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The Effectiveness of Learning Motivation on Science Literacy in Elementary School Students

Anisya Fitriani[1]
Institut Prima Bangsa, Cirebon, Indonesia
anisyafitriani8@gmail.com

Putri Melianti[2]
Institut Prima Bangsa, Cirebon, Indonesia
Putrimelianti10@gmail.com

Adinda Wulan Fitriyah[3]
Institut Prima Bangsa, Cirebon, Indonesia
adindawulanfitriyah@gmail.com

Abstract: This study aims to analyze the relationship between learning motivation and science literacy in primary school students. Motivation is an important factor in learning, while science literacy plays a role in developing critical and analytical thinking skills. Using a quantitative approach and correlational survey design, data were obtained from a sample size of 50 students (n = 50) from five public elementary schools in Cirebon, Indonesia. The research instrument consisted of a Likert scale questionnaire to measure the level of motivation as well as a written test to assess science literacy. The results of descriptive statistical analysis showed that students' motivation level was high, with an mean score of 31.82 out of 40. In contrast, science literacy was in the medium category, with an mean score of 16.02 out of 26. The correlational findings indicated that high motivation does not always go hand in hand with improved science literacy. This suggests that internal motivation needs to be balanced with relevant and contextualized learning strategies. Thus, effective science education demands an integrated approach that not only facilitates students' affective aspects but also enriches learning experiences through explorative and meaningful methods. The main contribution of this study lies in emphasizing the importance of integration.

Keywords: learning motivation; science literacy; science learning

INTRODUCTION

Education is a systematic process designed to develop and refine the basic abilities of individuals as a whole, both in intellectual and emotional aspects, which focuses on the formation of human character in relation to others. Education can be understood as a humanization process, which is an effort to enhance the comprehensive human qualities of young people through attitudes, actions, as well as activities, that reflect human values. Primary school is the initial stage of formal education that is included in the six-year compulsory education program. In this phase, learning activities are designed to prepare students to be able to continue their education to a higher level, either secondary or tertiary. One important aspect of the elementary school curriculum is the introduction of Natural Sciences (IPA) subjects, which aims to equip students with a scientific foundation as a provision in supporting the nation's progress, especially in the field of technology (Djumhana, 2007: 45). Sciences (IPA) is one of the core subjects in the education system in

Indonesia which is taught starting from elementary school to university level. Science is characterized as a field of science that studies various real natural phenomena, both in the form of events and cause-and-effect relationships that can be observed directly (Wisudawati, 2014).

Motivation is a psychological condition in the form of an impulse that arises consciously in a person to act in order to achieve certain goals. Motivation can also take the form of efforts that encourage individuals or groups to take action in order to achieve the desired goals or get satisfaction from what is done. In the context of learning, learning motivation is a drive that encourages students to act or take action because of a need, both from within and from the surrounding environment. This encouragement makes students behave positively at school, persevere in completing challenging tasks and facing various problems, and be able to process information deeply, both in the learning process in the classroom and outside the classroom (Tita 2019).

In the context of education at the elementary school level, literacy in science learning is an essential component that supports the formation of students who think critically, rationally, and reflectively on various natural phenomena. Literacy in science learning is not only limited to mastering basic concepts, but also includes students' ability to understand scientific information, formulate relevant questions, and draw conclusions based on reliable data and evidence. Science literacy focuses on building students' knowledge to use science concepts meaningfully, think critically and make balanced and adequate decisions on problems that have relevance to students' lives (Pratiwi et al., 2019). Therefore, strengthening scientific literacy from an early age at the primary school level is a crucial foundation for supporting the advancement of science education and fostering a generation equipped with scientific understanding and social responsibility (Fitria, 2017).

Internationally, science literacy is widely recognized as a key competency for preparing students to thrive in an ever-changing world. The Programme for International Student Assessment (PISA) regularly evaluates science literacy among 15-year-olds in participating countries, offering a global standard by which to measure student achievement. Indonesia's performance on PISA science assessments has historically been below the OECD average, indicating persistent challenges in the quality of science education and student engagement (OECD, 2018). This gap underscores the urgent need to understand and improve the factors that influence science literacy at earlier educational stages, such as in primary school. By examining the relationship between learning motivation and science literacy among Indonesian elementary students, this study provides valuable insights that align with global educational goals. Strengthening motivation and literacy from an early age could help Indonesia bridge its performance gap in international assessments and foster a scientifically literate population capable of contributing to global scientific and technological advancement.

Some previous studies have found a positive relationship between learning motivation and science literacy, but these studies are still limited to the general context or at higher education levels, so not many have specifically examined the relationship between the two in the context of science learning at the primary school level. This is where the research gap that underlies the importance of this study lies, specifically the need for further exploration of the extent to which learning motivation affects the science literacy of elementary school students empirically and measurably. The purpose of this study is to determine the relationship between students' learning motivation and science literacy at the elementary school level. This study is expected to contribute identifying internal factors of students that play an important role in shaping science literacy skills from an early age, as well as providing input to teachers and education policy makers when designing learning strategies that are able to increase students' learning motivation towards science.

METHODS

Research Approach and Design

The method used in this study is a survey method with a correlational approach, which aims to examine the relationship between two variables, namely learning motivation and science literacy. Surveys are used to identify relationships between variables and answer research questions objectively and measurably (Morrisan, 2012). The research employs a non experimental design, which focuses more on observing and analyzing natural relationships between variables under existing conditions without intervention (Creswell, 2014). This approach provides a more realistic picture of the phenomenon under study, by ensuring the rights and welfare of elementary school students who are research participants are protected. Parental or guardian consent and student assent were also obtained. For data analysis, Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS software was chosen over Covariance-Based SEM (CB-SEM) because it is more suitable for small sample sizes (n = 50), does not require strict data normality assumptions, and is more robust in handling complex models. Therefore, SmartPLS is an appropriate tool to explore the relationship between learning motivation and science literacy.

Population and Sample

According to Sugiyono (2017), population is the whole subject or object that has certain characteristics and qualities that have been determined by the researcher as the focus of the study, with the aim of drawing a conclusion from the research results. This study examined grade IV elementary school students from five elementary schools. In addition, the five schools are public elementary schools. Therefore, they are considered appropriate subjects for research on the learning motivation and science literacy of elementary school students.

Based on the opinion of Sugiyono (2017), A sampling technique is a method used to determine who will be included in a study as a sample. It ensures that researchers obtain data in accordance with their research objectives. In this study, the researcher used the purposive sampling technique, which is based on certain considerations or criteria determined by the researcher (Ferdinand, 2014). The researcher chose this technique because they wanted to obtain data from groups of students who were considered capable of providing relevant information according to the research needs. The sample selection criteria in this study are elementary school students who have various levels of academic ability, namely high, medium or low. A group of students was selected as the sample, ensuring that the total number of participants was sufficient. The selection was made by considering equity based on these ability categories, so that the results of the study could provide a balanced and comprehensive picture of the relationship between learning motivation and students' science literacy.

Data Collection Techniques

Data in this study were collected using two types of instruments, namely questionnaires to measure the level of student learning motivation, and written tests to measure literacy skills in science learning, especially on photosynthesis material. Questionnaire technique was used as a data collection method in this study. The instrument used is a list of questions or statements prepared by the researcher and addressed to respondents or participants to be filled in (Sugiyono, 2016). The questionnaire was designed

using a Likert scale format to assess responses through structured statements. This instrument includes measurements of variables such as motivation and literacy. The Likert scale is a type of measurement scale that provides a variety of response options, not limited to "agree" or "disagree" answers only, but includes a range of responses from very positive to very negative (Rangkuti, 2017).

Table 1. Result of Likert Scale

Statement	(McFarlane, 2013)	Definition Score
STS	Strongly Disagree	1
TS	Disagree	2
S	Agree	3
SS	Strongly Agree	5

Data Analysis Techniques

Quantitative analysis in this study is used as a method for processing data that has been collected from all relevant sources. This analysis process is carried out after all data is obtained in order to draw conclusions in accordance with the research objectives (Sugiyono, 2014). The validity test aims to evaluate the validity of the research instrument, namely the extent to which the instrument is able to measure what should be measured (Sugiyono, 2017). The results of this test will show whether the indicators on each variable are suitable for use in the next stage of analysis. Meanwhile, the reliability test aims to assess the level of consistency or reliability of the data obtained from the variable indicators under study (Ferdinand, 2014). Through this test, it can be seen whether the indicators used are reliable enough and can be maintained in further analysis.

Measurement of validity values uses the SmartPLS application to analyze data because this software is capable of testing variant-based structural equation models (SEM), which do not require normally distributed data. This approach is ideal when the sample size is small, as in this study (Ghozali & Latan, 2015). In addition, SmartPLS has the advantage of evaluating construct validity through the outer loading value, which shows the strength of the relationship between the indicator and the variable. An indicator can be said to be valid if its loading value is greater than 0.5, which indicates that the indicator significantly represents the construct being measured (Hair Jr. et al., 2014). A reliability test was conducted using Cronbach's alpha. The SPSS 24 application was used for the test.In this study, the analysis of the relationship between variables was carried out using correlation techniques. To understand how strong the relationship is, the criteria for interpreting the correlation coefficient (r) value are used. The correlation value ranges from 0 to 1 for a positive relationship, and -1 to 0 for a negative relationship. The closer to 1 or -1, the stronger the relationship between the variables. Based on the commonly used interpretation guidelines (Sugiyono, 2017), the correlation value between 0.00-0.199 is categorized as very weak, 0.20-0.399 is weak, 0.40-0.599 is considered moderate, 0.60-0.799 is strong, and 0.80-1.000 shows a very strong relationship. This interpretation is a reference to assess the strength and direction of the relationship between learning motivation and science literacy in this study.

Statistical Results

Structural Model (Inner Model)

Structural Model using the SmartPLS 4 application. The validity test results are described in the figure below.

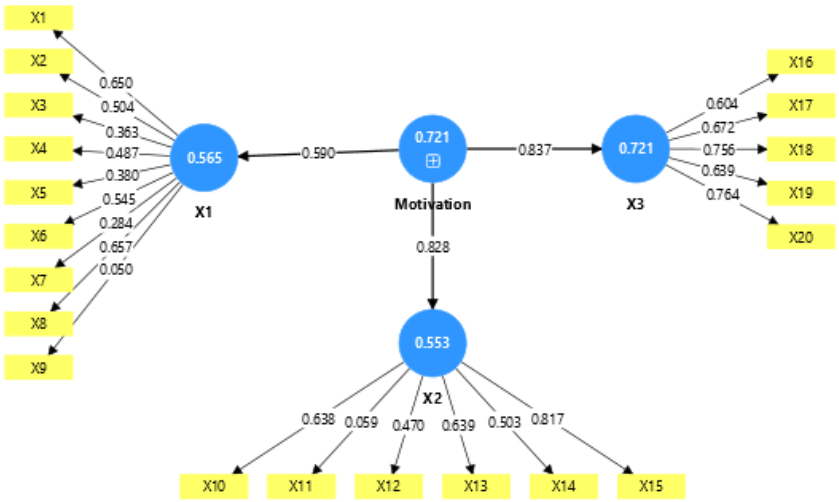

Figure 1. Structural Model (Inner Model)

Measurement Model (Outer Model)

Based on the results of the validity and reliability tests, it can be concluded that the data has a valid and reliable distribution.The results of statistical

Table 2. Calculations Related to this are Presented

Construct	Indicator	Outer Loading	Decision	Cronbach's Alpha	Decison
Self-Concept	X1	0,650	Valid	0.565	Reliabel
	X2	0,504	Not Valid		
	X3	0,363	Not Valid		
	X4	0,487	Not Valid		
	X5	0,380	Not Valid		
	X6	0545	Not Valid		
	X7	0,284	Not Valid		
	X8	0,657	Not Valid		
	X9	0,050	Valid		
Intrinsic Value	X10	0,636	Valid	0,553	Unreliable
	X11	0,059	Not Valid		
	X12	0,470	Not Valid		
	X13	0,639	Valid		
	X14	0,503	Not Valid		
	X15	0,815	Valid		
Utility Value	X16	0,604	Valid	0,731	Reliabel
	X17	0,672	Valid		
	X18	0,768	Valid		
	X19	0,639	Valid		
	X20	0,764	Valid		

The statistical reliability of the instrument utilized in this study was determined to be 0.717, as indicated by the Cronbach's Alpha value, with the instrument comprising 17 items. According to Taber (2018), alpha Cronbach's values greater than 0.7 are generally considered adequate for assessing internal consistency. This assertion is corroborated by the findings of Wen and Ahmad (2025), which indicate that an alpha score exceeding 0.7 signifies sufficient internal reliability of an instrument utilized for measurement. Therefore, the instruments utilized in this study are deemed to possess adequate reliability.

Structural Model (Inner Model)

Structural Model using the SmartPLS 4. The validity test results are described in the figure below.

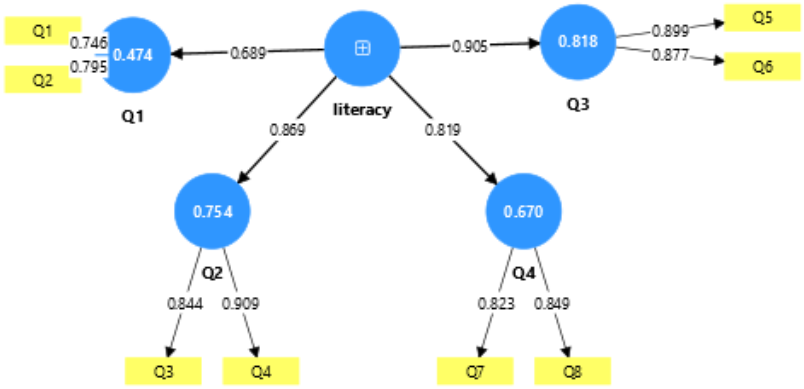

Figure 2. Structural Model (Inner Model)

Measurement Model (Outer Model)

Based on the results of validity and reliability testing, It has been determined that the data under consideration has a valid and reliable distribution.The results of statistical calculations related to this are presented in Table 3:

Table 3. Calculations Related to this are Presented

Construct	Indicator	Outer Loading	Decision	Cronbach's Alpha	Decision
Knowledge about science	X1	0,746	Valid	0.317	Unreliable
	X2	0,795	Valid		
Science is a way to find out	X3	0,844	Valid	0,704	Reliabel
	X4	0,909	Valid		
The investigative nature of science	X5	0,899	Valid	0,733	Reliabel
	X6	0,877	Valid		
interaction between science, technology and society	X7	0,823	Valid	0,570	Unreliable
	X8	0,849	Valid		

Based on table 3, it shows that all indicators of the loading factor value which is above 0.50 are proven valid. George and Mallery (2003), who are often cited, provide the following

rule of thumb: α > 0.9 (Excellent), > 0.8 (Good), > 0.7 (Acceptable), > 0.6 (Questionable), > 0.5 (Poor), and < 0.5 (Unacceptable) (Schrepp, 2020). Nunnally (1978) in the sense that α higher than 0.7 is an Based on the research aim to examine the relationship between learning motivation and science literacy among elementary school students, the following hypotheses are proposed:

1) H1 hypothesizes that there is a significant relationship between students' learning motivation and their science literacy levels. This assumption is grounded in previous studies suggesting that intrinsic motivation supports learning outcomes.
2) H2 posits that students with higher levels of learning motivation are more likely to demonstrate higher science literacy skills compared to students with lower motivation. These hypotheses aim to empirically test whether motivation can be considered a predictive factor for science literacy development in the context of primary education.

RESULT AND DISCUSSION

Descriptive Statistical Test Results

Descriptive statistical measurement of this variable needs to be done to see a general picture of the data such as the average value (Mean), highest (Max), and lowest (Min), and standard deviation of each variable, namely Motivation (X1), and Literacy (x2). Regarding the results of the Descriptive Statistics Test, it can be seen in the following table:

Table 4. Descriptive Statistical Test Results

	N	Minimum	Maximum	Mean	Std.Devitation
Motivation	50	20,00	40,00	31,8200	4,18788
Literacy	50	8,00	26,00	16,0200	4,60031
Valid N (listwise)	50				

Descriptive statistical analysis is an important first step in quantitative research, providing an overview of the obtained data. In this study, descriptive statistics were used to analyze two main variables, namely learning motivation (X1) and literacy (X2) of elementary school students. Measurements include minimum, maximum, mean or standard deviation values. The results showed that the motivation variable ranged from a minimum of 20.00 to a maximum of 40.00, with an mean of 31.82 and a standard deviation of 4.18. In comparison, science literacy showed a minimum value of 8.00 and a maximum of 26.00, with an mean 16.02 and a standard deviation of 4.60. The mean value of learning motivation of 31.82 indicates that in generally students are at a high level of learning motivation in the scale used. This is in line with the findings of Ramdani and Prihartini (2022) which stated that high motivation can significantly affect student learning success in primary schools. The relatively low standard deviation value (4.18) indicates that the distribution of data is not too far from the average, which means that the level of student motivation is quite homogeneous.

Meanwhile, the mean value of science literacy of 16.02 indicates that students' science literacy level is in the moderate category. This is in line with international research by Zhang & Cobern (2020), which found that science literacy among primary school-aged students tends to develop as exploratory science-based learning interventions increase. The standard deviation of 4.60 indicates slightly greater variation in literacy levels between students compared to learning motivation. This finding is in line with the study by Wulandari et al. (2021), which states that differences in science literacy abilities between students are

influenced by background experience and learning strategies used their teachers . In addition, research by Wahyuni and Saputra (2021) also emphasizes the importance of the contextual approach in improving science literacy, especially in science learning.

In an international context, according to research conducted by (Osborne & Dillon, 2008), although the results of the analysis show no significant relationship between motivation and literacy, this does not mean that the two variables do not affect each other at all. In many studies, it is explained that the relationship between motivation and learning outcomes including literacy, can be indirect or influenced by other intermediary factors. For example, according to Guthrie and Klauda (2014), high learning motivation can increase interest in reading, but if it is not accompanied by appropriate reading strategies, literacy improvement may not occur. In other words, motivation alone is not enough, students also need to know how to learn and read effectively.

Discussion of the Relationship between Motivation and Literacy Variables

Table 5. Result of Correlations

		Motivation	**Literacy**
Motivation	Pearson Correlation	1	,106
	Sig. (2-tailed)		,463
	N	50	50
Literacy	Pearson Correlation	,106	1
	Sig. (2-tailed)	,463	
	N	50	50

Based on the results of the correlation analysis between the learning motivation and literacy variables, a significance value (Sig. 2-tailed) of 0.463 was obtained. This value exceeds the general significance limit used, which is 0.05. Thus, there is no significant relationship between students' learning motivation level and their literacy ability in a sample of 50 respondents. This means that in this study, although students had high or low learning motivation, it was not directly related to their high or low literacy skills.

This finding may be surprising because in many educational theories, motivation is often considered an important factor affecting learning ability, including literacy. However, several international studies show that the relationship between motivation or literacy is not always strong or direct. For example, (Guthrie et al., 2004)state that motivation is important but its effect on literacy is highly dependent on the type of text, learning strategies and support from teachers. (Pintrich & De Groot, 2003) further emphasized that motivation to learn is a complex concept and consists of various dimensions, such as goal value, self-efficacy and regulation strategies, not all of which are directly related to literacy outcomes. In another study, (Wang & Guthrie, 2004) showed that although students have a high interest in reading, they do not necessarily have good reading ability if not supported by technical skills and a conducive learning environment.

The study by Taboada et al. (2009) shows that the relationship between motivation and literacy is indirect and more effective when accompanied by cognitive and metacognitive strategy interventions. This is in line with the results of a study by De Naeghel et al. (2012), who found that students with high learning motivation can still have low literacy skills if they do not develop effective reading habits. In contrast, in the context of digital learning, Schunk and DiBenedetto (2020) highlighted the importance of supportive learning environments and educational technology in bridging the relationship between motivation and learning

outcomes, including literacy, learnings from teachers, as well as a supportive learning environment.

According to Deci and Ryan's (2000) Self-Determination Theory, motivation alone is not enough if it is not accompanied by learning autonomy, a sense of competence and active engagement in the learning process. In this context, students who appear motivated may not necessarily be deeply engaged in understanding science texts or concepts. This is also in accordance with Hariani and Diani's (2021) research which states that although students have an interest in learning, science literacy skills will not improve without an interactive and contextual learning approach, such as the use of concrete media, project-based learning, or inquiry methods that make students think scientifically. Thus, the results of this study confirm that to improve students' literacy skills in science learning, it is not enough to generate learning motivation, but also need to pay attention to how students are invited to understand, explore and apply scientific knowledge in a real and meaningful way.

CONCLUSION

This research aims to analyze the relationship between learning motivation and science literacy among elementary school students. The analysis revealed that students' learning motivation was in the high category, with an average score of 31.82 out of 40, while their science literacy was in the medium category, with an mean score of 16.02 out of 26. However, the correlation test revealed no significant relationship between the two variables (sig. 0.463 > 0.05). This suggests that high learning motivation does not necessarily lead to increased science literacy. These results suggest that strong internal motivation alone is insufficient for mastering science literacy without appropriate learning strategies. Therefore, contextual, exploratory, and interactive learning approaches are important in strengthening science literacy in primary schools. Learning strategies that link science concepts with real life encourage critical thinking and active exploration. The theoretical implications of this study emphasize the importance of integrating psychological factors with effective instructional strategies to shape science literacy skills. Practically, teachers and policymakers should design learning methods that build a spirit of learning and provide meaningful, applicable experiences. Project-based pedagogy, inquiry, and concrete media models are recommended to bridge the gap between student motivation and science literacy outcomes. This study acknowledges the limitations of its small sample size (n = 50) and limited scope to five primary schools, which affect the generalizability of the findings. Additionally, potential mediating variables, such as learning strategies, environmental support, and teaching quality, have not been analyzed in depth. Therefore, further research is recommended to broaden the sample size, employ a mixed-methods approach, and include.

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