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The Use of Discovery Learning with Hands on Activity to Mathematical Literacy

Abdullah*

Universitas Negeri Semarang, Indonesia

*Corresponding Author: abdulbima92@gmail.com

Abstract. The background of this research is caused by the problem of low mathematical literacy ability which causes some students to be unable to solve mathematical contextual problems. The teacher centered learning process does not provide opportunities for students to develop their ideas properly so that students find it difficult to understand concepts correctly. Discovery learning is student centered learning so that students can build their ideas and discover concepts through their mental processes. Hands on activity is a learning media that supports student learning activities. The purpose of this study was to determine the effectiveness of discovery learning with hands on activity on mathematical literacy. This study uses a mixed methods. The research data was obtained through tests of students mathematical literacy, interviews and observation. The research sample consisted of 66 students of class X semester 1 of SMAIT Nurul Islam Tengaran. Quantitative data analysis using descriptive and inferential statistics. Qualitative research subjects were obtained from students who had the highest ranking in the previous class. So that the two highest ranking subjects were chosen, namely S1 and S2. The gain test obtained a significance of 0.000 <0.05, this indicates that there is an increase in mathematical literacy in the experimental class which is higher than the control class. The subject of S1 is able to master the 5 indicators of mathematical literacy very well. While S2 is able to master the 4 indicators of mathematical literacy well. Through discovery learning with hands on activity students can improve their mathematical literacy ability.

Keywords: Discovery Learning; Hands on Activity; Mathematical Literacy

INTRODUCTION

Mathematics is a universal science that forms the basis for the development of modern technology. Mathematics has a very important role in various disciplines and develops the reasoning power of human thinking. Human thinking ability is needed in the process of solving problems so as to be able to provide effective solutions. Where the ability to solve problems is the most important part in mathematical literacy. The existence of industry 4.0 demands to increase competitiveness in a very dynamic modern era. This means students or the public must develop self skills to master all information and knowledge. In line with this statement that in an effort to develop critical, logical and systematic thinking skills, mathematics is needed (Lailiyah et al., 2023). Therefore, mathematics plays an important role in preparing qualified and competitive human resources in the modern era ahead.

Mathematical literacy is a basic ability that is important for students to develop the quality of education. In this regard, having good mathematical literacy can solve contextual problems related to everyday life problems (Nur Hidayat et al., 2021). Mathematical literacy does not only have the ability to count, but students can reason and think logically in solving mathematical contextual problems related to everyday life (Maslihah et al., 2020). In line with this opinion that mathematical literacy does not only require mastery of the material, but requires reasoning, concepts and the use of mathematical tools to solve mathematical problems (Rahmah Hayati, 2019). Mathematical contextual problems are related to mathematical literacy. So that through the literacy process students can grow literacy in reading, arguing, counting, reasoning and interpreting mathematical symbols and concepts (Umbara & Suryadi, 2019). Mathematical literacy encourages one's awareness of the role of mathematics in life. Because the role of mathematical literacy is very important in the wider community, so those who are literate are not only students but the wider community in general (Genc & Erbas, 2019). Besides that, mathematical literacy is a component of mathematics that really encourages students to understand concepts and apply them to every situation (Salsabila et al., 2019). In line with this opinion that mathematical literacy is an individual's ability to formulate, present and interpret mathematical problems in various contexts (Syawahid, 2019). Because through the literacy process students will directly improve communication skills. Because mathematical communication skills are essential in the mathematical literacy component (Ahdhianto et al., 2020). In addition, that through mathematical literacy makes people aware and understand the

role of mathematics in real life (Genc & Erbas, 2019).

The results of participation in the assessment through the Program for International Student Assesment (PISA) sponsored by the Organization for Economic Cooperation and Development (OECD) from 2000 to 2018. The 2018 PISA test results show that Indonesia's mathematical literacy is still below the international average score. Of the 79 participating countries, Indonesia ranks 73rd with a score of 379 (OECD, 2019). There are several factors that impede students mathematical literacy, namely because students are used to questions that are routine in nature so that non routine questions related to contextual mathematical problems are not used to being worked on (Hakim et al., 2022). In line with this opinion, factors that affect students mathematical literacy abilities are also influenced by learning environment factors (Imamuddin & Sepriyanti, 2022). So that it is difficult for students to identify problems and make them in the form of simple mathematical models (Rahmah Hayati, 2019). One of the most important components needed in the 21st century is mathematical literacy ability (Susanta et al., 2022).

Based on the results of observations at SMAIT Nurul Islam Tengaran, the results of the math literacy test were still low. This was evidenced by students still not being able to master the PISA level related to mathematical competence, namely levels 6, 5, and 4 well. Where at each of these levels it is closely related to indicators of mathematical literacy, namely communicating, mathematizing, representation, reasoning and argument, and devising strategies for solving problems.

The role of learning methods or models is needed so that students mathematical literacy skills can increase. In addition, the role of the educator is the first component in the learning process activities. Discovery learning is a student-centered learning model that can encourage cognitive activity through literacy activities so students can discover concepts and apply them (Tokada et al., 2017). Through discovery learning it can improve students cognitive abilities because students are directly involved in learning activities so that recovery learning is very effectively implemented in the classroom (Gunawan et al., 2020). In line with these findings that implementing discovery learning in the classroom can develop students literacy habits (Winarni et al., 2020). To support the literacy process activities, it is supported by learning media based on Hands on Activity. Hands on activity is any activity that creates students direct experience with problem objects where students solve problems by involving hands directly (Nurjanah et al., 2020). In addition, learning through hands on activity is effective in increasing conceptual understanding, fostering active student learning, and improving good communication (Wardono et al., 2020). Communication skills are one of the indicators of mathematical literacy, so that hands on activities can encourage students to be more active and enthusiastic in solving mathematical problems through hands on activities.

METHODS

This study uses a mixed methods research method that focuses on the effectiveness of hands on activities based discovery learning on students mathematical literacy abilities. The research subjects were class X SMAIT Nurul Islam Tengaran, totaling 66 students. Data were obtained through tests of mathematical literacy skills, structured interviews, and observation. Quantitative data were analyzed using descriptive and inferential statistics. Meanwhile, qualitative data analysis was carried out by selecting two subjects who had the highest ranking from the previous class. Then given the problem of mathematical literacy each of the two problems. The results of student answers were analyzed based on indicators of mathematical literacy and structured interviews. Indicators of mathematical literacy can be presented in the table below.

Table 1. Relationship between mathematical processes and basic mathematical ability

	Formulating	**Employing**	**Interpreting**
Communicating	Reading, making questions, objects or pictures that make sense of a problem	Indicates the work involved in obtaining a solution	Build and communicate explanations and arguments in the context of the problem
Mathematising	Identify variables and mathematical structures that underlie realistic problems	Using understanding in a context to accelerate completion	Understanding the levels and limitations of the mathematical solutions of the models used
Representation	Representing real world problems in a mathematical form	Can understand, connect and use various representations in interacting with problems	Can connect two or more representations related to the problem situation.
Reasoning and Argument	Describes, provides justification for identifying and designing representations of the real world	Provide justification for the processes and procedures used to determine outcomes	Describe a mathematical solution and provide explanations and arguments to support it
Devising strategies for solving problems	Selecting or devising a plan to reshape real world problems	Enables effective control mechanisms on multi step completion procedures	Design and implement strategies to evaluate and validate solutions.
Using symbolic, formal and technical language and operations	Use appropriate variables, symbols, diagrams and models to describe contextual problems	Understand and utilize formal constructs based on definitions, rules and use algorithms	Understand the relationship between the problem context and the representation of the solution
Using mathematical tools	Use mathematical tools to describe mathematical relationships	Know and use mathematical tools according to the context of the problem	Use mathematical tools and remember the context of the problem

RESULTS AND DISCUSSION

This study focuses on indicators of mathematical literacy, namely communicating, mathematizing, representation, reasoning and arguments, devising strategies for to solve problems, mathematical symbols and formal language and rules and using mathematical tools.

Table 3. Increase Test Results (Gain)

Independent Samples Test

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*Lower*	*Upper*
Value_G	*Equal variances assumed*	3.299	.074	9.993	58	.000	.47567	.04760	.3803	.57095
	Equal variances not assumed			9.993	50.499	.000	.47567	.04760	.3800	.57125

Based on the gain test results in table 3, obtained a significance value of 0.000 <0.05. So it can be concluded that the class that gets discovery learning with hands on activity is higher than the students in the class that get conventional learning.

The research subjects were obtained from students who had the highest ranking from the previous class, so S1 and S2 subjects were selected. The two subjects were given math

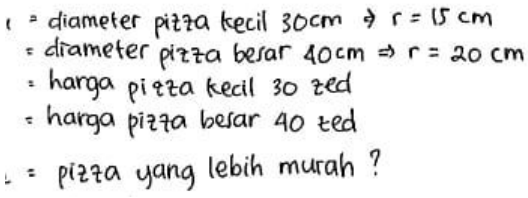
literacy questions then followed by interviews to reconfirm the answers they had written.

Mathematical literacy problem

"A pizza shop serves two choices of pizza with the same thickness but different sizes. The small pizza has a diameter of 30 cm and costs 30 zed and the large pizza has a diameter of 40 cm and costs 40 zed. Which pizza is cheaper. Give the reason?"

The results of the work can be analyzed based on seven indicators of mathematical literacy, namely communicating, mathematising, representing, reasoning and argument, devising strategies, using symbolic, formal and technical language and operations, using mathematical tools. The following is the result of student work.

Problem Solve by the Subject of one (S1)
Understanding Problems

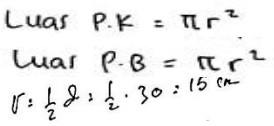


Translation:
The diameter of a small pizza is 30 cm. So that, the radius of a small pizza is 15 cm
The diameter of a big pizza is 40 cm. So that, radius of a big pizza is 20 cm.
The price of a small pizza is 30 zeds
The price of a large pizza is 40 zeds
which pizza is cheaper?

Figure 1. Stage of understanding the problem S1

Based on Figure 1, S1 is able to understand the information conveyed by the problem, it can be seen that S1 is able to write down what is known. This shows that S1 is able to communicate real world information in writing into a simple mathematical form, so that the indicator of mathematical literacy, namely communicating is fulfilled.

Devising a Plan

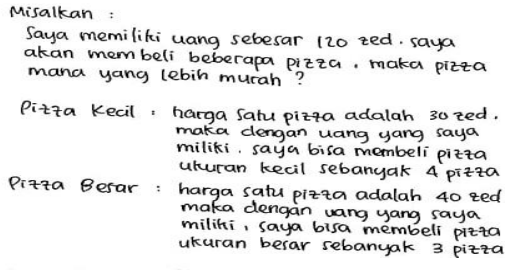


Translation:
Area of small pizza = πr^2
Area of large pizza = πr^2

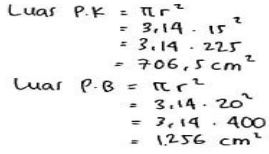
Figure 2. Stage Devising a Plan of S1

Based on Figure 2. S1 is able to make a good settlement plan. This can be seen from the results of S1 work being able to write the formula for the area of a circle and the formula for the radius of a circle well. This shows that S1 is able to relate mathematical concepts to real world applications.

Carry Out the Plan



Translation:
Example:
I have 120 zeds. I will buy some pizza, so which pizza is cheaper?
The small Pizza = The price of one pizza is 30 zeds, so with the money I have, I can buy 4 small pizzas
The large pizza = The price of one pizza is 40 zeds, so with the money I have, I can buy 3 big pizzas



Translation:
Area of a small pizza is 706,5 cm^2
Area of a large pizza is 1.256 cm^2

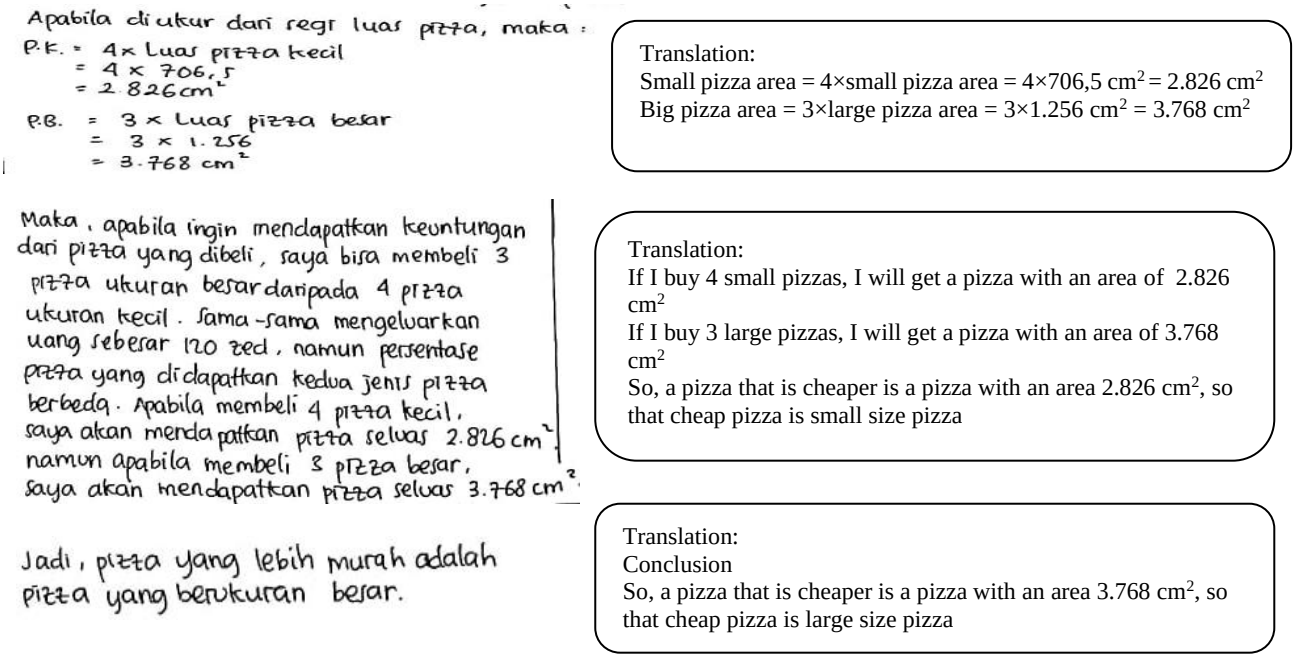


Figure 3. Stage of Carry Out the Plan of S1

From the results of the work in Figure 3 that S1 has been able to apply mathematical concepts well, it can be seen that S2 is able to calculate the area of a pizza circle and the length of the radius of the circle. It can be seen from the results of undergraduate work that they are able to apply indicators of mathematical literacy well, namely representating, reasoning and arguments, devising strategies for problem solving, using symbolics, formal language and rules. this shows that using discovery learning can improve students' critical thinking (Putri et al., 2020). The results of this study are also supported by other studies that use discovery learning to increase student activity in learning (Waziana et al., 2020).

Looking Back

Based on the results of S1 work, it shows that S1 has been able to systematically solve problems well. This can be seen at the stage of understanding the problem S1 is able to write down the information contained in the problem. At the stage of drawing up a plan or strategy for solving S1, they are able to connect mathematical concepts in a simple way, namely writing the formula for the area and radius of a circle. The stages of implementing the settlement plan can be seen that S1 calculates the area and radius of the circle carefully and S1 is also able to make a good illustration of simplifying the problem. This can be seen that S1 makes an example in figure 3. Then makes conclusions based on the solution well. This can be seen that the indicators of mathematical literacy are well fulfilled.

Problem Solve by the Subject of Two (S2)
Understanding Problems

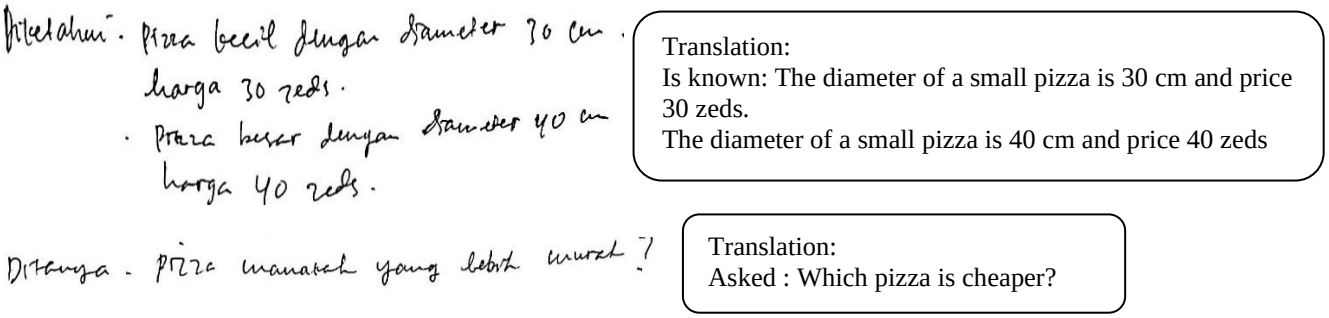


Figure 4. Stage of understanding the problem S2

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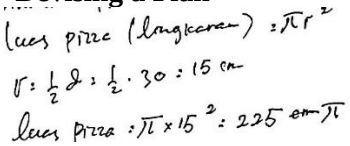
From Figure 4 it is found that S2 is able to rewrite information contained in real world problems such as writing down what is known and what is asked. This can be seen that the indicators of mathematical literacy are fulfilled.

Devising a Plan

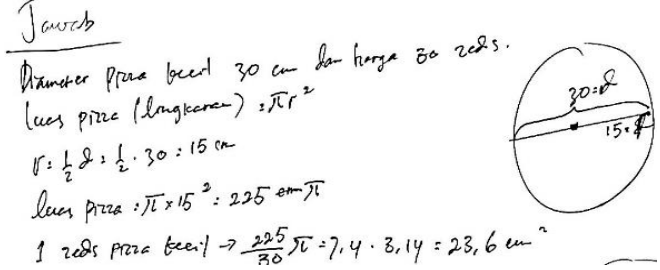


Translation:
The area of a small pizza and big pizza = πr^2

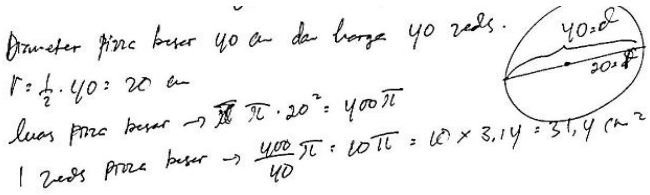
Figure 5. Stages Devising a Plan S2

Based on Figure 5, it shows that S2 is able to connect understanding of mathematical concepts from real world problems, it can be seen that S2 writes the formula for the area and radius of a circle.

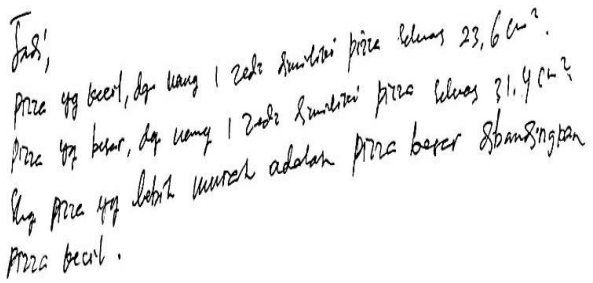
Carry Out the Plan



Translation:
Answer : The area of a small pizza 30 cm and price 30 zeds. Area of small pizza is πr^2.
The area of a small pizza is $\pi \times 15^2 = 225\pi$.
So that, the price of 1 zeds small pizza is 23,6 cm^2



Translation:
The area of a large pizza 40 cm and price 40 zeds. Area of large pizza is πr^2.
The area of a large pizza is $\pi \times 20^2 = 400\pi$.
So that, the price of 1 zeds large pizza is 31,4 cm^2



Translation:
The small pizza, 1 zeds can get a pizza with an area 23,6 cm^2.
The large pizza, 1 zeds can get a pizza with an area 31,4 cm^2.
So that, then a cheaper pizza is a large pizza with an area 31,4 cm^2

Figure 6. Stage of Carry Out the plan S2

Figure 5 shows that S2 is able to calculate the area and radius of small and large pizza circles. The results of S2 work are also seen to be able to determine the price of 1 zeds can get a small pizza with an area of 23,6 cm^2 and the price of 1 zeds can get a large pizza with an area of 31,4 cm^2. Then S2 is also able to draw conclusions correctly. However S2 didn't draw correctly, but S2 was able to calculate the radius by r =1/2 d. This can be seen in Figure 6. This shows that S2 is able to show indicators of mathematical literacy well, namely communicating, mathematising, reasoning and arguments, using symbolic and formal language and rules and making interpretations by concluding the results of the solution correctly. through the application of discovery learning can improve mathematical reasoning, communication, and self confidence (Siregar et al., 2020). In addition, applying discovery learning can improve students'

mathematical problem solving (Purwaningsih et al., 2020).

Looking Back

Based on the stage of understanding the problem that S2 is able to write down what is known and what is asked. The master's problem solving planning stage is able to connect mathematical concepts correctly. Then the implementation stage of planning S2 was able to describe the answers correctly. So that the indicators of mathematical literacy are visible, but the indicators using mathematical tools are not visible because S2 only draws circles manually. After conducting interviews that S2 did not draw using anchors.

CONCLUSION

Based on the results of the gain test analysis, it was obtained that the class value increase in discovery learning with hands on activity was higher than the class that received conventional learning. Based on the results of solving mathematical literacy problems, it was found that S1 and S2 subjects were able to apply 5 indicators of mathematical literacy well, namely communicating, mathematising, representation, reasoning and argument, devising strategy, using symbolics and formal, technical language, using mathematical tools. Both subjects were able to reason and argue well. So that through discovery learning with hands on activity it is effective in increasing students' mathematical literacy.

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