



The Relationship Between Scientific Literacy Skills and Self-Efficacy of Junior High School Students in Science Learning

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Abstract

This study aimed to determine the level of scientific literacy skills and self-efficacy of junior high school students in science learning. This research was conducted through the administration of a scientific literacy test and a self-efficacy questionnaire. The research instrument consisted of a scientific literacy test in the form of essay questions that measured three indicators of scientific competence, and a self-efficacy questionnaire adapted from Bandura with indicators of magnitude, strength, and generality. The results showed that students' scientific literacy level was in the very low category, with the majority of students (81.1%) only reaching the nominal literacy level. It indicates that although students can recognize basic concepts in science, they still have difficulty explaining scientific phenomena and using scientific evidence logically. Meanwhile, students' self-efficacy level is generally in the moderate category, although it is still relatively low in some indicators, such as generality. The correlation test shows a significance value of $0.305 > 0.05$ with a Pearson correlation coefficient of 0.098, which means there is no significant relationship between scientific literacy skills and self-efficacy. The coefficient of determination of 0.0096 indicates that the contribution of scientific literacy to self-efficacy is only 0.96%, while other factors influence the other 99.04%. The analysis showed no significant relationship between students' scientific literacy skills and self-efficacy, as scientific literacy contributed only minimally and was largely influenced by other factors.

Keywords: Science Competence, Academic Self-efficacy, Science Learning, 21st Century Skills

Introduction

The Programme for International Student Assessment (PISA) noted that Indonesian students' mastery of scientific literacy, particularly science competencies, remains weak. This conclusion is supported by data from interviews conducted with educators at SMP Negeri 5 Batam, which revealed that many students still experience difficulties in various dimensions of scientific literacy. First, regarding competency, some students still have limitations in recognizing scientific problems in science learning, including formulating or asking questions that align with the context of the subject matter. Second, some students encounter obstacles in explaining scientific phenomena revealed in academic evaluations and assigned assignments. Third, some students cannot connect scientific evidence to opinions, while others can express assumptions or personal opinions. Fourth, some students are not yet able to draw conclusions related to scientific observations, and students still tend to be directed and guided by teachers in their conclusions. Fifth, some students are still not competent in understanding the content of reading materials. Sixth, some students' attitudes toward scientific issues are still relatively low, as can be observed from their lack of participation in conveying and interacting critically with emerging scientific issues in their environment.

Scientific understanding through scientific literacy is one of the elements determining the quality of human resources (HR) in thinking and problem-solving. Furthermore, strengthening scientific literacy in the current generation is not aimed at shaping them into scientists, but rather at equipping them with an understanding of science and technology to make decisions that impact their survival, both now and in the future (Pratiwi et al., 2019). However, educational issues in Indonesia remain unresolved, which is literacy. Current conditions indicate that students' competency in understanding science remains relatively low, even though this is an essential part of scientific literacy.

Regarding science learning, Armas & Syahrir (2019) argue that educators must emphasize the importance of direct or contextual experiences to help students develop the skills necessary to gain a deeper scientific understanding of nature. However, teachers' understanding of scientific literacy is often limited. In fact, scientific literacy should involve more than just reading, writing, and analyzing texts; it should also encompass the application of knowledge and critical thinking (Yusmar & Fadilah, 2023). In addition to educators' limited understanding of scientific literacy, Yanti et al. (2020) also emphasized that students' scientific literacy is closely related to learning motivation.

Learning motivation is related to students' scientific literacy skills and self-efficacy. This statement aligns with Widya & Muwakhidah (2021), who stated that individuals with high learning motivation tend to have a strong belief in continuing learning. Motivated students will spend more time studying, demonstrate greater diligence, complete assignments on time, and persevere in facing failure or difficulty. Self-efficacy is an individual's belief in completing tasks and facing problems without comparing themselves to the achievements of others. This belief drives students to succeed in learning, accompanied by confidence in their efforts, decisions, and perseverance (Ningsih & Hayati, 2020 as cited in Estiningtyas et al., 2024). The problem faced by most students in Indonesia is low self-efficacy. A common problem is that students often doubt their talents, resulting in a lack of confidence, unwillingness to participate in assignments, an inability to complete activities, avoidance of tasks they consider challenging, and doubts about their abilities (Fitriani & Rudin, 2020).

Scientific literacy, as described by OECD (2019), requires more than just knowledge of scientific concepts and theories; it also involves an understanding of common practices and methods of scientific inquiry, as well as how these approaches enable the advancement of science. However, the achievement of scientific literacy does not rely solely on cognitive ability affective factors such as self-efficacy also play a crucial role. According to Bandura (2006) as cited in Nanda & Widodo (2015), self-efficacy is an individual's belief in their ability to carry out the actions required to achieve certain outcomes. In science learning, students with high self-efficacy

tend to be more persistent in solving problems, more active in their thinking, and more skilled in applying scientific reasoning.

Scientific literacy is a crucial competency for students to face the challenges in the 21st century. Scientific literacy encompasses more than just understanding scientific concepts; it also includes identifying scientific issues, explaining scientific phenomena, and using scientific evidence to make decisions. However, international surveys, such as the Programme for International Student Assessment (PISA), indicate that Indonesian students' scientific literacy remains relatively low. This is evident among students at SMP Negeri 5 Batam, where most students struggle to logically and coherently explain scientific concepts. Self-efficacy is also a crucial factor influencing student learning success. Self-efficacy relates to students' confidence in completing tasks, facing challenges, and achieving success. However, observations at SMP Negeri 5 Batam show that many students still exhibit low levels of self-efficacy, such as a lack of confidence in expressing opinions, hesitation in completing challenging assignments, and preferring to avoid challenges rather than face them.

Several studies have revealed a strong connection between scientific literacy and self-efficacy. For instance, research conducted by Lestari et al. (2020) entitled “Hubungan Antara Self Efficacy dengan Literasi Sains pada Materi Ekosistem di SMA Negeri 1 Tasikmalaya” found a very strong positive correlation, with self-efficacy contributing 56.2% to the variation in scientific literacy. In contrast, another study by Arifiyyati (2022) entitled “Correlation Between Scientific Literacy with Higher Order Thinking Skills and Self-Efficacy in Biology Learning” reported no significant relationship between the two variables. These differing findings indicate that the relationship between scientific literacy and self-efficacy still requires further investigation. Therefore, this study was conducted to analyze the levels of scientific literacy and self-efficacy of students, as well as to examine whether there is a significant relationship between the two.

Based on these problems, it is important to conduct this research to determine the extent of the level of scientific literacy and self-efficacy of students and their correlation. Therefore, this study aimed to investigate the level of students' scientific literacy and self-efficacy, as well as to examine whether there was a significant relationship between the two variables.

Research Method

The present study was conducted using a quantitative method with a correlational design, carried out in June 2025. The population consisted of all seventh- and eighth-grade students of SMP Negeri 5 Batam in the 2024/2025 academic year, with a total of 111 students. The sampling technique applied was total sampling, so that the entire population was included as the research sample. Data was collected through research instruments. First, students' scientific literacy was measured using a scientific literacy test developed based on PISA scientific competency indicators, namely identifying scientific issues, explaining scientific phenomena, and using scientific evidence. The test consisted of six essay questions constructed in accordance with the Learning Outcomes of Phase D, specifically the interaction of living things with their environment. The scientific literacy test was validated and its reliability was confirmed, with a Cronbach's Alpha coefficient of 0.737. Meanwhile, self-efficacy was measured using a questionnaire adapted from (Marddiyah, 2022). The questionnaire, which had been validated and proven reliable with a Cronbach's Alpha coefficient of 0.949, consisted of 40 statements representing Bandura's indicators of self-efficacy: magnitude (task difficulty level), strength (belief intensity), and generality (breadth of applicability). For data analysis, descriptive statistics were employed, followed by assumption testing, including a One-Sample Kolmogorov-Smirnov normality test with a Monte Carlo approach. The hypothesis was tested using Pearson Product Moment correlation analysis. All statistical analyses were performed with the assistance of IBM SPSS Statistics version 26. Guidelines for the degree of single correlation relationships used are shown in Table 1 below.

Table 1. Guidelines for the Degree of Single Correlation Relationships

Coefficient Interval	Description
0,00 – 0,199	Very weak
0,200 – 0,399	Weak
0,400 – 0,599	Moderate
0,600 – 0,799	Strong
0,800 – 1,000	Very strong

Source: Sugiyono (2023)

Result and Discussion

The literacy skills of students at SMP Negeri 5 Batam are as follows:

Table 2. Descriptive Analysis of Science Literacy Skills

Descriptive Statistics					
Science Literacy	N	Mean	Standard Deviation	Minimum	Maximum
	111	10.78	3,304	0	19

Literacy skills of 111 students at SMP Negeri 5 Batam. Based on the analysis, the lowest score was zero and the highest score was 19, with an average score of 10.78 and a standard deviation of 3.304. Details of the categorization of these abilities are shown in Table 3

Table 3. Distribution of Scientific Literacy Ability Categories

No.	Science Literacy Category	Frequency	Percentage (%)
1.	Very good	0	0
2.	Good	1	0.9
3.	Enough	12	10.8
4.	Not enough	8	7.2
5.	Very less	90	81.1
Amount		111	100

The literacy ability categories show that 81.1% of students at SMP Negeri 5 Batam demonstrated a very low level of scientific literacy. Table 4 presents the results regarding the students' scientific literacy abilities.

Table 4. Distribution of Scientific Literacy Ability Levels

No.	Scientific Literacy Level	Frequency	Percentage (%)
1.	Multidimensional Literacy	0	0
2.	Conceptual Literacy	1	0.9
3.	Functional Literacy	20	18
4.	Nominal Literacy	90	81.1
Amount		111	100

The literacy ability levels above show that most students at SMP Negeri 5 Batam have scientific literacy abilities at the nominal literacy level, as indicated by 81.1% of the total respondents. The distribution of students' scientific literacy abilities is reviewed further through each indicator, as seen in Table 5.

Table 5. Distribution of Science Literacy Ability Indicators

No.	Indicator	Total Score	Mark	Percentage (%)	Category
1.	Identifying scientific issues	433	48.76	36	Very less

2.	Explaining phenomena	scientific	365	41.1	30.49	Very less
3.	Using scientific evidence		399	44.93	33.33	Very less

The table indicates that students still perform very poorly on all indicators of scientific literacy, particularly on the indicator of identifying scientific issues, with a score of 36%. The description of the self-efficacy abilities of students at SMP Negeri 5 Batam is as follows:

Table 6. Descriptive Analysis of Self-Efficacy Ability

Descriptive Statistics					
Self-efficacy	N	Mean	Standard Deviation	Minimum	Maximum
	111	104.59	6.811	76	119

The table above presents descriptive data regarding the level of self-efficacy measured by 111 students at SMP Negeri 5 Batam. Data analysis revealed a minimum score of 76 and a maximum score of 119, with an average of 104.59 and a standard deviation of 6.811. The categories of self-efficacy abilities can be seen in Table 7 below.

Table 7. Distribution of Self-Efficacy Ability Categories

No.	Self-Efficacy Category	Frequency	Percentage (%)
1.	Very high	0	0
2.	Tall	13	11.71
3.	Currently	95	85.59
4.	Low	3	2.70
5.	Very Low	0	0
Amount		111	100

The category distribution table above indicates that the majority of students have adequate self-efficacy, with a dominant tendency in the moderate category. Self-efficacy results are also evident in the distribution of self-efficacy indicators, as shown in Table 8 below.

Table 8. Distribution of Self-Efficacy Ability Indicators

No.	Indicator	Total Score	Mark	Percentage (%)	Category
1.	<i>Level</i>	4,258	68.50	34.14	Low
2.	<i>Strength</i>	4,583	68.81	34.30	Low
3.	<i>Generality</i>	3,093	63.33	31.56	Very Low

Table 11 presents the distribution of students' self-efficacy scores. These results indicate that, in general, students' self-efficacy across the three indicators remains low, particularly in the generality aspect, reflecting low student confidence in dealing with various situations or tasks.

Statistical Prerequisite Tests and Hypothesis Tests

The normality test aims to identify whether the data distribution in this study follows a normal distribution pattern. In this study, the test was conducted using the one-sample Kolmogorov-Smirnov statistic with a Monte Carlo approach. The initial step was to regress all variables to obtain residual data simultaneously. The one-sample Kolmogorov-Smirnov test was performed on the residual data to determine whether the data distribution was normal. This test uses a significance level (p-value) of 0.05 as the reference limit. The data are normally distributed if the significance level is greater than 0.05. The results of the normality test using the one-sample Kolmogorov-Smirnov test with a Monte Carlo approach are shown in Table 9.

Table 9. Results of the One-Sample Kolmogorov-Smirnov Normality Test with a Monte Carlo Approach

One-Sample Kolmogorov-Smirnov Test			
			Unstandardized Residual
N			111
Normal Parameters ^{a,b}	Mean		.0000000
	Std. Deviation		6.77813382
Most Extreme Differences	Absolute		.085
	Positive		.085
	Negative		-.079
Test Statistic			.085
Asymp. Sig. (2-tailed)			.046 ^c
Monte Carlo Sig. (2-tailed)	Sig.		.376 ^d
	99% Confidence Interval	Lower Bound	.364
		Upper Bound	.389

Based on the normality test results shown in Table 9, the significance value (Monte Carlo Sig. 2-tailed) obtained was 0.376. This value is greater than 0.05, meaning the residual data from the regression of the two variables, scientific literacy and self-efficacy, are normally distributed. The normality test results can also be seen in Figure 1, the P-Plot normality test, which is a graphical analysis.

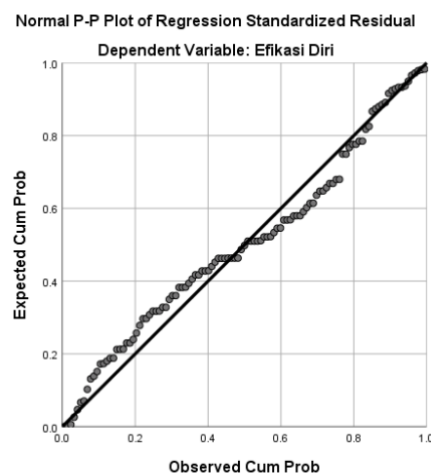
**Figure 1.** P-Plot Normality Test

Figure 1 shows that the data points are distributed along the diagonal line in the normal probability plot. Thus, it can be concluded that the three variables in this study meet the assumption of normality and are suitable for further analysis using parametric statistical tests. The results of the hypothesis test, which examined the correlation between scientific literacy skills and self-efficacy, are shown in Table 10 below.

Table 10. Results of the Correlation Test Between Scientific Literacy Skills and Self-Efficacy

Variable	Sig (2-tailed)	Pearson Correlation	Category	Determination Correlation (R Square)
Science Literacy With Self-efficacy	0,305	0,098	Very Weak	0,0096

Based on Table 3, a significance value (Sig. 2-tailed) of 0.305 was obtained, greater than 0.05. It indicates no significant relationship between scientific literacy skills and student self-efficacy. The Pearson correlation coefficient of 0.098 indicates a weak and likely insignificant relationship. Furthermore, the coefficient of determination (R Square) was 0.0096, indicating that the contribution of scientific literacy skills to self-efficacy was only 0.96%.

Based on the overall analysis, students' scientific literacy skills were categorized as very low. It is reinforced by the finding that most students only reached the nominal level, indicating that they could identify and understand the basic characteristics of a particular concept, but had not yet understood the function or purpose of the design. All three demonstrate very low achievement when examined individually across scientific literacy indicators, including identifying scientific issues, explaining scientific phenomena, and using scientific evidence. Of these, the ability to explain scientific phenomena is the weakest indicator, indicating that students have difficulty understanding and explaining scientific concepts logically and coherently.

This study aligns with the results of research conducted by Arifiyyati (2022), which stated that there was no significant relationship between scientific literacy skills and self-efficacy, with the relationship being very weak or likely insignificant. The contribution of self-efficacy to scientific literacy is only 0.9%. The relationship between the two can be explained by students' attitudes toward science, particularly their confidence. Self-efficacy reflects students' belief in their ability to complete tasks, set and achieve goals, and apply these attitudes to develop their skills. Such characteristics intersect with scientific literacy activities, which involve solving and evaluating problems as well as interpreting scientific data or facts. Therefore, individual confidence is essential for engaging effectively in these activities (Lestari et al., 2020). However, the weak relationship between self-efficacy and scientific literacy skills may also be influenced by students' low scientific literacy abilities and their self-efficacy. Many students feel anxious when their scores fall below the minimum competency standard or insecure when comparing themselves with peers they consider more intelligent. In addition, distractions in a noisy learning environment make it difficult for them to stay focused, and a lack of confidence often prevents them from expressing their opinions, causing them to remain silent rather than participating actively (Arifiyyati, 2022).

The low scientific literacy of students in Indonesia is influenced by various fundamental aspects related to learning resources, the learning process, and the educational environment. First, using textbooks as the sole learning resource remains dominant in many schools. Science material is primarily presented textually without reinforcement through exploratory activities or hands-on practice. This reliance on textbooks results in students passively receiving information without developing scientific thinking skills. It makes learning boring and non-contextual, resulting in shallow conceptual understanding. Second, many students experience misconceptions about scientific concepts. It is due to curriculum pressures that demand material completion quickly, leading teachers to neglect the depth of students' understanding often. Material is presented quickly, without reinforcing meaning or connecting it to real life. As a result, students memorize information without truly understanding it, and the concepts learned are easily forgotten (Fuadi et al., 2020).

Third, the learning process lacks a connection between the material and everyday life. Students often feel that science lessons are irrelevant to the realities they face. This disconnect makes it difficult for them to understand the benefits and applications of science in their lives. The lack of contextual experience hinders them from connecting theory to real-world phenomena.

Furthermore, poor scientific reading and comprehension skills are also a significant obstacle. Students are generally unfamiliar with reading scientific texts, so they struggle to grasp important information, interpret data, or understand evidence-based arguments. This problem is exacerbated by the low reading culture in the community at large. Finally, the unsupportive learning environment and school climate are also significant factors. Learning remains teacher-centered, classroom interaction is minimal, and exploration of scientific concepts is rare. Furthermore, many schools lack adequate facilities or resources to support active and meaningful science learning. These conditions leave students unmotivated and unfamiliar with scientific literacy-based questions or assignments (Fuadi et al., 2020).

According to Hasnawati et al. (2023), educators must adopt a more active, student-centered learning approach. The learning process should emphasize the verbal delivery of concepts and encourage students to construct their own understanding through various exploratory activities. In this regard, the teacher's role is as a facilitator, creating a learning environment that encourages students to think critically, investigate, and draw conclusions from observations or experiments. Exploratory activities such as experiments, direct observation, and literature studies can hone students' scientific thinking skills. Through this approach, students learn to observe phenomena, formulate problems, make predictions, and analyze and draw conclusions based on the evidence found. These activities build conceptual understanding and foster scientific attitudes such as curiosity, honesty, and objectivity.

Low academic self-efficacy in students is influenced by two main factors: internal and external. Internal factors include a lack of enthusiasm for learning, low motivation, and an inability to develop learning skills, which makes students lazy, passive, and reluctant to seek solutions when facing difficulties. Meanwhile, external factors are evident in a lack of teacher support and guidance, and students' habits of disobeying instructions from homeroom teachers or peers. This condition causes students to give up more quickly, lose interest in learning, and even resort to quick solutions like cheating. These two factors influence each other, weakening students' confidence in completing academic assignments (Raihani et al., 2024).

Efforts to improve student self-efficacy through guidance and counselling services using the Rational Emotive Therapy (RET) approach. This preventive effort is carried out for students with high self-efficacy by providing motivation and assuring them of their ability to complete assignments, achieve, and overcome feelings of inferiority to prevent their self-confidence from decreasing. Meanwhile, for students with low self-efficacy, through mentoring, curative efforts are carried out to change irrational thinking patterns to rational ones, foster positive beliefs, and develop the courage to face academic challenges. Guidance and counselling teachers also form study groups so students with low self-efficacy can be motivated by more confident peers, accompanied by regular progress evaluations. Through these steps, positive changes are seen in students, such as becoming more active, enthusiastic, persistent, and able to complete assignments well (Nurfadhilla, 2020).

Conclusion

This study demonstrates that junior high school students' scientific literacy is still at a very low level, while their self-efficacy is in the moderate category. The analysis confirmed that there is no significant relationship between the two variables, as self-efficacy contributes only minimally to scientific literacy. These findings suggest that scientific literacy cannot be explained solely through students' confidence but is also shaped by other factors, such as teaching strategies,

learning resources, and the classroom environment. The strength of this study lies in its use of validated and reliable instruments for both variables, providing a solid measurement foundation. However, its limitation is that the data were drawn from a single school with a relatively small sample, which restricts the generalization of the results. Future studies should therefore involve a broader population and explore additional factors that may influence scientific literacy and self-efficacy.

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