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Relationship of grade level and gender towards science literacy abilities in islamic senior high students

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ABSTRACT

Science literacy is one of the abilities that every individual student must have and is also a prerequisite for 21st century life skills through integrated education, starting from family, school, and to society. This research aims to determine science literacy abilities and to determine the relationship between gender and class-level science literacy abilities in students in grades X, XI, and XII at Islamic Senior High School (ISHS) of Batu City. The research design used is quantitative research using descriptive methods (quantitative descriptive). The location of this research is at ISHS of Batu City. Purposive sampling was in the sampling process, which involved selecting a sample based on specific attributes, such as gender. There are 20 male and female students at the class level, and the results of ability in science literacy are X=46% and XI=60%. Based on this data, if it is based on the criteria for classes X, the results obtained for the gender aspect show that there is no significant interaction with the results of students' science literacy abilities. It can be concluded that there is a significant interaction between students' science literacy skill and grade level.

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INTRODUCTION

Science literacy is an important skill that every student must have and is a prerequisite for forming life skills that are integrated with different educational environments, including family, school, and society (Amala et al., 2023; Lestari et al., 2020; Putri et al., 2020). Science literacy includes applying scientific knowledge, identifying questions, and drawing evidence-based conclusions to understand and make decisions about natural phenomena and changes resulting from the activities of humans (Narut & Supradi, 2019). Science literacy includes science attitudes, conceptual knowledge, and science processing skills. Students need to acquire science knowledge because it allows them to understand, articulate, and apply science concepts to solve problems (Fakhriyah et al., 2017; Virtič, 2022). This skill also cultivates a heightened sense of awareness and sensitivity to the environment when making decisions based on scientific evidence, which often relies

on science and technological advances. Therefore, students must develop a strong science foundation to accurately understand the phenomena around them.

The application of science literacy to meet the challenges of the 21st century requires every student to make every effort to adapt to every aspect of life (Fortus et al., 2022; Kartimi & Winarso, 2021; McFarlane, 2013). According to Handayani et al. (2022), one of the keys to meeting the challenges of the 21st century is science culture, or in other words, science culture, which shapes thinking and action skills by involving the ability to think and "using science thinking to recognize and respond." to social issues. According to Pratiwi et al (2019), equipping students with science literacy is important because it pursues two main goals. First, understanding science concepts can satisfy personal curiosity and bring joy that can be shared with others. Second, countries around the world face complex problems that require scientific knowledge and reasoning to make decisions that impact the well-being of many people. This includes issues related to the environment, such as air quality, water purity, and forest sustainability. Therefore, measuring students' science literacy is very important to be able to determine the quality of students' literacy (Gormally et al., 2012; Hanfstingl et al., 2023; Shaffer et al., 2019) to improve the quality of education in Indonesia.

Indonesian people, especially the younger generation, must have good literacy in various fields so they can live independently in society (Liliasari, 2014). related to responding and making decisions (Aryani et al., 2016). The concepts or facts discovered at school are skills that serve as a benchmark for students to be able to master science literacy skills (Angraini, 2014). Students with less developed science literacy are less able to solve problems in situations that usually occur to them, while students with more developed literacy skills tend to be more able to solve problems in situations that are less familiar and tend to be difficult (Lodge et al., 2018; Lusardi, 2019; Protheroe et al., 2009). Literacy abilities, especially in the field of science, are one of the interesting things to research, considering that there is still little literature and research that addresses this matter, and there are still a few journals explaining that students' science literacy abilities are still low (Nurazizah et al., 2022).

The results of research conducted by Nurazizah et al. (2022) in the field of science literacy showed differences in understanding of science literacy between male and female students. PISA 2012 also revealed that male and female students had differences in their understanding of science literacy for each indicator. In Indonesia, especially, online learning has turned into a great challenge. This is because there are many areas with low internet access and inadequate facilities (Azhari & Fajri, 2021; Octaberlina & Muslimin, 2020).

Apart from gender, at Islamic Senior High School (ISHS) in Batu City, the science department itself is divided into 3 class levels, namely classes X, XI, and XII. Students with a high grade level are of course required to have higher science literacy skills than those at a lower grade level because they are considered to have acquired a lot of material and have more knowledge and experience (Nurmaliah, 2009), so it is very suitable to use the grade level as a benchmark and reference for how well students learn and understand science literacy. The results of the research will look at the abilities of students in classes X, XI, and XII, which can be used to evaluate learning in schools and education in general.

The abilities possessed by each student at different grade levels are influenced by various factors, including experience (Abdelrahman, 2020; Cardino, Jose M. & Ortega-Dela Cruz, 2020;

Fukada, 2018; Gbollie & Keamu, 2017; Reber, 1986; Shi & Qu, 2021; Stehle & Peters-Burton, 2019; Steinmayr et al., 2019), communication, and educational level, including grade level (Afifah & Hastuti, 2014). The higher the grade level that an individual has taken, the more knowledge about science literacy is expected to increase. This follows what Delić et al. (2018) said regarding grade levels, older students are believed to have different learning abilities because they have different learning strategies at each grade level. Therefore, class level is interesting to discuss to see whether class level influences students' ability to master science literacy.

Based on this, on a local scale, it is very important to analyze the science literacy of ISHS students as an initial picture of students' science literacy and a picture of the quality of science learning in Batu City. So that the results obtained can become a document that reflects the policies to be implemented. This research aims to analyze students' science literacy abilities by examining aspects of science competence (science process skills, conceptual knowledge, and science attitudes) through the topic of environmental pollution.

The urgency of learning environmental pollution material is that the content or essence contained in this material is very closely related to students' lives. The environment is the place where all living things live, including where students live, so all forms of environmental pollution will affect their lives. Changes that occur in the surrounding environment can be felt, have an impact on life, and are easily understood by students. This means that understanding environmental aspects and their relationship with the social context is very important for students to be able to understand natural phenomena that occur, know the causes of environmental damage, analyze the best solutions for environmental damage, and at the same time behave wisely towards the environment. In line with this, Purnama et al. (2020) stated that issues that occur in the environment around students are very important to understand because they relate to students' responsible behavior towards the environment. This research aimed to determine science literacy abilities and the relationship between gender and class-level science literacy abilities in students in grades X, XI, and XII at ISHS of Batu City.

METHOD

The research design used is quantitative research using descriptive methods. Quantitative research is research that is presented in numerical form, and data analysis uses statistics. The descriptive method is a method used to describe phenomena in a single variable or make comparisons between two variables. Therefore, quantitative descriptive research is research that clearly describes research results numerically by describing them.

The data collection process begins with the preparation stage, which is carried out to complete the things needed and used in the research. The preparation stages consist of interviews with supporting teachers, observation, and the distribution of questionnaires. Interviews with supporting teachers aim to compare the results of the analysis with the results of interviews; observations are carried out to obtain data related to student behavior as a comparison of the results of data analysis, and questionnaires are distributed so that researchers obtain the data that is used to carry out data analysis. The list of students selected to work is attached to the student attendance table.

After that, the implementation is carried out, and the researcher will visit the school that will be used for research. The staff members who work in the administrative area were then given research permits by the researcher to use as entry permits for guests. Subsequently, the researcher arranges with the Biology teacher to conduct research in class. The location of this research is at ISHS of Batu City, located at Jl. Pattimura No.25 Batu, Temas, Batu District, Batu City, East Java, and the participants were all students of X, XI, and XII (MIPA Class/Math and Science Class).

The Purposive Sampling technique was used, to determine samples with specific characteristics, male and female. At the class level, there are twenty male and female students. The research sample was students in classes X, XI, and XII (MIPA Class) at each class level totaling twenty female and twenty male students. Table 1 shows that a total of 120 students from the three classes acted as respondents.

Table 1. Research Cluster

No	Origin cluster	Subject		Number of samples
		Male	Female	
1	X	20	20	40
2	XI	20	20	40
3	XII	20	20	40
	Total			120

The research data was analyzed by utilizing Microsoft Office Excell to calculate the percentage of science knowledge obtained in the areas of conceptual knowledge, science process skills, and science attitudes. The data was obtained from the results of students completing forms on Google. The level of science knowledge acquired is interpreted descriptively based on the student learning outcome criteria provided by Wulandari and Sholihin (2016) as follows in Table 2. The criteria employed to ascertain the outcomes of measuring literacy are based on a formula cited from Sutrisna (2021) which is presented as Formula 1.

Table 2. Learning Outcome Criteria

Score	Criteria
80-100	Very good
66-79	Good
56-65	Enough
40-55	Not enough
30-39	Very not enough

$$\text{Score} = \frac{\text{Score obtained}}{\text{Maximum score}} \text{ x } 100 \qquad (1)$$

The data collected from the questionnaire is subsequently analyzed to compute the results of all variables and to answer the problems raised in formulating the problem by testing the proposed hypothesis. The data analysis technique employed was the Two-Way ANOVA test using SPSS 26.0. Prior to conducting calculations using the Two-Way ANOVA test, it is necessary to perform a data normality test to determine whether the data follows a normal distribution or not.

Research tools refer to instruments or resources employed by researchers to enhance the efficiency and accuracy the data collection. These tools enable more comprehensive, more easily, and better results, in the sense of being more thorough, complete, and systematic to collect data. The

literacy tool according to OECD (2017) guidelines, consists of 30 questions adopted from previous research (Martinah et al., 2022) and is described in Table 3.

Table 3. Design material questioner

Dimensions of Science Literacy	Indicator	Number of questions
Science content	Content knowledge Procedural knowledge	1-7
Science competency	Explain science phenomena Interpret data and scientific evidence	8-17
Science context	Personal Environment	18-25
Attitude	Environmental awareness	26-30

RESULTS AND DISCUSSION

Results of Science Literacy Abilities

Data processing involves utilizing Excel to implement criteria-based provisions. The study revealed that the average performance results for class X, XI, and XII students respectively were X=46% and XI=60%. Based on this data, the average percentage for classes X and XII is relatively low, while for class XI it is considered sufficient.

Table 4. Test of between-subject effects

Tests of Between-Subjects Effects

Dependent Variable: Value

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6485.867[a]	5	1297.173	8.176	.000	.264
Intercept	311100.833	1	311100.833	1960.795	.000	.945
Gender	30.000	1	30.000	0.189	.665	.002
Class	5772.317	2	2886.158	18.191	.000	.242
Gender * Class	683.550	2	341.775	2.154	.121	.036
Error	18087.300	114	158.661			
Total	335674.000	120				
Corrected Total	24573.167	119				

a. R Squared = 0.264 (Adjusted R Squared = 0.232)

Based on the results of the Two-Way ANOVA Test, the results are shown in Table 4. The data presented in Table 4 indicates that there is no significant difference between the knowledge of male and female students [F(1.114)=0.189; P=0.665>0.05]. The table indicates that there are significant differences between classes in the results of science literacy abilities [F(2.144)=18.191; P=0.000<0.05]. In addition, there was no significant interaction between class and gender on the results of students' science literacy abilities [F(2.144)=2.154; P=0.129>0.05]. The method also has limitations, as it is not easy to make questions that fit the level of thinking of the students and the amount of time wasted, especially if students cannot answer the questions.

Gender Aspect

The results of the Two-Way Anova test indicate that there is no statistically significant difference or no correlation between gender and science literacy abilities [F(1.114)=0.189; P=0.665>0.05]. The statistical tests on the gender aspect indicate that there is no significant difference between gender and students' science literacy abilities. This shows that there is no significant difference in the mindset of students, especially at ISHS of Batu City, regarding the gender aspect. The mindset of male and female students should be different. This is confirmed by the statement from Yanti et al., (2019) that female students' thinking abilities are higher because, at the interpretation indicator stage, female students are able to understand and express the meaning given in the questions so they are able to understand situations, data, events, and assessments.

Table 5. Univariate test gender

Univariate Tests

Dependent Variable: Nilai

	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	30.000	1	30.000	.189	.665	.002
Error	18087.300	114	158.661			

Scientific literacy does not tend to be influenced by gender aspects because intellectual ability is not correlated to a person's gender, but is more related to factors such as interests and education. A fair education system can mitigate gender gaps in scientific literacy by providing equal opportunities and resources to all students. Changes in gender norms and stereotypes can also play a significant impact in empowering women to freely pursue their interests in science without feeling pressured. Women's achievements in science as role models can have a positive impact on the enthusiasm of young women in scientific literacy. Cultural and environmental factors also play a significant role, with some societies having traditional views on gender roles which can influence participation in science education. Hence, an inclusive approach in education and the development of scientific literacy continues to be necessary to ensure that all individuals, regardless of gender, have equal opportunities to develop their understanding of science.

Gender is a significant determinant of an individual's knowledge, as evidenced by multiple studies. Hermawan et al (2018) stated that women have a higher level of knowledge expectations than men. However, the finding of this study indicates that gender does not have a significant impact on knowledge results. Responding to these results, researchers looked for the cause of this phenomenon. Learning motivation is a crucial factor that differentiates student learning outcomes and learning motivation is an absolute requirement for carrying out certain learning activities that come from within oneself and also from outside the individual, gender is not the main factor in achieving maximum learning outcomes (Andriani & Rasto, 2019). Gender differences are also related to how to determine life habits, and usually, men have certain habits in dealing with problems, as do women. According to Barnas and Ridwan (2019), from a biological perspective, it seems acceptable that there are dispositional differences that cause different behavioral learning between male and female students so this will also influence attitudes and behavior. In the data obtained, female students demonstrate an ability to achieve higher grades, this indicates that female students tend to be more careful than male students.

Class Aspect

The results of the Two Way ANOVA test show that there is a statistically significant difference or relationship between gender and science literacy abilities [F(2.144)=18.191; P=0.000<0.05]. The results of the next Two-Way Anova test on the class factor, it was found that in the class factor, there were significant differences between classes in science literacy abilities. According to the statement from Delić et al (2018) findings, the grade level of older students has more learning abilities because they have different learning strategies because with different student learning strategies the level of students' science literacy abilities will also increase. increases as students master many things. Apart from that, as you get older, your understanding and thinking patterns will also develop (Raharjo & Indarjo, 2014). Class level is related to age because the higher a person's age, the more experience and knowledge they have (Yanuar et al., 2022). Higher-level classes have a high level of curiosity and social behavior, which influences the way students think and learn and vice versa. This affects students' knowledge. Apart from that, at the class level, the implementation of learning related to the curriculum and education system, the choice of teaching methods and models carried out by teachers which include facilities, facilities and teaching materials also influence differences in students' science literacy abilities (Sutrisna, 2021). Based on the results of interviews and observations, according to teachers who teach biology subjects, students' abilities in this subject show that there are differences in the results of the students' abilities, the higher or older they are, the more their thinking patterns will increase. This is in line with the results of research on students' literacy abilities which show an increase. So, if the educational level of the students being trained becomes higher, the quality of resources will also increase (Aisyah et al., 2021).

Table 6. Univariate test aspect class

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	5772.317	2	2886.158	18.191	.000	.242
Error	18087.300	114	158.661			

CONCLUSION

Based on this research finding, several important points can be highlighted. Firstly, The average results of students in classes X, XI, and XII are as follows: X=46%, XI=60%, and class XII=44%. Based on the provided data, it can be inferred that classes X and XII have a low average percentage, while class XI falls into the sufficient category. Furthermore, the data indicates that there is no significant interaction between gender and students' science literacy abilities. Lastly, the data shows that there is a significant relationship between grade level and students' science literacy abilities. We recommend that further investigation focus on aspects of grade level and gender in science literacy. A wider range of subjects and schools will improve a valid and general picture. Other aspects that might influence science literacy are also possible to research.

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