

Effect Of Differentiated Learning On Science Literacy Skills Of Junior High School Students

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ABSTRACT

This study aims to determine how the implementation of differentiated learning with the Discovery Learning model, is there an effect of differentiated learning on student abilities, and how students respond to differentiated learning. The research design used in this research is Pre-Experimental Design with Pretest-Posttest Control Group design form. The data analysis technique in this research is quantitative. This research was conducted in one of the schools in Lamongan in the 2023/2024 school year with a sample size of 60 students. The results showed that 1) Based on the observation results, the implementation of differentiated learning with the Discovery Learning model is included in the very good category with an average observation score of 88%. 2) Differentiated learning is proven to have a significant effect and can improve science literacy skills as evidenced by the N-Gain results of 0.70 in class 7D and 0.66 in class 7E. 3) Student responses to the application of differentiated learning fall into the very good category, as evidenced by the percentage of students answering the questionnaire of 90% in the very good category, 8.3% in the Good category, 1.6% in the Fair category, and 0% answering Very Poor.

Keywords: *Differentiated Learning, Discovery Learning, Science Literacy.*

INTRODUCTION

Quality education is education that can meet and support every student in meeting their needs Afurqan et al., (2020) in (Miqwati et al., 2023). The different characteristics and uniqueness of each student is a common thing in learning (Mujiono et al., 2018; Miqwati et al., 2023). Although students are in the same place or class, it cannot be denied that there are differences such as learning styles, backgrounds, initial abilities of students, and differences in student learning interests.

The diverse characteristics and abilities of students make teachers have to think more creatively in order to prepare and provide learning activities that can meet the needs of students according to the needs of interests and abilities based on their development (Rogowsky et al., 2020; Morgan, 2013; De Jager, 2013). One of the lessons that can accommodate the differences in students' diverse learning abilities is through recognizing the talents and learning styles of each learner. Knowing students' talents and learning styles will make it easier for teachers to map out more optimal learning activities.

Differentiated Learning is a learning model that is carried out by adjusting student learning needs (Herwina, 2021) or (Student center learning) student-centered learning (Fitra, 2022; Miqwati et al., 2023). In differentiated learning, there is a readjustment of students' interests and readiness to get improved learning outcomes (Smale Jacobse et al., 2019).

Effective learning activities are certainly the desire of every teacher in school. To achieve an effective and quality learning activity, teachers need to pay attention to students' science literacy skills in solving problems in everyday life and being able to produce useful scientific products (Nofiana and Julianto, 2017). Science literacy skills can be defined as the ability to identify science facts, choose appropriate research or investigation methods, and the ability to analyze evidence that has been obtained from the investigation and then form a conclusion (Rizkita et al., 2016; Gormally, 2012).

The problem of education in Indonesia today is science literacy where literacy skills are still low. The weak condition of students' abilities in the field of science, especially science literacy, is evidenced directly through the results of the science literacy assessment organized by the Organization for Economic Co-operation and Development (OECD) through the PISA program for 15-year-old children (Rusilowati, 2018).

Based on the results of observations made by researchers on October 23, 2023 at SMP Negeri 2 Lamongan, more precisely in class VII H, students tend to look less active in participating in learning because learning runs monotonously and the lack of tools or props as well as supporting learning media in learning activities. This is what makes students' low interest in learning because of conventional and makeshift learning. The results of interviews conducted by researchers at SMP Negeri 2 Lamongan on October 23, 2023 with 2 science subject teachers separately obtained the conclusion that students in the classroom found several problems that occur in schools in learning activities, namely the lack of student activeness in learning, low learning motivation and learning activities that are still focused on teachers who are active actors or controllers in learning activities (Teacher center) so that there is a lack of interaction and feedback between teachers and students. This occurs due to a lack of student interest in learning due to learning activities that seem monotonous so that students' curiosity about new chapters or subchapters does not increase and make students' science literacy skills even lower.

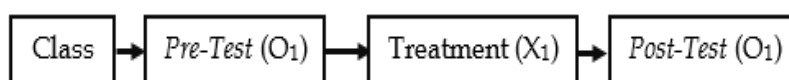
Teachers need to carry out a new strategy to be able to improve students' science literacy skills, through differentiated learning carried out by researchers by raising science material in grade 7 in the sub chapter How humans affect the ecosystem. From the observations that have been made, teachers have difficulty in delivering the material because of low student interest in learning models and materials that are quite monotonous and boring so that students become more difficult to capture and understand the material delivered by the teacher. Through differentiated learning applied by researchers, students can learn science material as well as science literacy which is directly related to natural phenomena and can see and observe directly in everyday life. In addition, the use of differentiated learning can be applied and developed to respond and overcome the needs of different students in learning, both in learning readiness, learning style, learning potential and interest, so that learning runs more optimally.

Therefore, it is necessary to carry out a strategy to improve students' science literacy skills, these efforts can be carried out through differentiated learning which will be carried out by researchers in future learning research activities. In accordance with research conducted by Fikri, et al (2020). which raised the research title of developing E-LITE'S teaching materials to improve science literacy in junior high school students. It can be concluded that the results of the research conducted are the achievement of students' scientific literacy before and after using teaching materials is 25% better, and 91% of students strongly agree with E-LITE'S teaching materials. From several research titles that have been used by researchers as study materials, a research title that raises the effect of differentiated learning on students' science literacy skills has not been found.

RESEARCH METHODS

The research method used in the study was Pre Experimental Design, using one group of subjects without using a control group, namely the one group pre-test and post-test design (Sugiyono, 2019). Because in research testing, the comparison of the results of the pre-test and post-test research is seen. The research design can be seen in Figure 1.

Figure 1. Research Design One Group Pre-Test And Post-Test Design



Keterangan :

O₁ : Pre-Test

X₁ : Differentiated learning treatment

O₁ : Post-Test

The variables in this study are independent variables in the form of differentiated learning, dependent variables in the form of students' science literacy skills and control variables in this study, namely the material used in research activities (Material on Human Influence on Ecosystems). The population in this study were 326 students. The sampling technique in this study is using purposive sample technique, namely determining the sample with consideration of certain criteria. To determine the number of research samples calculated using the Isaac and Michael formula with an error rate of 10%, a research sample of 56.2 was obtained and rounded up to 60 respondents / students.

The data collection techniques used in this study were tests, distribution of student response questionnaires, and learning observations while the data analysis techniques used were the feasibility test of research instruments and learning devices, this test has the aim of validating research instruments and learning devices made by researchers before conducting research. Prerequisite tests, including normality tests and homogeneity tests, both of these tests have different purposes. Normality test is used to determine whether the data between variables are normally distributed or not (Putriana, 2021). The homogeneity test is an assumption test used to determine whether the objects under study have the same variant or not (Niland et al., 2020). In this study, the Levene Test was used to test homogeneity. The learning implementation analysis was carried out by conducting learning observations. Observers in this analysis are from 1 school science teacher and 1 student. The results of the questionnaire analysis will be used by researchers as a measuring tool for students' opinions about learning carried out in class and the nature of this questionnaire is closed which will be analyzed by descriptive analysis using a Likert scale. Hypothesis testing (Sampe t-test and N-Gain Test) The t-test was used to determine the effect of differentiated learning applied in learning activities. The sample test was analyzed using the SPSS version 26 for windows program.

RESULTS AND DISCUSSION

Result

This research was conducted using a quantitative method, which before data analysis was carried out, a prerequisite test was carried out first to determine whether the data between one variable and another were normally distributed or not (Putriana, 2021). The overall results of this study can be presented as follows.

Student pretest data after the normality test in classes D and E obtained a sig of 0.150 and posttest data obtained a sig of 0.200 where both data were > 0.05 so that it could be stated that both data were normally distributed.

To test the influence and improvement of students' scientific literacy, t-test and n-gain test are needed. The t-test results obtained that the sig value (2 tailed) is 0.000 which means $0.000 < 0.05$. So that in accordance with the decision-making criteria for testing the two-sided test hypothesis, namely H_0 is accepted and H_a is rejected if the sig level is > 0.05 , then H_a is accepted and H_0 is rejected if the sig level is < 0.05 . This means that H_a is accepted and H_0 is rejected or there is a significant effect on students' science literacy skills after differentiated learning. While the N-Gain test obtained the average value of the pretest results of class D which amounted to 56.6 and class E amounted to 57.7. After differentiated learning in the classroom, it was found that the increase in student learning outcomes / student science literacy skills increased significantly. The average posttest results of class D students were 87 and class E was 85.7. Both classes get N-Gain values that fall into the Moderate category in accordance with Table 3.9 Classification of N-Gain values because they have an N-Gain value of 0.70 for class D and 0.66 for class E where both values are not more than 0.7 so that they fall into the Moderate N-Gain category.

Table 1. Average Results Of Science Literacy Skills

Group	N	Pretest	Posttest	N-Gain	Category
Class D	30	56,6	87	0,70	Medium
Class E	30	57,7	85,7	0,66	Medium

The analysis of learning implementation was carried out when learning activities took place and was observed by 2 researcher observers, namely 1 teacher at school and 1 science education student. Below is a table of the average value of the learning implementation observation sheet.

Table 2. Average Score Of Observation Sheet For Learning Implementation

Class	Meeting 1		Meeting 2		Meeting 3		Average (%)
	Observer 1	Observer 2/student	Observer 1	Observer 2/student	Observer 1	Observer 2/student	
D	95	81	90	87	94	85	89
E	84	90	87	80	89	96	87
Average							88

Based on Table 2 above, it is written that the results of learning observations in class D obtained an average score of 89% from 2 observers in 3 learning meetings. In class E, an average score of 87% was obtained from 2 observers in 3 meetings. The overall average observation of learning implementation is 88%. So that in accordance with table 3.6, the category of observation of learning implementation if the value obtained is > 75 the category obtained is very good. It can be concluded that the overall average value of learning implementation is 88% which means $P > 75$ which is included in the very good category.

The effect of differentiated learning on students' science literacy skills can be seen from the results of the paired sample t test. Hypothesis testing decision making using a two-sided test or paired sample t test is by looking if the t-count price is in the acceptance of H_0 or between the table prices, then H_0 is accepted and H_a is rejected. So if the tcount price \leq ttable then H_0 is accepted. Below is Table 4 which is the result of the t-test conducted using SPSS Version 26 for windows software.

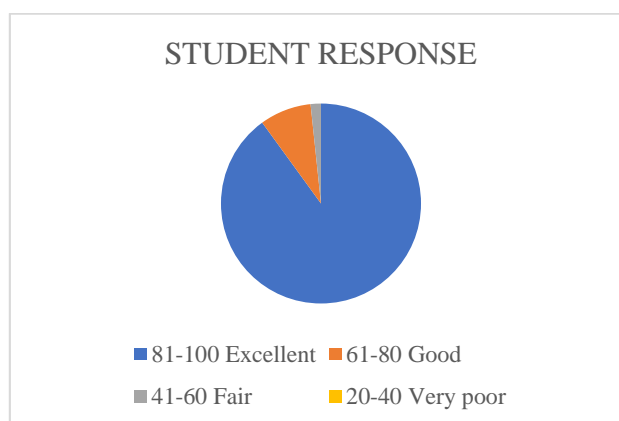
Table 3. Paired Sampel T-Test Result

Data	Mean	t	Df	Sig. (2-tailed)	Sig value
Pretest and Posttest (Class D & Class E)	-29.167	-24.507	59	.000	0.000 < 0.05

Based on Table 3, it is written that the sig value of the results of the paired sample t-test is $0.000 < 0.05$. This means that H_0 is rejected and H_a is accepted, which means that there is a significant effect on students' science literacy skills after differentiated learning.

Students response questionnaires are given to students with the aim of knowing how students respond to differentiated learning activities that have been applied by researchers during learning activities. The following is a picture of the results of the student response quistionaire

Figure 2. Response Questionnaire Results



Based on Figure 2, it can be seen that the average score of students' answers is in the interval 81-100 or in the very good category. The number of students answering statements in the very good category was 54 students, 5 students answered statements with good category results, 1 student answered with sufficient category results and 0 students with very poor category answers. So it can be concluded that students' responses to the application of differentiated learning are very good. The recapitulation of students' questionnaire answers can be seen in the appendix.

Comparison between class 7D and class 7E in answering the response questionnaire obtained an average value of 49% and 47.8% of the average value of class 7E. So it can be concluded that students' responses to differentiated learning tend to be better in class 7D compared to class 7E.

Discussion

Differentiated learning is carried out in accordance with the diversity of students in the classroom. Student diversity itself can be viewed through 3 different aspects, namely Readiness, interests and student learning profiles, Tomlinson, (2001) in (Marlina, 2019). Through this differentiated learning activity, students' science literacy skills are expected to increase while to be able to improve students' science literacy skills teachers also need to apply student science literacy indicators which have 3 aspects, namely aspects of Explaining Scientific Phenomena, Evaluating and Designing Scientific Investigations, and interpreting data and evidence scientifically. The three aspects are described into 15 points shown in Table 4 below.

Table 4: Science Literacy Indicators

No.	Science Literacy Indicators Aspect
Aspect 1: Explaining Scientific Phenomena	
1	Recall and apply appropriate scientific knowledge
2	Use, identify and produce clear and representative models
3	Make and justify appropriate predictions
4	Propose hypotheses
5	Explain the potential implications of scientific knowledge for society
Aspect 2: Evaluating and Designing Scientific Inquiry	
6	Identify questions explored in a given scientific study
7	Distinguish questions that can be investigated scientifically
8	Propose ways of exploring questions
9	Evaluate ways of exploring questions
10	Describe and evaluate different ways of ensuring the veracity of data
Aspect 3: Interpreting Data and Evidence Scientifically	
11	Transform data from one representation to another
12	Analyze and interpret data and draw conclusions appropriately
13	Identify assumptions, evidence and reasoning in science-related texts
14	Scientific evidence and arguments based on other considerations
15	Evaluate scientific arguments and evidence from various sources

The following is an explanation of the 3 aspects of science literacy contained in Table 4 proposed by Mijaya:

- a. Explaining scientific phenomena: students can understand and explain scientific phenomena that occur around their environment and can identify environmental problems independently.
- b. Evaluating and Designing Scientific Investigations: students determine a cause of the problem by making a hypothesis, starting an experiment readily and can evaluate the results of the experimental activities carried out. Can be written or presented through tables or graphs.
- c. Interpret data and evidence scientifically: Transform data from one representation to another, create evidence from the results of the experiment and can interpret the data presented.

Table 5 below is a recapitulation of the results of grouping student learning styles based on the results of the diagnostic assessment.

Table 5. Recapitulation of Student Learning Style Grouping Results

Class	Visual	Audiotory	Kinesthetic
7D	14	11	5
7E	15	5	10
Total	29	16	15

Each student has a great opportunity to apply their prior knowledge when differentiated learning is applied which will ultimately be able to stimulate the development of student creativity, Safarati & Zuhra, (2023) in (Lisnawati et al., 2023) so that there are various LKPDs applied in learning activities with different learning styles, namely visual, audiotory and kinesthetic. Each class before starting learning activities is divided into several groups based on students' learning style abilities. Diagnostic assessment is carried out in these student grouping activities. Through the Akupintar website (learning style test) students will get a percentage of the student's learning style then the teacher groups students based on the results of the diagnostic assessment.

This differentiated learning activity applies the discovery learning model for its learning syntax. Based on the data obtained by researchers, an average percentage of 88% was obtained in the assessment of learning implementation. The implementation of this learning is assessed in accordance with the syntax contained in the teaching module with differentiated learning and the Discovery Learning model.

While the minimum components in the teaching module consist of several components, namely the module title, learning objectives, LKPD and bibliography. In preparing teaching modules, researchers need to pay attention to the format of the teaching module design. The design of differentiated learning teaching modules is listed in Table 6.

Table 6: Teaching Module Design

Part	Description
Cover	Front view of the teaching module
General information	Contains: <ol style="list-style-type: none"> 1. Module Identity, 2. Initial Competencies, 3. Pancasila Student Profile, 4. Infrastructure Facilities, 5. Student Taget, 6. Learning Model
Core component	Contains: <ol style="list-style-type: none"> 1. Learning Objectives, 2. Meaningful Understanding, 3. Lighter Questions, 4. Learning Activities, 5. Assessment
Appendix components	<ol style="list-style-type: none"> 1. LKPD 2. Reading material 3. Glossary 4. Bibliography

The assessment was given by 2 observers, namely from 1 school science teacher and 1 UNISLA science education student. The implementation of learning was carried out to find out whether the implementation of learning carried out by researchers was in the category of very good, good, less good or not good. The assessment results obtained from the 2 observers can be interpreted that the implementation of the applied learning is included in the very good category because it has an overall average of the assessment results from the observers which is 88%.

This is in line with research conducted by (Moutawaqil, 2023) entitled Improving Literacy through Differentiated Learning. The study states that differentiated learning is able to improve the literacy skills of fifth grade students of SD Negeri 2 Karangluhur in the 2023/2024 academic year as evidenced by an increase in the percentage of completeness of student literacy assessment results from a percentage of 42% to 72%. The success of students in learning activities is also inseparable from the actions of teachers as facilitators who are able to understand the interests and needs of students to create an inclusive and interesting learning environment (Lisnawati et al., 2023).

The effect of differentiated learning can also be seen in Table 3 that there is a significant effect that occurs in students after differentiated learning activities are applied. This is in accordance with the decision-making requirements, namely if $P < 0.05$ then H_0 is accepted and H_a is rejected, and vice versa. In Table 1. It can be seen that the average pretest result of class D students is 56.6 and class E is 57.7. From the pretest results, it can be seen that the average ability of classes D and E is different. After the two classes were treated, there was a significant increase between classes D and E. Class D increased by 30.4 with an average posttest score of 87 and class E increased by 28 with an average posttest score of 85.7. Both classes have a moderate category in terms of improving students' science literacy test results.

Students' response to learning was obtained through the distribution of questionnaires. This questionnaire was given to all students / research samples at the last meeting of the study. The highest percentage of student responses was in the very good category as many as 90% of students responded with an average answer in the very good category on each indicator. Based on the results of student responses, it can be seen that the indicators of each question in the questionnaire were answered on average in the excellent category starting from indicators of satisfaction, assessment and response, motivation, and student interest in the application of differentiated learning (Hairina et al., 2020). This means that the differentiated learning that is applied is considered very good when applied in learning.

In line with research entitled improving the quality of teacher learning through workshops and mentoring differentiated learning conducted by Ajeng Gelora Mastuti in 2022. Writing that the impact of the implementation of differentiated learning in teaching practice is known from the results of giving student response questionnaires which obtained a percentage of student response of 92% which is pleasant to the learning practiced (Mastuti & Rumodar, 2022).

CONCLUSIONS

Based on the results of research and discussion, it can be concluded that: (1) Based on the observation of the implementation of differentiated learning is included in the very good category with an average learning observation value of 88%. (2) Based on the results of the influence test and the improvement of students' science literacy, it shows that there is a significant influence between differentiated learning on students' science literacy skills. The effect is evidenced by the results of hypothesis testing which obtained a sig (2-tailed) value of $0.000 < 0.05$. And the increase in students' science literacy skills is evidenced by the results of the N-Gain value of 0.70 for class D and 0.66 in class E, which means that both classes fall into the category of moderate improvement. (3) The results of the questionnaire analysis of students' responses to differentiated learning are said to fall into the excellent category. This is evidenced by the percentage of students answering the questionnaire of 90% in the Very Good category, 8.3% in the Good category, 1.6% in the Fair category, and 0% answering Very Poor.

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