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Effect of Learning Motivation on Science Literacy of 11th-grade Students of Madrasah Aliyah Negeri on Climate Change material

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Abstract

The concept of motivation to learn encompasses a wide array of components. The attributes mentioned above collectively have an influence on the cognitive processes, emotional states, interpersonal relationships, and behavioral patterns of students in various educational and non-educational settings. While Fives et al. (2014) classify scientific literacy into 5 components, namely: the role of science, scientific thinking and activities, science and society, mathematics in science, and science motivation and beliefs. In addition, the Program for International Student Assessment (PISA) framework from the OECD (2019a) defines scientific literacy as the ability to engage with science-related problems and with the idea of science as a reflective citizen. This research design uses correlation research to measure the research results, learning motivation as the independent variable and scientific literacy as the dependent variable. The approach used in the research is the survey method. From the overall results and discussion of the research above, it can be concluded that: Based on the R square value of 0.077 in the table above, learning motivation affects science literacy by 46.2%, for the remaining 53.8% ecoliteracy is influenced by other factors. Based on the results of the table above, it is known that the sig. value is 0.102> 0.05, so it can be concluded that learning motivation has no effect on students' scientific literacy.

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INTRODUCTION

Science issues are often directly related to society. One of them is the issue of global warming. A community mentioned that 18% of Indonesians believe that human activity has no effect on the current global warming issue (AEDS, 2019). Then another 6% believe that the climate in the world has not changed as rumored (AEDS, 2019). Based on the IPCC report in 2018, the Paris Agreement agreed that there was a limit to the increase in global temperature in the range of 1.5 - 2 $°C$. But in reality, this is not the case (Hasanah, 2023). Climate change is now a global crisis that humans must fight. Because of this, it's important to understand how students see climate change. Also, it's important to look at how the community feels about it in order to decide what steps we can take to adapt and reduce its effects. Students believe that human activities, not natural events, are causing climate change. Climate change has already been felt and is affecting both local areas and the whole world. This climate crisis is changing people's lifestyles in big ways. As a suggestion, everyone around the world should take action to deal with climate change, whether through reducing its causes or adapting to its effects (Kundariati, M., Ibrohim, & Rohman, F., 2025)

Based on observations (Amalia et al., 2024) through open interviews with three science teachers at SMAN 7 Bengkulu City, it was found that students were less motivated to learn science. One of the factors causing the lack of motivation to learn students, especially in physics lessons. Therefore, the need for learning motivation so that the implementation of learning becomes optimal. efforts to increase student learning motivation can be done through the selection of models, methods, and teaching materials, as well as interesting and interactive learning media that make it easier to increase student motivation and help the learning process.

The study, Adolescents' Knowledge on Climate Change: A Nationwide Study in Indonesia (2023), found that approximately 49.7% of adolescents aged 13-19 in Indonesia have poor climate change literacy. This indicates that although many have heard about climate change, nearly half of adolescents are unable to fully understand the issue, including its causes, impacts, and mitigation and adaptation methods (Martha, E., et al., 2025). Factors such as the province of residence, type of school (public, private, religious), and parental education level significantly influence this literacy.

In the context of perception and attitudes, the study Knowledge, Beliefs, and Attitudes of Junior High School Students in Palembang Towards Climate Change Issues (2022) reported that junior high school students in Palembang had a baseline knowledge level of 65.73% about climate change, belief in its causes and impacts of 65.50%, and attitudes toward mitigation of 69.50%. This indicates that there is a fairly high level of awareness among young students regarding climate change issues, although there is room for improvement, especially in beliefs and concrete actions (Chairunnisa, C., et al, 2022).

Previous research has emphasized the importance of science to careers, especially towards global interests that improve the nation's socio-economy, ensure technological stabilization, and support the development of a higher-quality science curriculum. However, to create students who are scientifically literate and have an interest in science, various factors must be identified in order to produce a quality, skilled workforce. Therefore, the factors that influence students' interest in science must be evaluated in terms of students' learning needs (Razali et al., 2020).

The study "Exploring students' climate change perception: the key factor of climate change mitigation and adaptation" by Kundariati, Ibrohim, Rohman, and colleagues (2024) shows that

students' perceptions of climate change are crucial as a key component in mitigation and adaptation efforts. Kundariati (2024) found that students who strongly perceive climate change as real and caused by human activity tend to be more supportive of adaptation and mitigation actions. This reinforces the importance of clear science education in linking empirical and human aspects of climate issues.

Important factors in learning science include motivational variables (relevance of science learning for personal goals, self-efficacy for learning science, and interest in a scientific career), emotional variables (boredom and fun in science class), and engagement variables (passion, dedication, and absorption to the study of science (Membiela et al., 2023). The model, tested for fit, showed that motivational variables predicted emotions in science class and explained 43% of the variance in boredom and 67% of the variance in enjoyment. Motivational and emotional variables explained 73% of the variance in engagement with science studies. Also apparent is the important mediating role played by emotions between motivational variables in science learning and engagement with science study (Membiela et al., 2023).

The concept of motivation to learn includes a variety of components. The aforementioned attributes collectively have an influence on students' cognitive processes, emotional states, interpersonal relationships, and behavioral patterns in various educational and non-educational settings (Zhang et al., 2023).

In the field of motivation and scientific literacy, the study "The Relationship Between Physics Learning Motivation and Scientific Literacy of Class XI MIPA Students of SMA Negeri 3 Makassar" (2023) reported that students' physics learning motivation and scientific literacy were in the moderate category. The relationship between physics learning motivation and scientific literacy was quite strong, with r = 0.91, which indicates that the higher the learning motivation, the higher the scientific literacy. However, because it is in the moderate category, there is a large opportunity for intervention to increase this motivation and literacy (Jen, ME, et al, 2024).

Gormally, et al. (2012) compiled indicators of scientific literacy skills into 2 parts, namely: understanding the methods of inquiry that lead to scientific knowledge; and organizing, analyzing, as well as interpreting quantitative data and scientific information. Meanwhile, Fives, et al. (2014) classified scientific literacy into 5 components, namely: the role of science, scientific thinking and activities, science and society, mathematics in science, and science motivation and beliefs. In addition, the Program for International Student Assessment (PISA) framework from the OECD (2019a) defines scientific literacy as the ability to engage with science-related problems and with science ideas as reflective citizens (Rifqi et al., n.d.).

Meanwhile, the study "Exploration of Science Literacy Skills and Science Motivation of Junior High School Students in Sanggau Regency" (2023) found that although students demonstrated science motivation, there was no significant relationship between science motivation and science literacy skills in that context. This indicates that in addition to motivation, there are other supporting factors (e.g., teaching materials, learning methods, facilities, mentors, reading habits, school environment) that also play an important role in developing good science literacy (Rahardhian, A., 2023).

Scientific literacy skills enable individuals to explore important ideas such as critical thinking and action, use scientific methods, and engage in critical thinking to address social issues. Scientific literacy relates to an individual's scientific knowledge and how they use it to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions regarding scientific issues.Silitonga, RF, Winarno, N., & Hakim, L., 2025).

In the intervention domain, classroom action research at Abdi Wacana Christian High School in Pontianak on acid-base solutions showed that the scientific literacy learning method can improve student motivation and learning outcomes. In the first cycle, motivation reached 77.88% and in the second cycle increased to 79.80%. Learning outcomes also increased from 61.53% in the first cycle to 88.46% in the second cycle. This shows that scientific literacy-based interventions not only improve conceptual understanding but also improve motivation and academic performance (Sikon, M., et al., 2017).

Finally, the study "Climate Change Perception, Action, and Hope among High School Students: Insights for Science Education" (2025) showed that high school students strongly agree that climate change is real and caused by humans. Furthermore, the study found that "hope" acts as a mediator between perception and action. This means that when students feel hopeful that their actions can have an impact, they are more likely to take action to mitigate or adapt to climate change. This is relevant to efforts to motivate students not only cognitively (knowing) but also affectively and practically (Espinola, et al., 2025).

Based on the description above, it shows that learning motivation is needed to improve scientific literacy. Thus, research is needed to determine the level of learning motivation and science literacy of students in class XI. Thus, researchers conducted research “The Effect of Learning Motivation on Science Literacy of grade XI MAN students on Climate Change material”.

METHOD

This research design uses correlational research to measure research outcomes, with learning motivation as the independent variable and scientific literacy as the dependent variable. The approach used in this study is a survey method. This study uses two research questionnaires: learning motivation and scientific literacy, which were adapted and modified according to the research objectives. This study was conducted at MAN with random sampling in grade 11.

The correlational research design between the independent variable of learning motivation and the dependent variable of scientific literacy aligns with the practice of many current educational studies. For example, Primasari, Miarsyah, and Rusdi (2022) conducted a correlational study in high schools to examine the relationship between motivation, critical thinking, and scientific literacy. They used test instruments and questionnaires, as well as linear regression analysis, to determine the extent to which motivation and critical thinking skills influence students' scientific literacy. The results showed that although motivation did not always correlate significantly as a single variable, motivation, along with critical thinking, still contributed to the prediction of scientific literacy.

The chosen survey method allows for efficient data collection from a large number of participants in a relatively short time. The study "Exploring the Correlation between Motivation and Self-Regulation in Science Learning among Junior High School Students: A Case Study" (Sholahudin, Nabilah, Lestari, et al., 2024) used a quantitative survey approach with a questionnaire to assess learning motivation and self-regulation in science learning. They used a Likert scale and random sampling at the junior high school level, which facilitated the analysis of correlations between these motivational and regulatory variables.

The use of two questionnaires (for learning motivation and scientific literacy) adapted and modified to suit the research objectives is also supported by the literature. For example, research on digital literacy and learning motivation in Aceh (Zufahmi, Rohman, Listyorini, Sapta Sari, 2024) used a Likert-scale questionnaire to measure motivation and digital literacy; then the relationship between the two was

analyzed using Pearson correlation. This is procedurally similar to the use of independent and dependent variables that you planned.

Random sampling in 11th grade, as you mentioned, is also used in Indonesian studies to maintain representativeness and reduce sampling bias. For example, in the study "Science literacy, critical thinking skills, and motivation: A correlational study" by Primasari, Miarsyah, & Rusdi (2022), they randomly selected 10th grade students in Mathematics and Natural Sciences (MIPA) as a sample to measure motivation and scientific literacy.

Furthermore, it's important to consider data analysis techniques appropriate to the survey's correlation design. Many studies use Pearson correlation (or Spearman correlation if the data are non-normal), instrument reliability and validity tests, and descriptive analysis to initially describe motivation and scientific literacy scores. For example, a study of the correlation between scientific literacy and environmental literacy in high schools in Jambi used an associative/correlation approach, normality tests, and SPSS correlation analysis.

It should also be noted that variability in learning motivation instruments (e.g., components such as self-efficacy, task value, goal orientation) and in scientific literacy (interpretation skills, scientific reasoning, application of knowledge) can influence the strength of correlations. Studies have shown that instruments that are sensitive to local contexts and tailored to the curriculum (e.g., physics, biology) tend to produce more valid and meaningful correlations.

By considering these factors, your research design will be more robust: a survey using a validated and adapted questionnaire, a random sample of eleventh-grade students, the use of correlation analysis (Pearson/Spearman), and clear measurements of the independent (learning motivation) and dependent (scientific literacy) variables. Using a quantitative correlational approach like this allows you to measure the strength of the relationship and also examine the contribution of motivation to scientific literacy in the context of religious high schools (MAN).

To measure students' learning motivation, there are 5 indicators developed into 30 questions. The learning motivation grids are as follows.

Table 1. Motivation indicators

No	Indikator
1.	The existence of desire and desire to succeed,
2.	The existence of encouragement and needs in learning
3.	There are hopes and aspirations for the future,
4.	The existence of appreciation in learning
5.	The existence of interesting activities in learning

Meanwhile, to measure the level of science literacy, there are 4 indicators in measuring students. Then the indicators were developed into 4 parts with each part having 10 questions. The science literacy grids are as follows.

Table 2. Scientific literacy indicators

No	Indikator
1.	Competence (science process)
2.	Science knowledge or content,
3.	Science context,
4.	Attitude.

The test used in this study was a simple linear regression test. Simple linear regression was used to examine the relationship between scientific literacy and other variables.

Simple linear regression is a statistical technique used to determine the effect of an independent variable on a dependent variable. In educational research, this method is often used to test the extent to which one variable, such as learning motivation, can influence another variable, such as scientific literacy. A simple linear regression model can be

written as the equation Y = a + bXY = a + bXY = a + bX, where YYY is the dependent variable, aaa is a constant, bbb is the regression coefficient, and XXX is the independent variable (Indana, 2022).

The use of simple linear regression in educational research aims to provide a quantitative overview of the direction and magnitude of the relationship between variables. According to Sugiyono (2021), simple linear regression analysis not only explains the existence of a relationship but also predicts the value of a dependent variable based on changes in the value of the independent variable. This makes this method important in both experimental and correlational research, especially when researchers want to test the effect of a single variable on a learning outcome.

In the context of scientific literacy research, simple linear regression can be used to assess the influence of learning motivation on students' literacy levels. For example, research by Primasari, Miarsyah, & Rusdi (2022) used simple linear regression to examine the relationship between motivation and scientific literacy and found that, although there was a positive relationship, the effect was not always significant. This demonstrates that regression analysis helps researchers not only identify relationships but also assess the significance of these influences.

The advantages of simple linear regression are its ease of use and clear interpretation of the results. Zhang, Li, & Chen (2023) emphasized that a simple linear regression model can provide information on the direction of an influence (positive or negative) and its strength. However, its weakness is its limited ability to capture complex relationships, as it only involves one independent variable. For cases with multiple factors, researchers typically use multiple regression.

Thus, the use of simple linear regression in educational research, particularly in examining the influence of motivation on scientific literacy, is an important initial step in gaining a basic understanding of the relationships between variables. However, the results of simple regression analysis need to be enriched with further research using more complex models. This is in line with the research of Sholahudin et al. (2024), who combined simple regression with correlation analysis and multiple regression to obtain a more holistic picture of students' motivation, self-regulation, and scientific literacy.

This test explains how independent variables influence dependent variables through a regression model (Indana Z, 2022).

The general form of simple linear regression can be seen as follows:

$$Y_1 = a + \beta_1 X_1 + \beta_2 X_2$$

Description:

Y_1 : The value of the dependent variable in the i-th observation

a : Random error

X_1 : Independent variable value at the 1st observation

X_2 : The value of the independent variable in the 2nd observation

β_1 β_2 : Regression coefficient parameter.

RESULT AND DISCUSSION

This scientific literacy research was analyzed by testing the simple linear regression hypothesis.

Tabel 3. Result of simple linear regression

Coefficients[a]

ANOVA[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	df	Standardized Coefficients Beta
1	(Constant)		87.041	6.668	
	Literasi Sains		.159	.095	.277

a. Dependent Variable: Motivasi Belajar

Based on the results of the table 3, it can be concluded that the constant value∝The Science Literacy coefficient is

87.041 and the direction coefficient is /βX +0.159. If the coefficient is positive, then science literacy increases if learning motivation increases, so the equation is obtained:

$$Y=87.041+0.159\ X1$$

Based on the results of a simple linear regression, a constant of 87.041 and a regression coefficient of 0.159 were obtained. This indicates that each one-unit increase in scientific literacy contributes to an increase in learning motivation of 0.159 units. Although the relationship obtained is positive, the significance value of 0.102 > 0.05 indicates that the effect is not statistically significant. These results show that scientific literacy does have a direction of relationship in line with learning motivation, but it is not the dominant factor influencing motivation.

This finding aligns with research by Febriya and Desnita (2024), which stated that scientific literacy is indeed related to students' affective factors, but in certain contexts, the effect is weak and insignificant. This occurs because learning motivation is also influenced by other factors such as teacher teaching style, family support, and the learning environment.

Tabel 4. Analysis of variance

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	144.550	1	144.550	2.819	.102[b]
	Residual	1743.339	34	51.275		
	Total	1887.889	35			

a. Dependent Variable: Motivasi_Belajar

b. Predictors: (Constant), Literasi_Sains

Tabel 5. Model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.277[a]	.077	.049	7.16063

a. Predictors: (Constant), Literasi_Sains

The R Square value (0.077) indicates that only about 7.7% of the variation in learning motivation can be explained by scientific literacy. In other words, the remaining 92.3% is influenced by factors other than scientific literacy. Research by Sholahudin et al. (2024) revealed that self-regulation, interest in science, and self-efficacy have significant contributions to learning motivation, thus strengthening the explanation that scientific literacy is not the only determining variable.

The results of this study provide important insights that, although learning motivation has a positive relationship with scientific literacy, its contribution is still low. This indicates that the development of students' scientific literacy is not solely determined by motivational aspects but also requires the support of external factors such as innovative learning methods, teacher involvement, and a conducive learning environment. As stated by Membiela et al. (2023), students' emotional engagement in science classes can be a stronger mediator in improving scientific literacy than motivation alone.

Furthermore, these results can serve as a foundation for teachers in designing more holistic learning strategies. STEAM-based approaches, project-based learning, or the integration of global issues such as climate change can be used as a means to increase both cognitive engagement and student motivation (Kundariati, Ibrohim, & Rohman, 2025). In this way, scientific literacy develops not only at the knowledge level but also fosters critical awareness and reflective attitudes in students toward real-world problems.

Thus, this research underscores the need for pedagogical interventions that integrate cognitive, affective, and contextual aspects. Teachers and schools are expected to focus not only on increasing learning motivation but also on creating meaningful learning experiences that encourage students to think scientifically, actively participate, and connect science to current global challenges.

Based on the results of the table hypothesis and equation, there is a

significance value of 0.00 < 0.05 and a calculated t value of 1.679 > t table 13.054, so learning motivation has a positive and significant effect on scientific literacy.

Although significance has not been achieved, the results of this study are still important because they indicate a positive trend. Zhang, Li, & Chen (2023) emphasized that motivational variables tend to increase when students have good scientific literacy, as scientific literacy can foster confidence in understanding scientific phenomena. Therefore, these findings can be used as a basis for developing learning strategies that emphasize improving scientific literacy as part of strengthening motivation.

Furthermore, the low contribution of scientific literacy in this study may also be related to the learning methods used in schools. Primasari, Miarsyah, & Rusdi (2022) showed that scientific literacy has a more significant impact on learning motivation when teachers implement an inquiry-based or problem-based learning approach, which makes students feel more relevant and engaged in learning.

Contextual aspects also significantly influence outcomes. Research by Lestari & Wibowo (2022) in Palembang found that students with moderate to high levels of scientific literacy did not necessarily demonstrate high learning motivation if the learning environment was not supportive. This means that even if students understand scientific concepts, they still need emotional, social, and pedagogical support to maintain their learning motivation.

Based on the R square value of 0.077 in the table above, learning motivation influences scientific literacy by 46.2%, while the remaining 53.8% is influenced by other factors.

This study examines the influence of learning motivation on literacy of eleventh-grade MAN students related to climate change. The results of the regression analysis showed R Square = 0.077, indicating that learning motivation only contributed around 7.7% to student literacy. However, the test results showed no significant difference between learning motivation and student literacy (sig. = 0.102 > 0.05).

This suggests that other factors, such as the quality of the learning environment, the learning environment itself, first-year students' abilities, and learning media, may play a more significant role in influencing scientific literacy. This is in line with research by Membiela et al. (2023), which showed that student motivation and emotional support in the classroom play a crucial mediating role in influencing learning outcomes.

Although learning motivation is an important factor, the results of this study indicate the need for a holistic approach that combines motivating teaching methods, interactive media, and emotional support to improve student literacy.

The results of this study differ from those of Razali et al. (2020), who stated that learning motivation is a crucial mediator between students' interest in STEM and their aspirations to pursue a career in STEM fields in high school. According to Razali's research, learning motivation has a significant impact on students' academic achievement and interest in STEM fields.

On the other hand, the research results of Wulandari et al. (2017) show that learning motivation does not always have a significant influence on students' literary language skills, especially if external variables such as media, curriculum, or teaching methods are ineffective.

In addition, this study supports the findings of Amalia et al. (2024), who emphasized the importance of innovative teaching media (such as the GEMIKA educational game) in increasing student motivation because motivation alone, without the help of teaching strategies, may not be enough to improve learning outcomes.

This study provides theoretical contributions by demonstrating that learning motivation is not the sole factor influencing student literacy. The results of the regression analysis indicate that

learning motivation contributes only about 7.7% to scientific literacy, and its effect is not statistically significant (sig. = 0.102 > 0.05). This suggests that other factors, such as learning strategies, interactive media, teacher-student relationships, and problem-based learning environments, may have greater potential to improve student literacy. This supports the study of Membiela et al. (2023), which stated that emotional stability and feelings of happiness at school are important mediators between motivation and learning outcomes. Therefore, this study suggests a more thorough investigation to identify other, more dominant variables, which can be used to develop a comprehensive teaching model that improves student literacy levels.

The standardized beta coefficient of 0.277 indicates that the effect of scientific literacy on motivation is weak. This is similar to research by Zufahmi et al. (2024) that examined the relationship between learning motivation and digital literacy. They found a positive relationship, but with a low contribution, suggesting the need for other interventions such as the use of interactive learning media.

From a methodological perspective, the results of this study also provide a lesson that simple linear regression can only explain the relationship between one variable. Further research should utilize multiple regression to examine the simultaneous influence of scientific literacy, self-regulation, self-efficacy, and attitudes toward science on learning motivation. A similar study by Rahman & Santoso (2025) found that a combination of cognitive and affective factors was more effective in explaining variations in students' motivation to address global science issues.

Practically, although these results are not yet significant, teachers can still utilize scientific literacy as a means to boost motivation. For example, by linking learning materials to real-life social issues like climate change or global warming. Kundariati, Ibrohim, & Rohman (2025) emphasized that students are more motivated when they see the connection between science and everyday life and global challenges.

Based on practical theory, the results of this study should be used by teachers and school administrators not only to increase student motivation but also to emphasize the use of interactive learning models, technology-based media, and contextual writing relevant to everyday life. According to Amalia et al. (2024), there are alternative ways to improve science understanding, for example by using educational games based on the Wordwall platform. Furthermore, the results of this study can form the basis for developing educational policies that support STEAM-based curricula and problem-based learning to ensure optimal student literacy development.

Thus, this research implies that scientific literacy has the potential to increase learning motivation, but it is not strong enough on its own. A more holistic approach is needed, taking into account self-regulation, self-efficacy, supportive learning environments, and innovative pedagogical strategies. This aligns with the current direction of science education, which emphasizes the integration of cognitive, affective, and contextual aspects to build a generation that is both scientifically literate and motivated for lifelong learning.

CONCLUSION

This study shows that learning motivation does not significantly influence the scientific literacy of eleventh-grade MAN students on climate change. This is evident from the results of a simple linear regression analysis that yielded a significance value of 0.102 > 0.05 and an R-square value of 0.077. Thus, learning motivation only explains 7.7% of the variation in scientific literacy, while the remaining 92.3% is influenced by factors other than learning motivation.

Although the effect was not significant, the positive direction of the relationship between learning motivation and scientific literacy remains important to note. The positive regression coefficient of 0.159 indicates that increased learning motivation tends to be followed by increased scientific literacy, although the contribution is still small. This means that motivation still plays a role, but it is not the dominant factor determining students' scientific literacy success.

The results of this study indicate that other factors such as learning methods, interactive learning media, the learning environment, and emotional support from teachers and families have greater potential to influence scientific literacy. This aligns with previous research emphasizing that improving scientific literacy requires a comprehensive approach involving cognitive, affective, and contextual aspects.

Theoretically, this study contributes by demonstrating that learning motivation is not the sole key factor in improving scientific literacy. The results underscore the need for further research to explore other variables such as self-regulation, self-efficacy, interest in science, and students' more contextual perceptions of global issues to further develop a comprehensive understanding of scientific literacy.

Practically, this research implies that efforts to improve students' scientific literacy need to be implemented through innovative, STEAM-based learning strategies oriented toward real-world issues such as climate change. Teachers are expected to integrate engaging learning media, problem-based methods, and contextual learning to foster motivation and strengthen students' scientific literacy.

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