discovery learning with performance assessment effective of students' mathematical literacy. Students with high visual-spatial intelligence can reach each indicator well, although some indicators have insignificant errors. Students with middle visual-spatial intelligence have significant errors on each indicator. Students with low visual-spatial intelligence cannot achieve every indicator of mathematical literacy. Found uniqueness in students with high visual-spatial intelligence, namely with the presence of images contained in the problem, students are helped to understand the problem presented. Understanding or communication is the main key for students to continue the next stage of mathematical literacy. However, students with high visual-spatial intelligence are constrained in algebraic material.

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INTRODUCTION

Literacy has a multiplier effect, including eradicating poverty, reducing child mortality, curbing population growth, achieving gender equality, and guaranteeing sustainable development, peace and democracy (UNESCO, 2015). Mathematical literacy plays a role in improving the quality of people's lives as the culprit. This is confirmed by Sari et al (2015), Wahyuningsih et al (2017), and Lange (2006), through mathematical literacy skills, one will be able to apply the concept of knowledge to solve everyday life problems that can be the main capital to meet demands working world. That is why, mathematics is still believed to be a thinking tool that is useful for dealing with new times (Zevenbergen, 2004). The mathematical literacy that is taught through education is intended so that people are skilled in facing the challenges of the life to come. Of course, to know literacy skills for the readiness of competitiveness between nations, Indonesia needs to measure it.

Student mathematics literacy as had been shown by the 2015 Program for International Student Assessment, Indonesia ranks is 63 out of 71 countries with a value of 386, while the overall average is 490 (OECD, 2016). In fact, Indonesian students' mathematical literacy scores on content change and relationship (26.0); space and shape (25.8); and quantity (25.9) is weak (Mahdiansyah & Rahmawati, 2014). Students turned out to be less able to understand teaching material especially geometry. If viewed from the national scale indicated by the report on the results of the junior high school national examination in 2017 that the mastery of mastery of the subject matter, students in Indonesia lack in terms of the ability to understand the nature and elements of building space, and use it in problem solving (Puspendik, 2015). In the national exam there are questions related to everyday problems, it can be concluded that students in Indonesia have not been able to solve mathematical literacy questions properly. This is because mathematical literacy is in line with the Standard Content of mathematics subjects in the 2013 curriculum (Wardono, 2014: 364). Thus, the data can be used as supported data of the refelection Indonesia students' mathematical literacy.

SMP An Nur Ungaran was the implementing place of this study. Regrading mathematics learning activities by using 2013 curriculum. Based on the observations of mathematics learning activities at SMP An Nur Ungaran, students had a habit of being silent when asked, hesitant in expressing questions or answers, waiting for teacher guidance, and having difficulty in solving math problems, especially in geometry material. Geometry learning is useful for students as a basis for mastering, learning, and understanding other mathematical material as well as geometry concepts at a higher level (Buyung et al, 2017). Students can develop mathematical literacy in the form of space & space when learning geometry. In this study, we examine the basic material of geometry, namely lines and angles. This is adjusted to the academic potential of students in Ungaran's diverse An Nur Middle School. This diversity of academic potential or multiple intelligence students confirms that there are various ways to improve students' mathematical literacy (Fathani, 2016: 144).

Basically, every individual has a lot of intelligence or is known as multiple intelligences. Gardner (1983) defines at least eight kinds of multiple intelligences, namely linguistics, logical-mathematics, visual-spatial, interpersonal, intrapersonal, musical, bodily kinesthetic, and naturalist. In line with space and shape content, visual-spatial intelligence is the ability to provide images and the ability to transform the world of visual space, including the ability to produce mental images and create graphical representations, three-dimensional thinking, and re-create the visual world (Rahmah, 2008) . Thus, basically individuals have senses of geometry and can be optimized through learning activities.

According to Kusumawardani (2015), through discovery learning models give students the opportunity to play an active role in the learning process and the application of discovery learning can improve students' mathematical literacy. The active role of students will appear in data processing and verification. In both of these activities, students are asked to prove the correctness or failure of the hypothesis set out, related to the information obtained. Then, students are asked to interact with other students in the group in conducting a careful examination to prove the correctness or failure of the hypothesis set earlier. Balim (2009: 16) states that the

discovery learning model is effective for the success of student learning outcomes. In addition, the involvement of active students in learning accompanied by appropriate media can also improve visual-spatial intelligence of students (Gani et al, 2017: 21).

The strategies of learning are the most important process to be attentive. According to Wiyanto et al (2006) the assessment strategy is one of the factors that can facilitate the success of learning. The use of appropriate assessment during the geometry learning process is a matter that can increase the mastery of capabilities to be achieved (Masrukan et al, 2017). Thus, an assessment of the learning process is needed as a decision-making tool about the quality of learning shown. According to Stenmark (1991) performance assessment is useful to increase students' understanding of the problems given and the solutions they are working on and make learning more relevant to real life.

Based on the benefits, this assessment is suitable juxtaposed with discovery learning models to improve students' mathematical literacy. If viewed from the target to be achieved a performance assessment that includes knowledge, reasoning, skill, product, affect is in accordance with the spirit of discovery learning learning scientific approach. The results of the Maretasani (2016) study emphasize that good performance (performance) students will achieve goals (orientation) which in this context is solving mathematical problems. Based on the previous description, the purpose of this study are: (1) testing and knowing the effectiveness of the discovery learning model with a performance assessment of student literacy and (2) analyzing student literacy based on visual-spatial intelligence.

METHODS

The type of research used is mixed method (quantative and qualitative mixture). The mixed method research design that will be used is concurrent embedded. Mathematical literacy data collection on discovery learning with performance assessment will use quantitative and qualitative methods simultaneously. The quantitative research design used was a quasi experimental design type nonrandomized control group, pretest-posttest design.

The study had been done at SMP An Nur Ungaran with angular and line material. The experiment is applied on 2 sample class, which are 7^{th} grade B as an experimental class by using discovery learning wuth performance assessment and 7^{th} grade A as control class by using discovery learning.

The technique of collecting data of this study would be done by mathematical literacy test. Mathematical literacy tests would be conducted twice, which are before treatment (pretest) and after treatment (posttest). The other collection data for student skill based on visual-spatial intelligence would use visual-spatial intelligence test and interviews. The visual spatial intelligence test adopted from Hindal (2014) consisting of 33 items. The results of construct validity and content validation carried out by two (judgment experts) in this case the master of psychology showed a visual spatial intelligence test categorized well with an average score of 3.86 and categorized very well with an average score of 4.86. In addition, the visual spatial intelligence test has been tested and tested for its validity and reliability. Thus, visual spatial intelligence tests can be used.

The technique of data analysis on students' mathematical literacy by discovery learning with performance assessment would use prerequisite test of the initial capability test, the data included normality and homogeneity test and average similarity test, while the analysis of hypothesis testing used final ability test data includes normality test, homogeneity test, completeness test, average difference test, and difference difference average test.

RESULT AND DISCUSSION

The grouping of students based on visual-spatial intelligence was done before the implementation of the learning process. The results of the analysis on the visual-spatial intelligence test obtained student grouping data presented in Table 1.

Table 1. Student Grouping Data based on Visual-Spatial Intelligence

Category of Visual-Spatial Intelligence	Number of Student
High	10
Middle	9
Low	4

Based on Table 1, the percentage of selected research subjects was 20% of the number of students in the class, namely each of the visual-spatial intelligence categories was chosen by 2 students. Based on the results of data analysis showed that the two samples came from a population with normal distribution, had a homogeneous variance, and there was no difference in average. Thus, both samples have the same conditions.

The examples of problems given to students to test mathematical literacy can be seen in Figure 1. Regarding the description of students' mathematical literacy in general are summarized in descriptive statistics of mathematical literacy in Table 2.

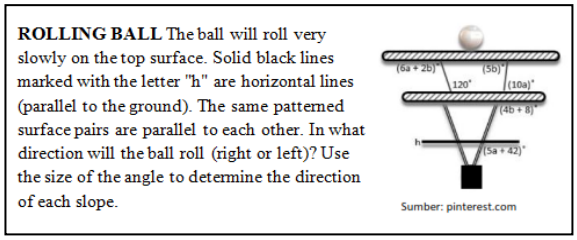

Figure 1. Examples of Problems with Space and Shape Content Literacy

Table 2. Descriptive Statistics of Student Mathematics Literacy

Descriptive Statistics	Experiment	Control
Means	71.43	61.52
Variance	170.07	114.26
Standard Deviation	13.04	10.69
Completeness	78.26%	50.00%

The results of the study showed that the mathematics literacy of students in the class using discovery learning with a performance assessment reached the minimum completeness limit, which was 78.26%. That is, students in the class that apply discovery learning with performance assessment are completed individually. The results of the independent t-test showed that the mathematics literacy average of students in the class using discovery learning with performance assessment was more than the mathematics average of students in the class using discovery learning. Thus, discovery learning with an effective performance assessment of mathematical literacy of 7th grade students of SMP An Nur Ungaran 2017/2018 school year.

Student activities on discovery learning with performance assessment in the form of learning experiences to rediscover the completion of a problem. Experience of discovery learnimg with performance assessment in accordance with Ausubel learning theory, namely learning to rediscover concepts found by students makes students learn meaningfully (Suherman, 2003: 32-33). The process of discovery learning directly supported by performance assessment is useful for detecting students' abilities in terms of knowledge and skills (McNaught, 2015: 73). Performance assessment is a form of evidence from the supervision of the continuity of the learning process which is certainly in accordance with the ability of students' knowledge and skills.

The targets that must be achieved by students will be recorded in the performance assessment sheet, namely knowledge, reasoning, skill, product, affect (Masrukan, 2014: 34). Thus, discovery learning with performance assessment requires students to do something. Student activities assessed include the preparation phase of the material / tool that will be used for work, implementation in solving the problems presented, and reporting the accuracy and completeness of the completion individually or in groups. This is in line with Arhin (2015: 110) which states that performance assessment is a complete type of assessment because it combines summative assessment and effective formative assessment. In the process of discovery learning with student performance assessment will be assessed as an illustration of the student's performance. On the one hand, this value can be used as a form of appreciation for students for their performance. According to Schreurs (2014: 108), having respect for individuals will have a positive emotional impact so that the individual can show positive behavior.

Student mathematics literacy data based on visual-spatial intelligence includes indicators, namely (1) communication, (2) mathematical, (3) representation, (4) reasoning and argumentation, (5) devising strategies for solving problems, (6) using symbolic, formal, and technical language and operation, (7) using mathematics tools. The percentage of student literacy scores based on visual spatial intelligence is shown in Figure 2.

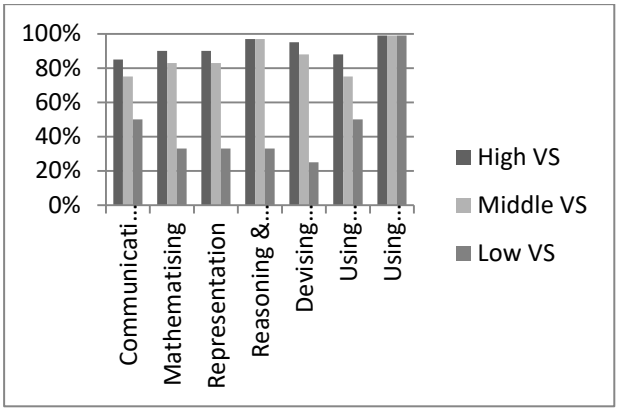

Figure 2. Percentage of Mathematics Literacy Scores for Students based on Visual-Spatial Intelligence

Based on Figure 2 shows that mathematical literacy of students who have high and medium visual spatial intelligence is better than mathematical literacy students who have low visual spatial intelligence. The lowest achievement of mathematical literacy of students who have low visual spatial intelligence is on the mathematical indicators up to using symbolic, although there are similar results with the high and medium visual spatial intelligence categories, namely the using mathematics tools indicator. The aspect of using mathematics tools requires students to help represent images clearly with the hope that these images can help students find the correct completion of the problem. When solving mathematical literacy problems it is important for students to understand the communication aspect. The communication aspect can be reflected when students can express what is known and asked in the mathematical literacy questions presented. After students understand the problem, students will implement mathematical and devising strategies for solving problems. If students experience problems in both cases, students will be constrained by reasoning and argumentation, and using symbolic, formal, and technical language and operation to find the final solution to the problem of mathematical literacy.

Mathematical Literacy

Mathematical literacy of students with high visual-spatial intelligence is better than students with moderate and low visual-spatial intelligence. This is shown by students with high visual-spatial intelligence in terms of communication. Because the question of literacy presented is included in the space and shape content, students with high-intelligence visual-spatial help are communicated to what is known and asked with images. This is in line with the opinion of Riastuti (2018: 1) which states that high visual-spatial intelligence can help students solve geometry problems.

Students with high visual-spatial intelligence can easily represent the problems presented in mathematical literacy questions in the form of appropriate images. When representing an appropriate image to answer literacy questions, students with high visual-spatial intelligence use mathematical tools in the form of rulers. This is always done by students with high visual-spatial intelligence in order to facilitate their vision in reasoning.

Students with high visual-spatial intelligence can also do reasoning easily and he can mention the reasons for each completion he wrote. Although students with high visual-spatial intelligence can express from problems drawn to mathematical forms, they do not carry out the operation of algebraic equations perfectly. Students with high visual-spatial intelligence tend to use logic in completing algebraic equations or in this case at the mathematical stage. However, the disadvantage is that if students with high visual-spatial intelligence encounter algebraic equations that are not simple, then they experience difficulties. This is because students with high visual-spatial intelligence lack understanding in the procedure for completing algebraic equations.

Mathematical literacy of students with middle visual-spatial intelligence is similar to students' mathematical literacy with high visual-spatial intelligence. However, at the communicating stage, students with middle visual-spatial intelligence are

less than optimal. They cannot communicate what is known and are asked to use their own sentences. They write down what is known and are asked to use the same sentence as in the matter of literacy. Likewise at the stage of representing the problem in the form of images, students with middle visual-spatial intelligence describe the problem in accordance with the image presented in the question, which is accompanied by images that are not concerned with solving the problem of literacy.

Students with middle visual-spatial intelligence illustrate illustrations of mathematical literacy questions given using a ruler tool. The reason for using a tool is because it makes it easier to determine the problem solving strategy. In reality, students with middle visual spatial intelligence still have difficulty when determining literacy problem solving strategies, even after drawing. As a result the reasoning is sometimes wrong, so that it leads to the mathematical stage.

Starting from the main indicator, namely communication. Students with low visual spatial intelligence cannot communicate well about what is known and asked about mathematical literacy questions. This means that students with low visual spatial intelligence do not understand the questions given. As a result, these students have difficulty achieving the next indicator, except using mathematics tools.

The use of mathematical tools can be done well by students with low visual spatial intelligence. They have been accustomed to using mathematical tools or in this case a ruler by a mathematics teacher during mathematics learning. Habituation in learning is one of the methods of the teacher in educating students. Habitualism not only teaches knowledge, but is able to have an impact on students so students can feel the value of good and not, and are willing to do so from the smallest scope to a wider range (Hapsari, 2016: 9). Thus, students' reflexes when describing lines are required to use a ruler.

In a study that sought to improve mathematical literacy, students with high visual-spatial intelligence found uniqueness. The uniqueness is that with the images contained in the problem, students are helped to understand the problem presented. Understanding or the stage of communication (on mathematical literacy) is the main key for students to be able to continue the next stage of mathematical literacy.

CONCLUSION AND RECOMMENDATION

Based on the results of the study it can be concluded that discovery learning with effective performance assessment of students' mathematical literacy. Students with high visual-spatial intelligence can achieve all indicators of mathematical literacy even though some indicators of mathematical literacy exist with insignificant errors. Students with middle visual-spatial intelligence on each indicator of mathematical literacy have a significant error. Students with low visual-spatial intelligence cannot reach some indicators of mathematical literacy properly. Because the material tested is related to shape & space content, the association with students with high visual-spatial intelligence is relevant. However, students with high visual-spatial intelligence are constrained in algebraic material.

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