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THE INFLUENCE OF A STRUCTURED INQUIRY LEARNING MODEL ON INCREASING SCIENCE LITERACY COMPETENCY IN CLASS VIII OF SMP NEGERI 01 BAJENG

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Abstract: This study aims to: 1) find improvement of science literacy of VIII grade students of SMP Negeri 01 Bajeng, Gowa Regency who were taught using structure inquiry learning model and who were taught using conventional learning model, 2) the effect of structured inquiry learning model on improving science literacy. The population of this study was all students of class VIII of SMP Negeri 01 Bajeng, Gowa, totaling 9 classes with a total of 309 students. Sampling was taken using a purposive sampling technique to obtain class $VIII_A$ as an experimental class with a total of 29 students and $VIII_B$ as a control class with a total of 29 students. The results showed that 1) the science literacy competency of students who were taught using a structured inquiry learning model on the material of "Light and Optical Devices" increased with an average *N-gain* score of 0.54 in the medium category. Students' science literacy who are taught using conventional learning models has increased with an average *N-gain* score of 0.40 in the moderate category, 2) there is an effect of structure inquiry learning model on improving the science literacy competence of students in class VIII SMP Negeri 01 Bajeng.

Keywords: Structured Inquiry, Science Literacy Competency.

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INTRODUCTION

The rapid development of science and technology (IPTEK) is a sign that we have entered the 21st century. Where, every level of society is required to have various 21st century skills in order to survive and compete in this era. According to Wefusa (2015), students as part of society must be equipped with various 21st century skills, one of the 21st century skills that students must have is science literacy skills.

Science literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence, in order to understand and make decisions regarding nature and changes made to nature through human activities (Pratiwi, Cari, & Aminah, 2019). Science literacy is important for students to master, because it is related to how students understand the environment, health, economy and other problems faced by modern society which is highly dependent on technology and scientific progress and development (Nugraheni, Paidi, & Triatmanto, 2017). Countries such as America and Australia have made science literacy a specific standard at every level of education and an educational goal. So Indonesia should also start making science literacy the goal of science education today (Fatmawati & Utari, 2015).

Science literacy in Indonesia is still very low when compared to other countries. This can be seen from the results of surveys conducted by PISA Indonesia from 2000 to 2015 (OECD, 2017) Indonesia ranked 62nd out of 72 countries with a science literacy score of 403. In 2018, Indonesia's PISA ranking dropped again to 70th out of 78 participating countries with a science literacy score of 396. (OECD, 2019). Based on the results of the PISA assessment, it indicates that Indonesian students are mostly only good at memorizing material without knowing where the material can be applied. The low level of science literacy makes students less responsive to overcome changes and problems that exist around the environment (Nofiana & Julianto, 2018). The phenomenon is caused by the lack of curiosity of students, the inability of students to connect various concepts of science topics that are interrelated and tend to be theoretical (Lailatun, Mahdian, & Hamid, 2017), and the lack of educators' role in providing opportunities for students to develop their reasoning skills in the science learning process (Harlina, Ramlawati, & Rusli, 2020).

Observation studies that have been conducted at SMP Negeri 01 Bajeng, obtained information that educators generally know science literacy, but in the learning process educators do not direct students to familiarize the learning process that can improve science literacy. The science literacy skills of students have also never been measured, educators use conventional learning and conceptual mastery which is still the main reference, so that the learning applied tends to direct students to memorize more, interaction in learning becomes less directed and learning is less focused on students. Meanwhile, to familiarize students with the learning process that requires science literacy can train and improve students' science literacy.

According to Tjalla (2017), training science literacy to students in learning activities means expecting them not only to have an understanding of knowledge, but also the meaning of that understanding which is realized through scientific inquiry, awareness of science and technology as shapers of the material, intellectual and cultural environment, and a willingness to engage in the study of science-related problems. The condition of learning activities certainly requires the teacher's ability to apply various approaches, strategies, methods, and learning techniques that educate creatively in the subjects taught (Rudini & Ady, 2022).

One of the efforts made to overcome these problems is to use a structured inquiry learning model. According to Ali (2021), the structured inquiry learning model is an inquiry activity where questions and procedures are determined by the teacher, but students produce an explanation supported by evidence that has been collected, through group learning where students are given the opportunity to think independently and help each other with other student (Hasan, Ramlawati, & Mamin, 2019). The activities carried out in this learning process bring out scientific attitudes in students, have an active, a great curiosity, are involved in the situation as a whole and are reflective

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of a process and the results of the investigation found, an important step in structured inquiry is the inquiry process. Inquiry means the process of asking questions or looking for the core of the answer. All of these inquiry processes are also indirectly found in the competency aspects of science literacy.

Research that has been conducted by previous researchers reveals that the application of structured inquiry in the learning process can improve students' science literacy. As research conducted by Choerunnisa, Wardani, & Sumarti (2017), suggests that the use of structured inquiry that has been applied in the classroom is considered appropriate so that it can improve students' science literacy, this is indicated by an increase in the N-gain score in the experimental class which is higher at 0.72 than the control class of 0.63 and the average value of the experimental class is better than the control class with the achievement of classical completeness of more than 75%. The results of Ali's research (2021) also showed a significant effect of using the inquiry model in learning on students' scientific literacy, with an increase in scientific literacy reaching 84% (well implement category). Based on several studies that have been conducted, it can be concluded that the structured inquiry learning model can improve students' science literacy.

The characteristics of the inquiry learning model in the learning proces, students are invited to solve problems in the surrounding nature can be combined with material that is indeed related to natural phenomena around students. The material of light and optical devices is material that teaches natural phenomena or symptoms that occur around students (Rahmani, Halim & Jalil, 2015), concept the subject matter of light is directly related to everyday life so that to understand the concept educators are not enough to provide explanations to students but must also go through experiments conducted by students themselves, so that students will better understand and believe in the truth of concepts or conclusions after conducting experiments.

Based on the background and several studies that have been conducted, a study was conducted with the title "The effect of structured inquiry learning models on improving students' science literacy competencies in light material and optical devices in class VIII SMP Negeri 01 Bajeng".

METHODS

This research is a *Quasi Experimental research* with a *Nonequivalent Control Group Design* (See table 1).

Table 1. Research Design

Group	*Pretest*	Treatment	*Posttest*
Experiment	O_1	X	O_2
Control	O_3	-	O_4

(Source: Sugiyono, 2018)

O_1 : Experimental class *pretest*
O_2 : Experimental class *posttest*
O_3 : Control class *pretest*
O_4 : Control class *posttest*
X : Treatment with structured inquiry learning model
\- : No treatment (conventional)

The population in this study were all students in class VIII of SMP Negeri 01 Bajeng in the 2021/2022 school year consisting of 9 classes with a total of 304 students. The samples of this study were 2 classes, respectively class $VIII_A$ as the experimental class and class $VIII_B$ as the control, which

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obtained a total of 58 students using *purposive sampling*. The research procedure was carried out in 3 stages, namely, the preparation stage, the implementation stage, and the final stage. The preparation stage, namely, making observations at SMP Negeri 01 Bajeng and asking permission from the school to carry out research, making lesson plans (RPP) and student worksheets in accordance with the curriculum applied at SMP Negeri 01 Bajeng, making instruments in the form of science literacy tests in accordance with the indicators and learning objectives that have been prepared, validating instruments and learning devices by expert validators. Giving an initial test *(Pretest)* on the ability of science literacy in students before being given treatment. The learning process is carried out in 2 sample classes, namely the experimental class (class $VIII_A$) which is taught using a structured inquiry learning model and the control class (class $VIII_B$) which is taught using a conventional learning model in the even semester of the 2021/2022 academic year with 4 meetings each. The final stage, namely, giving posttest questions to both classes, using statistical formulas to process the final data, discussing the results of the study and determining conclusions and suggestions. In this study, the test used to obtain data on students' scientific literacy is a written test in the form of multiple choice questions of 20 items with the correct score equal to 1 and the wrong score equal to 0 which is adjusted to the achievement of indicators on scientific literacy. The scores obtained from the test results will then be analyzed to obtain an increase in students' science literacy. Science literacy scores are then grouped using the *Normalized N-Gain* criteria in Table 2.

Table 2. *Normalized N-Gain* Criteria

***N-Gain* Score**	***N-Gain* Criteria**
N-Gain ≥ 0,70	High
0,70 > *N-Gain* ≥ 0,30	Medium
0,30 > *N-Gain*	Low

(Source: Hake, 1999)

Inferential statistics were used to test the research hypothesis. Before testing the hypothesis, the prerequisite test of analysis was first carried out in the form of normality test with chi-squared. The data in this study were analyzed with the help of Microsoft Excel 2010. Normality test is done to determine whether the sample used is normally distributed or not. Normality testing used the Chi-Quadrat formula, namely:

$$\chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Hypothesis testing is done using the equation:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

RESULTS AND DISCUSSION

1. Results

a. Descriptive Statistical Analysis

The results of the descriptive statistical analysis showed the characteristics of the science literacy test of each research group.

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Table 3. Results of Descriptive Statistical Analysis of Pretest and Posttest Scores of Science Literacy

Statistics	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of samples	29	29	29	29
Ideal Score	20	20	20	20
Highest score	12	18	12	15
Lowest score	3	9	3	7
Average score	8,03	14,48	7,55	12,52
Standard deviation	2,52	2,82	2,69	2,32
Variance	6,30	7,97	7,26	5,40

Based on Table 3, the results of the *pretest of* science literacy in the experimental class as the treated class obtained an average score of 8.03 students with a standard deviation of 2.52. The highest score obtained was 12 and the lowest score was 3 from the ideal score of 20. Meanwhile, the control class obtained an average score of 7.55 with a standard deviation of 2.69. The highest score obtained was 12 and the lowest score was 3 of the ideal score of 20.

The posttest results of science literacy in the experimental class obtained an average score of 14.48 with a standard deviation of 2.82. The highest score obtained was 18 and the lowest score was 9 from the ideal score of 20. While the results of the science literacy *posttest* in the control class obtained an average score of 12.52 students with a standard deviation of 2.32. The highest score obtained was 15 and the lowest score was 7 of the ideal score of 20.

Table 4. Category Description of *N-Gain of* Science Literacy of Learners

Interval	Category	Experimental class		Control class	
		Frequency	N-gain	Frequency	*N-gain*
N-Gain ≥ 0,70	High	7	0,80	0	0
0,70 > *N-Gain* ≥ 0,30	Medium	19	0,50	22	0,45
0,30 > *N-Gain*	Low	3	0,20	7	0,21

Based on Table 4, it can be seen that the results of students' science literacy in the experimental class which fell into the high category amounted to 7 students with an *N-gain of* 0.80. The medium category amounted to 19 students with an *N-gain* of 0.50 and a low category of 3 people with an *N-gain of* 0.20. For the control class science literacy which included the high category there was none (0), the medium category amounted to 22 with an *N-gain of* 0.45 and the low category amounted to 7 with an *N-gain of* 0.21.

Table 5. Average N-gain Score of Science Literacy of Learners

Class	Score		Average *N-gain* Score	Category
	Pre-Test	*Post-Test*		
Experiment Class	8,03	14,48	0,54	Medium
Control Class	7,55	12,52	0,40	Medium

Based on Table 4, it can be seen that students for the *pretest* in the very good and good categories did not have any students who obtained these categories. The category started in the sufficient category amounted to 3 people with a percentage of 5.55%, for the less category there were 31 people with a percentage of 57.41% and for the failure category there were 20 people with a percentage of 37.04%.

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Table 5. N-Gain Analysis of Students' Science Literacy Indicators

No.	Indikator	Jumlah Soal	Rata-rata *Pretest*		Rata-rata *Posttest*		N-*Gain*	
			Eksperimen	Kontrol	Eksperimen	Kontrol	Eksperimen	Kontrol
1	Explaining scientific phenomena	8	3,48	3,31	6,17	5,72	0,60	0,51
2	Evaluate and design scientific research	7	2,38	2,41	5,10	4,10	0,59	0,37
3	Interpreting scientific data and evidence	5	2,17	1,86	3,21	2,69	0,37	0,26

Based on Table 5, it can be seen that there are results of increased achievement of science literacy indicators in experimental and control classes. The highest indicator improvement achievement in the experimental and control classes was in the indicator of explaining scientific phenomena, while the lowest indicator achievement in the experimental and control classes was interpreting scientific data and evidence.

b. Inferential Analysis

Analysis of the pretest science literacy test, from the results of the table calculation obtained the value of X^2 counted 3.684452 while the value of X^2 table at a significant level α =0.05 and degrees of freedom (dk) = k-1 obtained X^2 table = 11.07049769. Based on the results of the data analysis, it is stated that X^2 count < X^2 table, namely 3.68 < 11.07, it can be concluded that the *pretest* science literacy data of students is normally distributed. Analysis of the posttest science literacy test, from the results of the table calculation obtained the value of X^2 calculated as 4.630156 while the value of X^2 table at a significant level α = 0.05 and degrees of freedom (dk)= k-1 obtained X^2 table = 11.07049769. Based on the results of the data analysis, it is stated that X^2 count < X^2 table, namely 4.63 < 11.07, it can be concluded that the posttest science literacy data of students is normally distributed. Based on hypothesis testing using the t-test, the analysis results obtained t_{hitung} = 2.33 > t_{tabel} = 1.67 This means that H_o is rejected and $H1$ is accepted. So it can be concluded that the structured inquiry learning model has an effect on increasing students' science literacy competencies.

2. Discussion

This study was conducted at SMP Negeri 01 Bajeng, Gowa Regency, South Sulawesi Province with the aim of knowing the effect of structured inquiry learning model on improving the science literacy competence of class VIII students. Before the learning process was carried out, students were first given a *pretest* to determine the score of students' science literacy skills before being taught the structured inquiry learning model, then continued the learning process for four meetings, and ended with giving a *posttest* to determine the score of students' science literacy skills after being taught the structured inquiry learning model. Based on the results of the research that has been done, it shows that the structured inquiry learning model affects the improvement of students' science literacy competencies.

The pretest results of science literacy of experimental class students in Table 3 obtained an average score of 8.03 while the control class science literacy ability obtained an average score of 7.55. After learning activities, students' science literacy skills showed an increase. The *posttest* results of the experimental class taught with a structured inquiry learning model obtained an average score of 14.48, while the control class science literacy skills obtained an average score of 12.52.

The results of the average *N-gain* score of science literacy in the experimental and control classes in Table 5 are both in the medium category. Students taught with a structured inquiry

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learning model showed the average *N-gain* score achieved was 0.54. While in the control class taught with a direct learning model shows the average *N-gain* score achieved is 0.40. This means that the average science literacy ability of the experimental class is higher when compared to the average science literacy ability of the control class. The average *N-Gain* results indicate that the science literacy skills of students at SMP Negeri 01 Bajeng can be trained and improved, as evidenced by the average score of students occupying a medium category literacy level and the quantity of students in the high category is more than the low category in the experimental class. Learning at school greatly influences the variation in students' literacy scores, this is in line with the opinion of Harefa (2023) that the conditions of the learning environment at school affect the literacy scores of diverse students. Whereas in the control class there were no students who occupied a high category of literacy, the majority occupied the medium and low categories.

This is in accordance with the research of Nurhayati, Saenab, & Asriani (2019) which illustrates that students whose activity category is lacking can become active if they do learning that requires them to be involved in learning activities, by emphasizing physical activity, students will understand because they experience, they will also understand because they make their own observations by directly involving their sensory organs, thus gaining more meaningful experiences and what is learned will stick more strongly in their minds (Arwan, Tawil, & Ramlawati, 2021).

The structured inquiry learning model directs students to various activities including observing, formulating problems and hypotheses, asking questions, planning experiments, using tools and experimental materials and communicating, and students more easily remember the material that has been learned (Wardah, 2020). Science literacy skills by facilitating students with learning stages that are the basis for achieving aspects of science literacy competencies consisting of explaining phenomena scientifically, evaluating and designing scientific phenomena, and interpreting data and proving data scientifically, each syntax in structured inquiry learning is related to science literacy skills. In accordance with previous research, that inquiry-based learning has an effect in improving students' science literacy (Harefa, 2023). These results are also reinforced by the results of Asyhari & Clara's research (2017), which states that structured inquiry- based learning is effective on students' science literacy skills. Choerunnisa, Wardani, & Sumarti (2017), also stated that inquiry-based learning tools affect students' science literacy skills.

Based on the results of the *N-Gain* analysis of science literacy indicators in Table 5, the highest increase in science literacy indicators in the experimental class and control class is explaining scientific phenomena, *N-Gain* 0.60 and 0.51 respectively. There is a difference in the *N- Gain* scores of the two classes because students are lacking in recalling the right knowledge content in a given situation and using it to interpret and provide explanations to interesting phenomena (Siska, Setiadi, & Citra, 2020). Activities carried out in the experimental class students formulate problems in groups and determine how to solve problems, this process will require students to process the knowledge they have in solving the problem based on the conditions given by the educator, after that students collect data in testing activities, with activities to identify events or phenomena in everyday life.

The lowest increase in science literacy indicators in the experimental and control classes was interpreting data and scientific evidence, with an *N-Gain of* 0.37 and 0.26 respectively. The difference in the *N-Gain* scores of the two classes is significant because the indicator of interpreting data and scientific evidence is an individual's ability to analyze and evaluate data, provide responses and arguments to reach interesting conclusions (Siska, Setiadi, & Citra, 2020). Learners are required to have the ability to interpret scientific evidence or data obtained through observation activities or based on existing theories or literature (Winata, Cakik & Seftia, 2018). Whereas in the control class, students learn with a conceptual approach, where educators play a more role in the learning process, showing and explaining concepts.

In addition, when learning activities take place, researchers provide LKPDs based on the stages in the structured inquiry learning model, where there are several activities that can train

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students' science literacy skills including activities to identify problems around students, read and understand articles, solve problems, and conduct a series of experiments or practicums. When presenting, one group is given the opportunity to present the results of their experiments (Muliana, Muhiddin, & Yunus, 2019). Each group is able to exchange information about the results of the experiment based on the grouping and classification that has been done (Hasan, Ramlawati, & Mamin, 2019). This is in line with research conducted by Wulandari & Sholihin (2018) which states that science literacy skills are influenced by several factors, including the approach or method of science learning used by teachers in building concepts. The strategy aims to make students active in the learning process (Sari et al, 2021), understand lessons and obtain satisfactory learning outcomes. Learning that is able to arouse students' curiosity regarding learning topics and encourage students' enthusiasm for solving problems presented by educators is believed to be able to build science process skills which are part of the competency aspects of science literacy. Whereas in the control class that uses direct learning with a conceptual approach, where the educator plays more of a role in the learning process, showing and explaining concepts, the LKPD used is based on the stages of the conceptual approach where students only collect information by conducting group discussions to answer questions.

CONCLUSION

Based on the results of data analysis and discussion, the following conclusions are drawn:

1. The science literacy of students after applying the structured inquiry learning model on light and optical devices at SMP Negeri 01 Bajeng Gowa regency has increased with an average *N-gain* score of 0.54 in the medium category.
2. The science literacy of students taught using conventional learning models on light and optical devices at SMP Negeri 01 Bajeng Gowa regency has increased with an average *N-gain* score of 0.40 in the medium category.
3. There is an effect of structured inquiry learning Gowa regency model on improving the science literacy competence of students in class VIII SMP Negeri 01 Bajeng.

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