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Analyzing Islamic Boarding School Students' Scientific Literacy Skills on Physics Material

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Abstract

The purpose of this research was to analyze Islamic boarding school students' scientific literacy skills. The research used descriptive quantitative method. The research was conducted at the Islamic Boarding School in Jombang namely, SMA 1 Darul Ulum Unggulan BPPT. The research sample consisted of 51 students from class XI IPA. Data was collected using research instruments in the form of literacy tests on aspects of competence. The scientific literacy test instrument contains 14 questions about the description of physics materials that have been validated by three expert lecturers. The research results competence aspect was still in low category with an average 31.2. The research also found that the scientific literacy of Islamic boarding school students was still in the low category, with an average score of 35.7. The average score of scientific literacy for female students is 37.5 and for male students it is 35.1. All Islamic boarding schools are expected to implement and support activities that are useful for developing scientific literacy skills.

Keywords: Scientific Literacy; Islamic Boarding School; Physics

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INTRODUCTION

The 21st century is an era of openness and globalization (Wijaya et al., 2016). With the progress of the 21st century, everyone needs to adapt to keep up with the progress of science and technology. Advances in science and technology have an impact on everyday life and to optimize the capabilities of human resources are needed. One form of ability that can balance the progress of science and technology is scientific literacy (Rosidi, 2021).

Scientific literacy is a skill to form connection, scientific problems, scientific ideas, and the application of science in life (OECD, 2017). According to Budiarti (2021) Scientific literacy is an individual's ability to use knowledge in science and scientific process skills to understand the natural environment and make decisions. Meanwhile, according to Toharudin (2011) Scientific literacy is a skill to understand science, convey it, apply it to solve problems, and have a high sensitivity to oneself and the environment when making decisions based on scientific reasoning. Based on the understanding of scientific literacy from these sources, it can be concluded that scientific literacy is a person's ability to combine scientific knowledge and skills in everyday life, which is used as a basis for making decisions.

Based on PISA data in 2015, Indonesia got a score of 403 and was in the lowest eighth position out of 72 countries. This score is in the low category when compared to the international average of 493 (OECD, 2016). The factor behind the low level of scientific literacy in Indonesia is that students are not trained in solving scientific literacy type questions, students have difficult to apply the material in everyday life because students prefer memorize rather than interpret the material (Nasution et al., 2019). Another factor is

because students prefer multiple-choice questions than description questions, this is because the teacher gives learning evaluation questions but still doesn't use analytical questions, so students can't use their reasoning (Huryah et al., 2017).

PISA 2012 scientific literacy assessment priorities are related to several aspects of scientific literacy competence (Wulandari & Sholihin, 2016). Aspects of scientific competence include the explanation of scientific phenomena, evaluation and development of scientific questions, as well as scientific interpretation of data and evidence (OECD, 2019)

Table 1. Competency Aspect Indicators

Competency Aspect	Indicators
Explain scientific phenomena	Explain and implement appropriate scientific knowledge
	Identify and describe phenomena correctly
	Formulate hypotheses related to phenomena correctly
	State the hypothesis correctly
	Applying scientific phenomena in society
Evaluate and design scientific questions	Designing questions in scientific studies
	Classify appropriate questions for scientific exploration
	Explore questions with the scientific method
	Evaluating questions
	Proving questions to ensure the correctness and objectivity of the data
Interpretation data and evidence scientifically	Presenting data
	Examining data based on scientific evidence and facts
	Categorizing scientific evidence with other subjective-based discussions
	Evaluating scientific discussions and evidence from various sources (newspapers, internet, magazines, etc.)
	Draw the right conclusions based on the data and evidence obtained

(OECD, 2019)

Scientific literacy skills identified by the *World Economic Forum* to face the 21st century era (Agenda, 2016). Students need scientific literacy to understand the environment, health, economy, and current social problems and technology (Pratiwi et al., 2019). Because of the importance of having scientific literacy skills in facing the era of the 21st century, all elements of education are strived to promote the improvement of scientific literacy. Education is an important sector to improve the quality of human resources (Ramli et al., 2021). In the 21st century, good quality human resources are needed. Islamic boarding school or called Pondok Pesantren is the oldest Islamic educational institutions in Indonesia (Zulhimma, 2013).

Islamic boarding schools in the 21st century continue to carry out reforms both in terms of institutions and management (Syafe'i, 2017). Students in Islamic boarding schools need to follow the progress of science and technology in the 21st century so that Islamic boarding schools' education system continues to be developed. Islamic boarding schools keep up with the times, including in terms of study materials, namely with the existence of a science department and ready to be competent with national and international educational institutions (Ramli et al., 2021).

Physics is a science used by PISA to measure scientific literacy skills (Mukharomah et al., 2021). Physics is a branch of science that can be studied scientific literacy (Nurwulandari, 2018). In the boarding school environment, physical phenomena are often encountered such as the movement of students from the dormitory to the mosque which is the application of GLB and GLBB material, the use of air conditioning in the room which is the

application of thermodynamic material, the use of ablution showers which is the application of fluid material, and etc.

Based on the description explained, it is known that scientific literacy skills is needed in the 21st century era. Based on PISA data, the scientific literacy skills of students in Indonesia are still relatively low. Based on research by Ramli et al., (2021), it was concluded that the scientific literacy of students is low. If the problem of Indonesian students' low scientific literacy is not addressed soon, it will have an influence on the quality of human resources and stymie the country's growth in science and technology (Nasution et al., 2019).

Consider that the PISA' data is in general, without mentioning the identity of the school and with the existence of a science department at Islamic boarding schools and the importance of scientific literacy in the 21st century era that must be possessed by every individual, including students of Islamic boarding schools, research was carried out with the aim of analyzing Islamic boarding school students' scientific literacy skills on physics materials. The results of this research are expected to provide information about Islamic boarding school students' scientific literacy skills and to be used as material for evaluating the educational system, with the results can be a recommendation to improve scientific literacy skills.

METHOD

The research method used is a quantitative method with a descriptive approach. This research was conducted at the Darul Ulum Islamic Boarding School, Peterongan, Jombang, East Java, with a total of 51 students, consisting of 25 male students and 26 female students in class XI IPA SMA Darul Ulum 1 Unggulan BPPT.

The test instrument used in the form of scientific literacy ability questions as many as fourteen description questions that contain aspects of scientific literacy competence in physics material. The questions were developed based on contextual problems in Islamic boarding schools and on indicators of scientific literacy competence aspects and were validated by three expert lecturers from the Physics Department, Faculty of Mathematics and Natural Sciences, State University of Surabaya. At this validation stage using a validation sheet and calculated using the following formula

$$validity = \frac{score\ earned}{maximum\ score}\ x\ 100$$

The validation results are interpreted descriptively based on the scores obtaine

Table 2. Validation Category (Riduwan, 2013)

Score Range	Criteria
81 – 100	Very Feasible
61 – 80	Feasible
41 – 60	Middle
21 – 40	Weak
< 20	Very weak

After the instrument is declared theoretically valid, then a trial is carried out to obtain empirical validity which includes the reliability and item validity of the instrument. For the problem description, reliability is calculated using the Alpha equation as follows.

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum {\sigma_i}^2}{{\sigma_t}^2}\right)$$

Description :

r_{11} : The coefficient of reliability
n : Number of test items
$\sum {\sigma_i}^2$: Total score variance for each item
${\sigma_t}^2$: Question variance

The reliability coefficient obtained (r_{11}) is compared with *r product moment.* Scientific literacy test instruments can be declared reliable if r_{11} greater than *r product moment* (Arikunto, 2012).

For item validity, it is calculated using the following formula

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{N\sum X^2 - (\sum X)^2(N\sum Y^2 - (\sum Y)^2)}}$$

Description

r_{xy} : test item validity

X : test scores on items

Y : total score achieved

N : number of students

The items that were declared empirically valid were then used to analyze Islamic boarding school students' scientific literacy skills. The results of the research on students' scientific literacy skills were analyzed by calculating the scores obtained from the scientific literacy test results. The following formula is used to obtain the final scientific literacy score: :

$$N_{final} = \frac{score\ earned}{maximum\ score}\ x\ 100$$

The final score results are interpreted descriptively according to the learning outcomes criteria shown in Table 3.

Table 3. Criteria for Achievement of Scientific Literacy (Rosidi, 2021)

Score Range	Criteria
81 – 100	Very high
61 – 80	High
41 – 60	Middle
21 – 40	Low
< 20	Very low

RESULTS AND DISCUSSION

Literacy Test Instruments

The scientific literacy instrument was developed based on the competence aspects of scientific literacy. The test instrument contains 14 questions about the description of physics material based on contextual problems in Islamic boarding schools. The following table presents the distribution of questions per competency aspect.

Table 4. Distribution of Questions per Competency Aspect

Competency Aspect	Number of Questions	Question Number
Explain scientific phenomena	8	1,3,4,8,11,12,13,14
Evaluating and designing scientific questions	3	7,9,10
Interpret data and evidence scientifically	3	2,5,6

From Table 4, it is known that as many as 8 questions on the competence aspect explain scientific phenomena, 3 questions on the competence aspect of evaluating and designing scientific questions and 3 questions on the competence aspect of interpreting data and evidence scientifically. The scientific literacy test has 14 questions, with 10 questions on straight-motion material, two questions on fluid material, and two questions on thermodynamics material, as shown in Table 5. The following table presents the distribution of questions per physics material.

Table 5. Distribution of Questions per Material

Learning Materials	Number of Questions	Questions Number
Straight Motion	10	1,2,3,4,5,6,7,8,9,10
Fluid	2	11,12
Thermodynamics	2	13,14

Theoretic validation follows the development of a test instrument which is a scientific literacy question based on contextual concerns in Islamic boarding schools. Three professional lecturers analyzed materials, language, and construction to determine the theoretical validity of the scientific literacy test instrument. The results of the theoretical validation are presented in Table 6. Based on Table 6 is known the results of the theoretical validity obtained are 92.36%, which is in the very appropriate category to be used to measure students' scientific literacy skills.

Table 6. Theoretical Validity Results

Validity Aspect	Percentage (%)	Category
Materials	91.67	Very Feasible
Language	91.67	
Construction	93.75	
Average	92.36	

The empirical validity is done by calculating the reliable coefficients and the validity of the instrument items. Reliability is calculated using the *Alpha formula* and compared with the *r product moment table*. The instrument that has been developed has a *calculated r value* of 0.6413. This value is then compared with the value of *r table* with a significance level of 5% (db = n – 2) for n = 51, *the r table* value is 0.2329. Scientific literacy test instruments can be declared reliable if r_{11} greater than *r product moment* (Arikunto, 2012) so that the test instrument that has been developed can be declared reliable. According to Sugiyono (2012) the instrument can be declared reliable if the reliability coefficient is at least 0.6.

The validity of the item was obtained that the test instrument consisting of fourteen questions on the description of the scientific literacy test was included in the valid category with the provisions $r_{hitung} > r_{tabel}$ (Arikunto, 2016). The following is the item validity data presented in Table 7. Based on Table 7 is known that the 14 questions of the scientific literacy test instrument are declared empirically valid and can be used to measure the literacy skills of Islamic boarding school students.

Table 7. Question Item Validity

Learning Materials	r_{hitung}	r_{tabel}	Description
Straight Motion	0.37516	0.2329	Valid
	0.43971		Valid
	0.27627		Valid
	0.51333		Valid
	0.43948		Valid
	0.35794		Valid
	0.68762		Valid
	0.65487		Valid
	0.57091		Valid
	0.30563		Valid
Fluid	0.27629	0.2329	Valid
	0.24916		Valid
Thermodynamics	0.33759	0.2329	Valid
	0.2888		Valid

Scientific Literacy Profile

Based on research result, the data on the score of students is obtained which is presented in Table 8. From Table 8 is known that 24 students are in a low category, 17 students are a middle category, 8 students are in a very low category and 2 students are in a high category.

Table 8. Student' Scientific Literacy Test Score

Score Range	Category	Total
81 – 100	Very High	0
61 – 80	High	2
41 – 60	Middle	17
21 – 40	Low	24
< 20	Very Low	8

The average Islamic boarding schools students' score of scientific literacy is 35.7 and shows that scientific literacy is still relatively low. Ramli et al., (2021) found that students' scientific literacy skill was still relatively low. In line with that, Rosidi (2021) explains that students' scientific literacy skill is relatively low. Based on distribution of scores, students with low scientific literacy category showed the highest frequency.

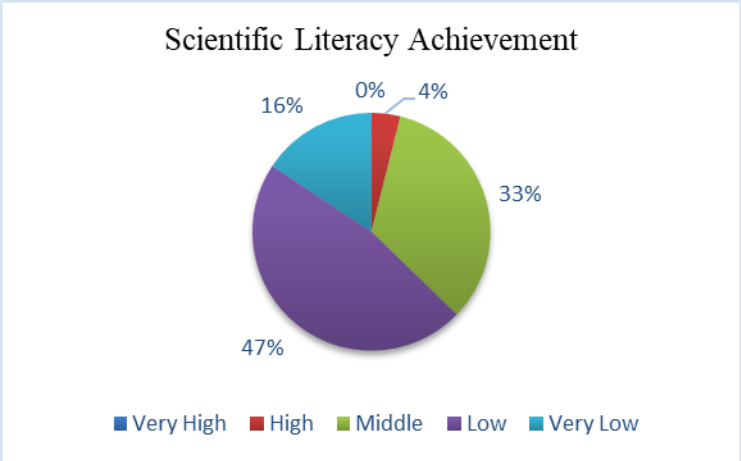

Figure 1. Scientific Literacy Achievment Diagram

The diagram of scientific literacy achievement shown in Figure 1 shows that 47% of boarding school students are in a low category. 33% of students are in a middle category, 16% in a very low category, and 4% in a high category.

According to the 2015 PISA framework concept, scientific literacy skills analyzed in terms of competence consist of three aspects. That is, students can explaining scientific phenomena, can evaluating and designing scientific questions, and can interpreting data and evidence scientifically. Table 9 presents data on scientific literacy abilities in terms of competence aspects.

Table 9. Score per Competency Aspect

Competency Aspect	Average	Category
Explain scientific phenomena	30.9	Low
Evaluating and designing scientific questions	27.5	Low
Interpret data and evidence scientifically	35.3	Low

Table 9 shows that the average student's scientific literacy ability on competency aspect is still relatively low in all aspects of competence. Based on the average score of overall ability, Islamic boarding school students' average score is 31.2 and included in the low category. It is consistent with recent research by Ramli et al., (2021) stated that scientific literacy is low in all aspects of competence, with an average score of 33.83.

Here are presented questions and one of the students' answers related to questions in the aspect of explaining scientific phenomena on indicators of applying scientific phenomena in society.

13. Pada wacana 4, disebutkan bahwa fungsi AC adalah sebagai pendingin ruangan. Jelaskan menggunakan hukum termodinamika bagaimana cara kerja AC sehingga dapat mendingnkan ruangan!

Figure 2. Instrumen Test Number 13

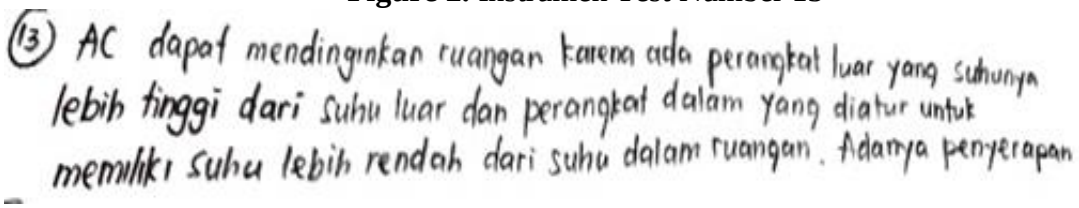

Figure 3. Sample of Student Answer Number 13

In Figure 2, presented scientific literacy test instrument on competence aspect to explain scientific phenomena and in Figure 3, one of the students' answers is presented at number 13. Based on students' answers, is known that students have not been able to connect the concept of science with phenomena that occur in everyday life - day. Students have not been able to connect AC phenomena with scientific concepts, namely on thermodynamic material.

Here are presented question and one of the students' answers in the aspect of evaluating and designing scientific questions on the indicators of designing questions in scientific studies.

7. Dari wacana 2 tersebut, tentukan pertanyaan ilmiah yang dapat disajikan sebagai rumusan masalah suatu penyelidikan!

Figure 4. Test Instrumen Number 7

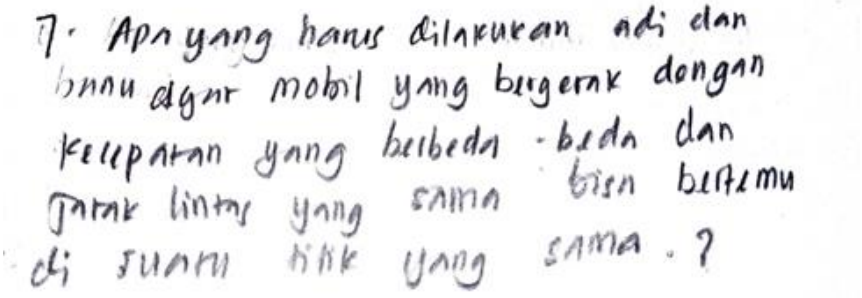

Figure 5. Sample of Student Answer Number 7

In Figure 4, presented scientific literacy test instrument on competence aspect of evaluating and designing scientific questions and in Figure 5, one of the students' answers is presented at number 7. From the students' answers, it is known that students are less able to formulate questions that are used for scientific research. Students can see that students are not used to making questions that connect two variables used for scientific research or experiments.

The following questions are presented and one of the students' answers related to questions in the aspect of evaluating and designing scientific questions on indicators exploring questions with the scientific method.

10. Dari wacana 2, susunlah langkah – langkah percobaan yang digunakan dalam melakukan percobaan

Figure 6. Test Instrument Number 10

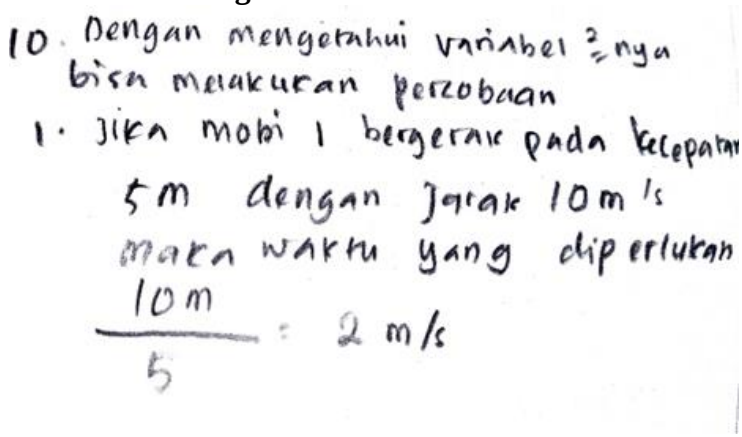

Figure 7. Sample of Student Answer Number 10

In Figure 6, presented scientific literacy test instrument on aspect of evaluating and designing scientific questions with indicators of exploring questions with the scientific method, and in Figure 7, one of the students' answers is presented at number 10. From the students' answers, is known that students are less able to develop methods or the steps of a straight-motion experiment.

Here are presented questions and one of the students' answers related to questions in the aspect of interpreting data and scientific evidence on indicators of interpreting data.

5. Perhatikan tabel berikut ini !

Berikut merupakan tabel data 5 hari santri Al Mubarok yang berangkat dari jarak yang sama menuju masjid dan mempunyai waktu tempuh yang berbeda – beda

No.	Hari	Waktu tempuh (s)	Jarak (m)
1.	Senin	120	100
2.	Selasa	140	
3.	Rabu	160	
4.	Kamis	180	
5.	Jumat	220	

Dari tabel tersebut berapakah nilai kecepatan santri Al Mubarok pada masing – masing hari? Sajikan grafik hubungan antara kecepatan dan waktu tempuh santri Al Mubarok!

Figure 8. Instrument Test Number 5

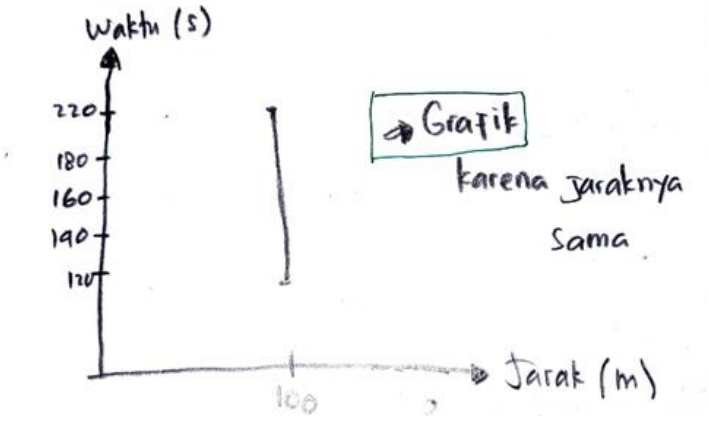

Figure 9. Sample of Student Answer Number 5

In Figure 8, presented scientific literacy test instrument on aspect of interpreting data and scientific evidence on the indicators of interpreting data and in Figure 9, one of the students' answers is presented at number 5. From the students' answers, is known that students appear to be less capable of interpreting data. form one to another. The instruction from question number 5 is to describe a graph of time and speed related by presenting a table containing distance and time information so that the speed value can be obtained.

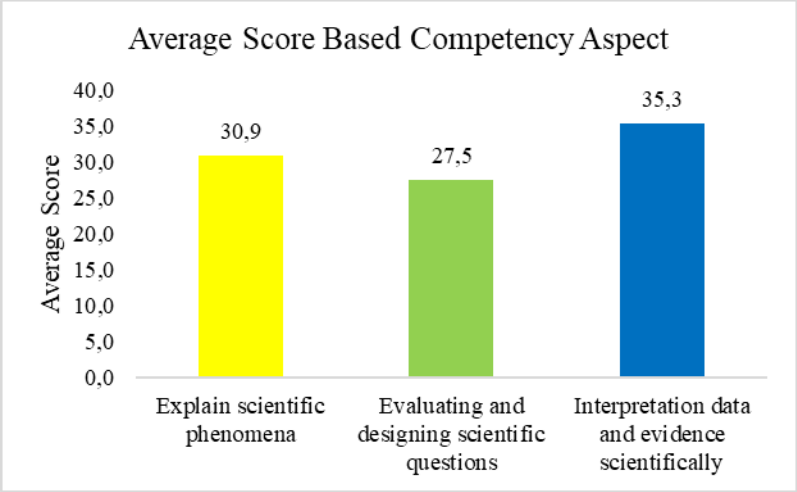

Figure 10. Graph Average Score of Competency Aspect

According to the graph of average scores of the competency aspect presented in Figure 10, it is known that the aspect of evaluating and designing scientific questions has the lowest average of 27.5, which is included in the low category. This is consistent with the findings of a recent research by (Rosidi, 2021) states that the ability to evaluate and design scientific questions is still relatively low. This is possible because students are not accustomed to solving problems that require an opinion on the problem. According to (Rohmi, 2017) , the low ability of competence aspect of evaluating and designing scientific questions is due to a lack of experience identifying experimental variables and opportunity to conduct scientific experiments.

In the aspect of competence in explain scientific phenomena included in a low category which is the average score obtained is 30.9 and consistent with the findings of a recent study by Arding & Atun (2020) which states that the indicator explaining scientific phenomena is still relatively low. The low aspect is because students are less able to relate scientific concepts with phenomena that occur in everyday life. According to research by (Ning et al., 2020) low scientific literacy skills in the aspect of explaining scientific phenomena is cused by students not being able to predict scientifically environmental phenomena and the changes that occur due to these phenomena.

From the aspect of competence in interpreting data and scientific evidence, the average score is 35.3 and is included in the low category. According to research by Ramli et al., (2021) found that the ability to interpret scientific data and evidence was still very low. This is because students are still not trained in interpreting data, both data from tables, graphs, and charts and are not trained in drawing conclusions. According to (Sutrisna, 2021) the low students' scientific literacy skills in the aspect of competence in interpreting data and evidence scientifically is due to the lack of students' practice in interpreting scientific data and making conclusions correctly.

Here are the average literacy score of students based on gender which is presented in Table 10.

Table 10. Score Scientific Literacy Based on Gender

Gender	Male	Famale
Average	35.1	37.4

In Table 10, the average score of scientific literacy of Islamic boarding school students based on gender is presented. In the table 10 is known that male students get an average score of 35.1 and female students get an average score of 37.4.

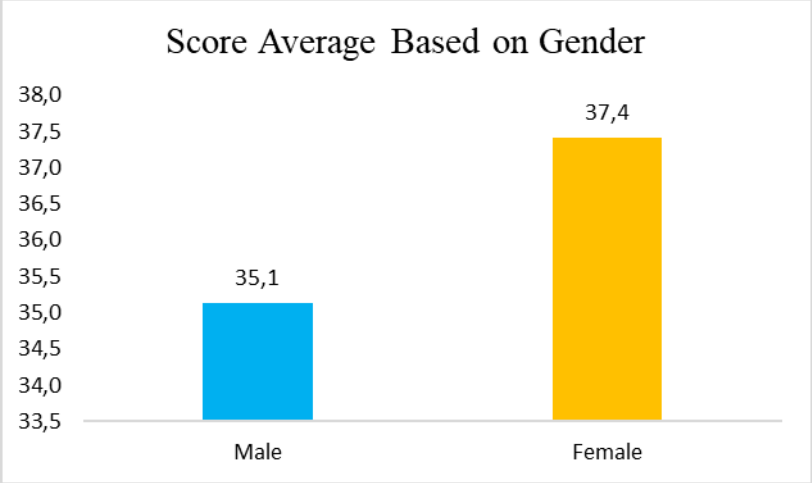

Figure 11. Graph Average Score Based on Gender

Male and female students have varied levels of scientific literacy, shown in Figure 11. Female students' average score is higher than male students' average score. This is consistent with the findings of a recent research by Fadlika et al., (2020) which found that the scientific literacy ability of female students was higher than that of male students. Female students tend to be thorough, diligent, and listen well to explanations, so that female students' scientific literacy skills are superior to male students' (Fadlika et al., 2020).

The low scientific literacy skill of Islamic boarding school students is caused by several factors, such as students who are not used to solving questions with a scientific literacy model (Mukharomah et al., 2021). According to (Rosidi, 2021) the high density of activities of Islamic boarding schools is also one of the causes of the low scientific literacy of students. The importance of increasing students' scientific literacy lies in the fact that scientific literacy is a combination of ideas related to science and scientific knowledge and various skills, including research, critical thinking, problem solving, and decision making (Lestari et al., 2020).

CONCLUSION

Based on the analysis of research data and the results of the discussion described, Islamic boarding school students' scientific literacy skills is still in a low category, with an average of 35.7. Based on the results of the research, the results per aspect of competence in explaining scientific phenomena obtained an average score of 30.9. Evaluating and designing

scientific questions obtained an average score of 27.5. Interpreting data and scientific evidence obtained an average score of 35.3. The average score of scientific literacy for female students is 37.5 and for male students it is 35.1.

RECOMMENDATION

The researcher's suggestion, based on the findings of this study, is that it is hoped that the entire academic community of Islamic boarding schools will implement and support activities that are useful for developing scientific literacy skills, such as familiarizing students with understanding science concepts in everyday life.

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