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Does Higher Student Confidence Lead to Better Science Literacy?

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Abstract: *Student confidence plays a crucial role in supporting students' ability to engage effectively with scientific concepts, yet its impact on science literacy remains underexplored. This study aims to analyze the relationship between student confidence and their science literacy skills in physics. A quantitative correlational design was employed to investigate this association among 50 high school students (aged 15-17 years), consisting of 28 females and 22 males, from one of Public High School in Lampung. Student confidence levels were measured using a structured questionnaire, while science literacy was assessed through a standardized test on the physics topic of Density. Data analysis involved Pearson's correlation coefficient and significance testing using Fisher's method. The results demonstrate a strong positive correlation ($r = 0.80$) between student confidence and science literacy, with statistical significance ($t = 12.97$, $p < 0.05$). These findings suggest that higher student confidence is associated with better science literacy, indicating the importance of fostering confidence to enhance science learning outcomes in physics education.*

Abstrak: Kepercayaan diri siswa memegang peranan penting dalam mendukung kemampuan siswa untuk berinteraksi secara efektif dengan konsep-konsep ilmiah, namun pengaruhnya terhadap literasi sains masih kurang diteliti. Studi ini bertujuan untuk menganalisis hubungan antara kepercayaan diri siswa dengan keterampilan literasi sains mereka dalam bidang fisika. Desain kuantitatif korelasional digunakan untuk menginvestigasi hubungan ini pada 50 siswa sekolah menengah atas (usia 15-17 tahun), terdiri dari 28 perempuan dan 22 laki-laki, dari salah satu SMA Negeri di Lampung. Tingkat kepercayaan diri siswa diukur menggunakan kuesioner terstruktur, sedangkan literasi sains dinilai melalui tes standar pada topik fisika tentang massa jenis. Analisis data menggunakan koefisien korelasi pearson dan pengujian signifikansi dengan metode fisher. Hasil penelitian menunjukkan korelasi positif yang kuat ($r = 0,80$) antara kepercayaan diri siswa dan literasi sains, dengan signifikansi statistik ($t=12,97$, $p<0,05$). Temuan ini mengindikasikan bahwa kepercayaan diri yang lebih tinggi berkaitan dengan literasi sains yang lebih baik, menegaskan pentingnya menumbuhkan kepercayaan diri untuk meningkatkan hasil pembelajaran sains dalam pendidikan fisika.

INTRODUCTION

Physics learning, rich with abstract concepts, demands students not only understand theoretical ideas but also apply them to everyday phenomena (Eliezanatalie & Deta, 2023; Gysin & Brovelli, 2021; Jusmaniar et al., 2024; Nikula et al., 2024; Sun & Liu, 2021). Effective physics education cultivates this connection, empowering learners to translate complex principles into real-life contexts (Jamil et al., 2024; Polatuly et al., 2024; Rupalestari et al., 2021). Among high school students aged 15-17, who are at a critical stage of cognitive development, fostering science literacy,

defined as the ability to apply scientific knowledge and critically analyze evidence, is essential for meaningful learning and future scientific engagement (Esposito et al., 2021; Muppalla et al., 2023).

Science literacy transcends mere knowledge acquisition; it embodies the capacity to interpret, reason, and evaluate scientific phenomena (Guerrero & Sjöström, 2024; Norambuena-Meléndez et al., 2023; Qiao et al., 2024). However, Indonesia's consistently low performance in international assessments such as PISA, scoring significantly below the OECD average (OECD, 2023), as shown in Figure 1.

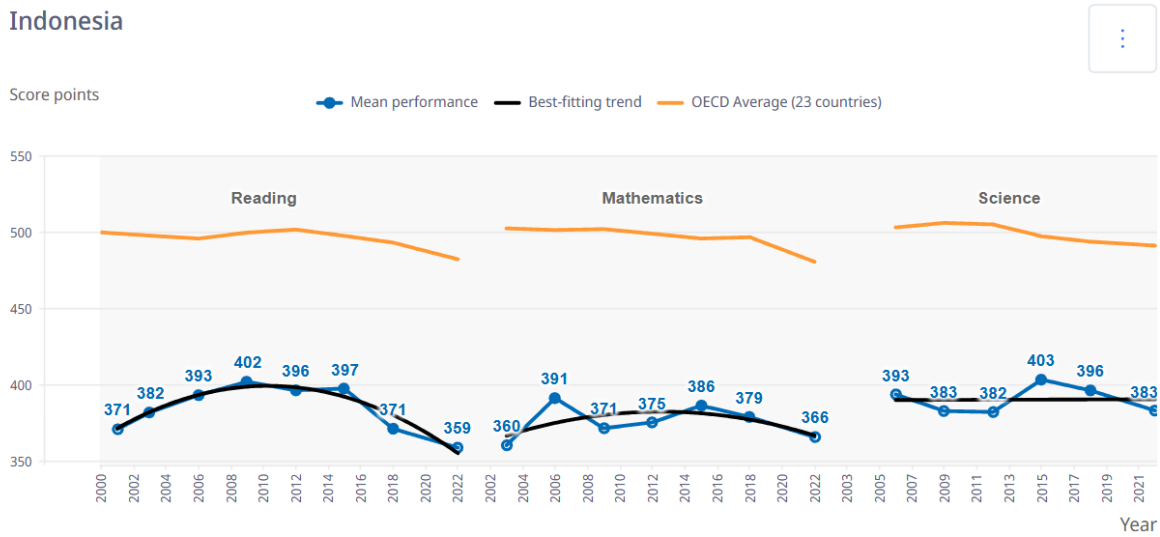

Figure 1. Profile of Science, Mathematics, and Reading Literacy of Indonesia in PISA 2022 (OECD, 2023)

Figure 1 reflects a systemic challenge in cultivating adequate science literacy among students. Despite numerous curricular reforms and innovative pedagogical approaches implemented over the years, outcomes remain uneven and suboptimal (Samala et al., 2024; Zhou & Hu, 2025). This highlights the complex and multifaceted nature of science literacy development, which cannot be fully addressed by instructional methods alone.

Recent research underscores the significant influence of affective factors, particularly self-confidence, on students' science literacy (Belova et al., 2024; Deng & Liu, 2025; Fuentesal-García et al., 2025). Self-confidence broadly impacts students' motivation, engagement, and perseverance when confronting challenging scientific concepts (Green et al., 2022; Merenda, 2021; Wu & Wu, 2022). While Bandura's concept of self-efficacy focuses on belief in one's capability to execute specific actions, self-confidence encompasses a more general sense of assurance that can determine how deeply students engage with science learning (Bandura, 1995; Pérez-Guerrero & Reyes, 2022; Yuberti et al., 2024). Empirical studies in biology and other sciences have demonstrated positive correlations between higher self-confidence and better conceptual understanding (Roeper et al., 2022; Shamdas, 2023). However, in physics, it is rarely studied.

Despite this growing recognition, there remains a clear gap in the literature regarding the quantitative examination of the relationship between self-confidence and science literacy in physics, especially among Indonesian high school students. Furthermore, most prior studies have either focused on broader science topics or university-level populations, leaving high school contexts underexplored. This gap is particularly urgent given the pivotal role high school education plays in preparing

students for higher education and scientific literacy essential for the 21st century.

Addressing this gap is crucial for advancing physics education in Indonesia, as understanding the role of self-confidence can inform teaching strategies that not only improve conceptual understanding but also foster students' intrinsic motivation and engagement with science. Ultimately, this study seeks to contribute to enhancing science literacy outcomes by integrating cognitive and affective dimensions of learning, thereby supporting national educational goals and global competitiveness.

Focusing on Archimedes' Principle, a concept that is both theoretically rich and observable in daily life, provides an ideal context to investigate this relationship. By concentrating on a single, well-defined topic, this study aims to produce precise and actionable insights. The novelty of this research lies in its targeted quantitative analysis of self-confidence domains and their correlation with science literacy in physics among Indonesian high school students aged 15 to 17.

METHODS

Research Design

This study employs a quantitative correlational design to investigate the relationship between student confidence and science literacy among high school students (Twomey & Kroll, 2008). The approach aims to describe levels of student confidence and measure its association with students' ability to apply and analyze scientific concepts within physics. Data collection and analysis were conducted following standard ethical procedures to ensure participant confidentiality and data validity. The complete process of this study is shown in Figure 2.

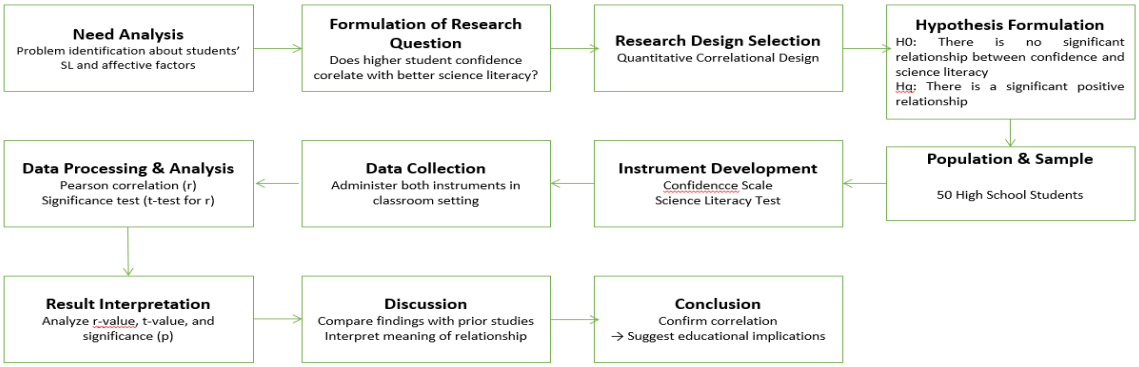

Figure 2. Research Flow

Participants

A purposive sampling technique was applied to select a total of 50 students from two high schools in Lampung, Indonesia. The sample consisted of 22 male and 28 female students aged between 15 and 17 years. All participants were enrolled in the physics course covering the topic of Archimedes' Principle. Informed consent was obtained from both students and their guardians prior to data collection.

Instruments

Two primary instruments were utilized:

1. Student Confidence Questionnaire (SCQ)

Adapted from Bandura's self-efficacy scale (Bandura, 1995) and validated for the Indonesian high school context (Hairida, 2017), this questionnaire measures students' confidence in understanding and applying physics concepts. The instrument consists of 20 Likert-scale items (1 = strongly disagree to 5 = strongly agree) covering cognitive and affective dimensions of confidence. Regarding the distribution of items, it is shown in Table 1.

Table 1. Item Distribution for SCQ

Var	Dimension	Indicator	Item Number + Statement	Item Number - Statement
Self Confidence	**Level,** refers to the difficulty in learning physics material, solving test questions, assignments, and practical physics tasks, which is believed to be achievable based on the perceived abilities possessed.	**Self-confidence** in one's ability to: a. Learn and understand the material b. Solve problems c. Complete assignments d. Perform physics experiments	2, 4, 6, 8, 10, 16	1, 3, 5, 7, 9, 15
		Interest in: a. Learning and understanding the material b. Solving problems c. Completing assignments d. Performing physics experiments	12, 14, 18	11, 13, 17
	Strength, refers to the strength or weakness of students' confidence in their ability to learn physics material, solve test questions, complete assignments, and perform physics experiments.	Fighting spirit in overcoming obstacles when: a. Learning and understanding the material b. Solving problems c. Completing assignments d. Performing physics experiments	19, 21, 23	20, 22, 24
		Strong self-confidence in one's potential to: a. Learn and understand the material b. Solve problems c. Complete assignments d. Perform physics experiments	25, 28, 30, 32	26, 27, 29, 31, 33
		Optimism in: a. Learning and understanding the material b. Solving problems c. Completing assignments d. Performing physics experiments	34, 35, 36, 38, 39, 40	37, 41
	Generality, students' confidence in abilities in various situations and conditions, ranging from activities that are usually carried out or certain situations that have never been done in the face of school assignments or physics problems, both through their behavior, cognitive, and affective.	Confidence in one's ability when facing specific situations in: a. Learning and understanding the material b. Solving problems c. Completing assignments d. Performing physics experiments	42, 44, 48	43, 45, 50
		Confidence in one's ability when facing more difficult and varied situations in: a. Learning and understanding the material b. Solving problems c. Completing assignments d. Performing physics experiments	46,	47, 49
		Total Items	26	24

2. Science Literacy Test (SLT)

Developed specifically for this study, the test assesses students' science literacy related to Archimedes' Principle. The test comprises 25 items combining multiple-choice questions with extended-response tasks that require explanation and reasoning. The test items are aligned with three cognitive domains of science literacy: understanding scientific concepts, evaluating scientific evidence, and applying scientific knowledge to real-world situations. The sample of the test is shown in Table 2.

Table 2. Sample item of the SLT

1st Tier	Topic: **Boiling Water**  1.1. Have you ever observed boiling water? When boiling water, one indication that shows the water has boiled is the formation of air bubbles rising	This tier measures fundamental scientific knowledge and how students can relate everyday observations to scientific principles. It is foundational in developing science literacy because it asks students to connect scientific theory to observable phenomena

	from the bottom of the water to the surface. Why do these bubbles rise to the surface? a. The bubbles rise to the surface because of the temperature difference between the bottom and the top of the water. b. The bubbles rise to the surface because the volume of the bubbles is smaller than the volume of water. c. The bubbles rise to the surface because convection is occurring within the water. d. The bubbles rise to the surface because of the difference in density between the bubbles and the water.	
2nnd Tier	1.2. Explain your reasoning for choosing the answer by answering the following questions and drawing a conclusion! • In your opinion, do the bubbles consist of 100% water, or is there another substance that makes up the bubbles? • If you believe there is another substance, can you name it? • If the bubbles are not 100% water, will the density of the bubbles be the same as the density of the water? Why? • Draw a conclusion based on your answers!	This tier focuses on scientific reasoning, where students must explain how the scientific concepts they have learned apply to real-world scenarios. It challenges students to analyze and synthesize information and provide evidence-based explanations, a critical component of science literacy

Both instruments underwent expert review and pilot testing to ensure content validity and reliability. Cronbach's alpha coefficients for SCQ and SLT were 0.88 and 0.85, respectively, indicating good internal consistency.

Procedure

Data collection was conducted during regular physics classes under supervised conditions. Students completed the SCQ first, followed by the SLT, within a total duration of 90 minutes. Instructions emphasized honest and independent responses. All completed questionnaires and tests were collected and coded for analysis.

Data Analysis

Descriptive statistics (mean, standard deviation) were used to summarize students' confidence levels and science literacy scores. Pearson's correlation coefficient was employed to examine the strength and direction of the relationship between student confidence and science literacy. The significance of the correlation was tested using Fisher's z-transformation at a 0.05 alpha level. Assumptions of normality, linearity, and homoscedasticity were checked prior to correlation analysis. All statistical analyses were performed using Microsoft Excel.

RESULTS & DISCUSSION

Measurement Results of Students' Self-Confidence

The following figures illustrate the levels of self-confidence among students in one of public high school in Lampung, analyzed according to each dimension:

1. Magnitude Dimension

The measurement of self-confidence in the magnitude dimension among male physics education students (sampled from 2nd-semester Class C) shows an average level of 50.71%, which, based on self-confidence criteria, is categorized as moderately high.

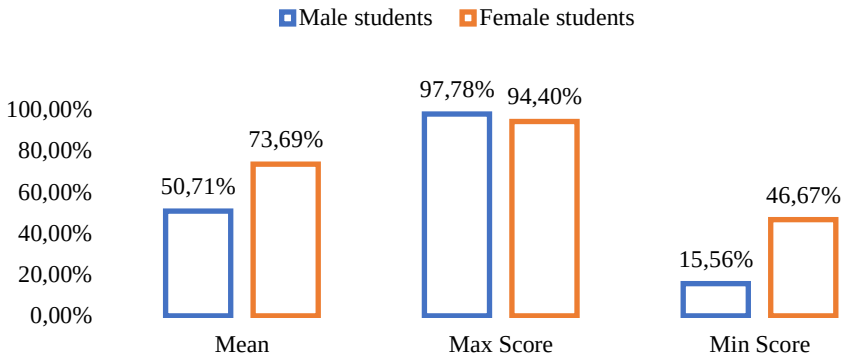

Figure 3. Magnitude Level of Male and Female Students

Meanwhile, female students (sampled from 2nd-semester Class B) show an average percentage of 73.69%, categorized as high. The magnitude dimension reflects the level of belief in overcoming learning difficulties and tasks. Thus, it can be concluded that male students generally have a moderate level of confidence in dealing with learning challenges and assignments, whereas female students generally possess a high level of confidence in overcoming such difficulties.

2. Strength Dimension

Regarding the degree of certainty in studying and completing tasks (strength), the average percentage for male physics education students is 47.55% (moderate), with a highest value of 90.43% and lowest of 26.96%. Female students averaged 70.99% (high), with a highest of 84.35% and lowest of 53.04%. Based on the graph, the highest strength value among male students is greater than that of female students; however, the minimum strength level achieved by male students is significantly lower than the minimum among female students.

Therefore, it can be concluded that although some male students demonstrate very high confidence in their ability to study and complete tasks, most tend to feel less confident in their physics learning and task completion capabilities, which could negatively affect their academic performance. In contrast, female students generally show a high level of confidence (70.99%) that positively influences their performance in studying and completing assignments.

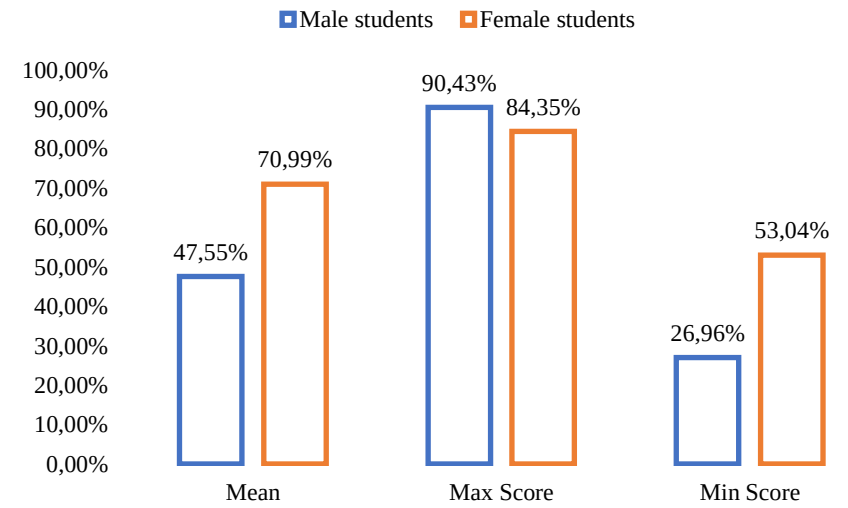

Figure 4. Strength Level of Male and Female Students

3. Generality Dimension

In the generality dimension, which refers to the breadth of self-confidence across different situations, male students achieved an average of 49.42%, categorized as moderately high, while female students scored higher, at 68.27%, categorized as high. Both groups' highest generality levels were equal at 86.67%. The lowest generality level for male students was very low at 17.78%, while female students' lowest was 48.89%. Generality reflects students' confidence in their ability to understand lessons and solve problems in unusual situations, such as independently grasping concepts without instructor guidance.

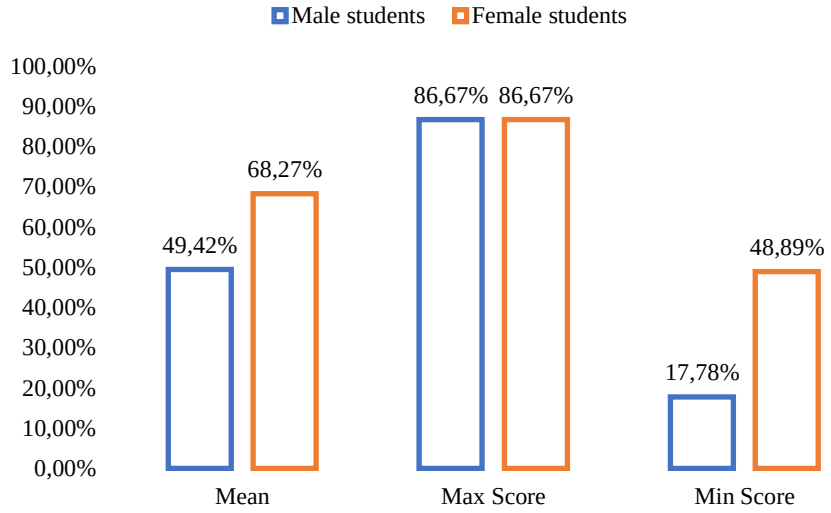

Figure 5. Generality Level of Male and Female Students

4. Overall Self-Confidence

Self-confidence refers to an individual's assessment of how well they believe they can perform necessary actions related to prospective situations. Here, it represents the belief of physics education students, as prospective physics teachers, in their ability to study and complete physics tasks. The average overall self-confidence level among male physics education students in this study was 49.07%, indicating a moderately high confidence in their ability to study and complete tasks under various circumstances.

Meanwhile, female physics education students showed a higher average of 71.46%, indicating a high level of confidence regarding their abilities to study and complete tasks in any situation.

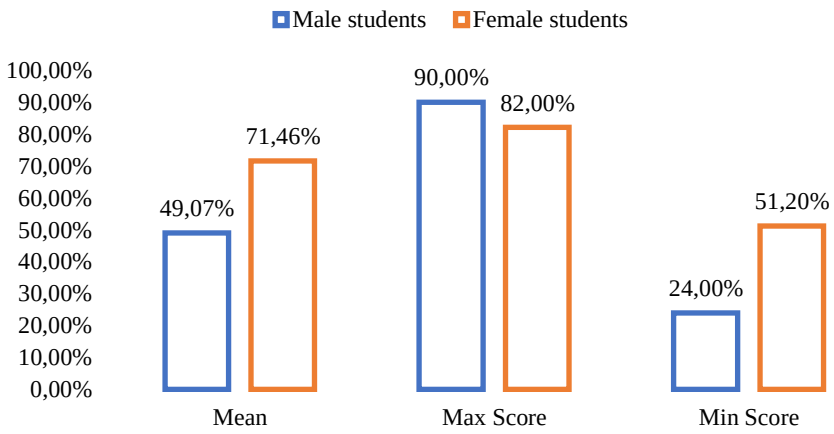

Figure 6. Overall Self-Confidence Level of Male and Female Students

Measurement Results of Students' Scientific Literacy

Based on the results of the science literacy test, the following graph illustrates the condition of science literacy abilities among physics students from one of the high schools in Lampung. Presented below is a graph showing the level of science literacy of male and female physics students at this high school in Lampung.

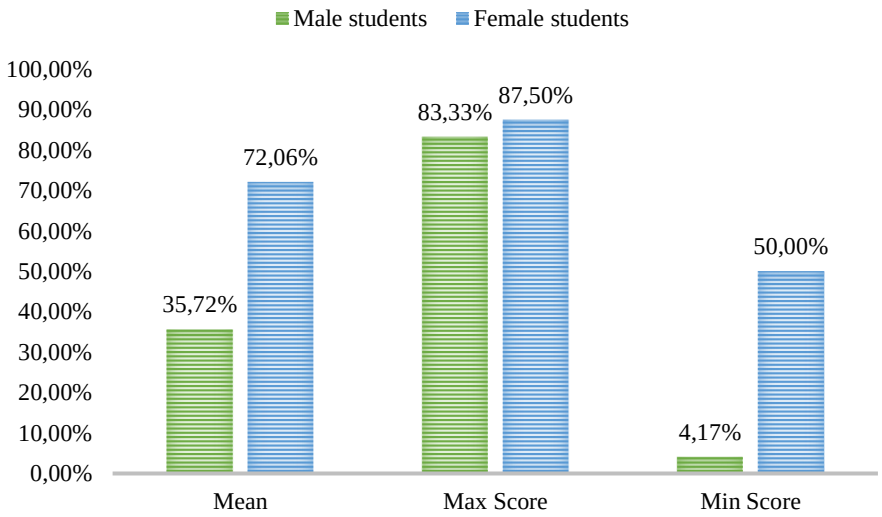

Figure 7. Science Literacy Levels of Male and Female Physics Students

Science literacy refers to an individual's scientific knowledge and the ability to use that knowledge to identify questions, acquire information, explain scientific phenomena, and interpret scientific issues using evidence such as laws, principles, and concepts. Simply put, science literacy is the ability to apply scientific knowledge, identify problems, and draw conclusions based on evidence in order to understand and make decisions about nature and its changes due to human activities.

Based on Figure 4.5, the average science literacy ability of male physics students is still considered very low, with an average score of 35.72%. Although the highest score falls within the very high category at 83.33%, the lowest score obtained by male students is extremely low, at only 4.17%.

In contrast, female physics students demonstrate a good average science literacy ability, reaching 72.06%. Their highest score is 87.50%, categorized as very high, while the lowest score is 50.00%, which falls into the moderate category.

Correlation

The correlation between self-confidence and science literacy among the students in this study was calculated using the Pearson correlation formula and the CORREL function to obtain the correlation coefficient (r). The results were shown in Table 2.

Table 2. Correlation Test Results

Correlation model	R_{table}	R_{count}	Conclusion	Criteria
Pearson	0,2732	0.8007	H_0 is rejected	(High)
correl	0,2732	0.8007	H_0 is rejected	(High)

Based on Table 2, it can be concluded that self-confidence has a strong positive relationship with science literacy. The results indicate that the higher a student's

self-confidence, the higher their science literacy tends to be. Among male physics education students, self-confidence was measured at a moderate level, which corresponds with their average science literacy categorized as very low. Conversely, female physics education students demonstrated a high level of self-confidence, which aligns with their science literacy being categorized as good.

This relationship occurs because self-confidence is positively associated with science literacy; thus, if a student's belief in their own ability is low, their science literacy is also likely to be low. These findings are consistent with previous studies, such as those by Ekohariadi (2009) and Temu Riyadi (2018), which reported a significant positive correlation between an individual's self-confidence and their science literacy ability.

Significance

The significance test in this study was conducted using the t-test, and the results are shown in Table 3.

Table 2. Significance Test Results

t_{table}	2.008559072
t_{count}	9.260958182
conclusion	$t_{count} > t_{table}$
	Therefore, the null hypothesis (H_0) is rejected, indicating a significant relationship

Based on the results of the significance test, it can be concluded that the relationship between self-confidence and science literacy is statistically significant. The findings of this study demonstrate a statistically significant positive correlation between self-confidence and science literacy among physics students. This implies that self-confidence plays a crucial role in shaping students' ability to comprehend and apply scientific knowledge effectively. Enhancing students' self-confidence could therefore serve as a strategic focus in educational interventions aimed at improving science literacy outcomes.

The statistical significance supports the notion that self-confidence is not merely an affective trait but a pivotal factor influencing cognitive engagement and academic performance in science education. Consequently, educators and curriculum developers should consider incorporating strategies that foster self-confidence alongside content mastery to optimize learning achievements.

The results of this study revealed a strong and statistically significant positive correlation between self-confidence and science literacy among physics education students. This aligns with previous research emphasizing the role of affective factors in cognitive development. Ekohariadi, (2009) and Riyadi et al. (2018) found similar positive associations between self-confidence and science achievement, suggesting that students who believe in their abilities are more likely to engage meaningfully with scientific content and perform better in related assessments.

These findings are also consistent with Bandura's theory of self-efficacy, which posits that individuals with higher confidence are more persistent, resilient, and motivated to overcome academic challenges (Bandura, 1995). In science education, this manifests as greater willingness to participate in inquiry, experimentation, and problem-solving, key components of science literacy.

Moreover, contemporary studies reinforce the importance of self-confidence in STEM learning contexts. For example, Y. et al. (2021) demonstrated that students with higher self-confidence showed improved comprehension in physics and were more likely to apply critical thinking skills during scientific tasks. Similarly, research by Ke et al.,

(2021) revealed that science literacy is not merely a function of content knowledge, but is also shaped by psychological traits, including confidence and self-perception.

In contrast, students with low self-confidence tend to avoid difficult tasks and underestimate their abilities, which may lead to disengagement and reduced learning outcomes (Zhang, 2022). This is particularly concerning in physics, a subject often perceived as difficult and abstract, where affective variables significantly influence student success.

Taken together, these findings highlight the need for science educators to integrate strategies that bolster self-confidence, such as mastery-based learning, positive reinforcement, and scaffolding, into instructional design. By fostering a supportive learning environment, teachers can enhance both the emotional and intellectual capacities of students, ultimately improving science literacy levels.

CONCLUSION

This study found a strong and significant positive correlation between student self-confidence and science literacy among high school physics students in Lampung. Students with higher self-confidence tended to demonstrate better science literacy skills, particularly in understanding and applying physics concepts such as Archimedes' Principle. The findings highlight the critical role of self-confidence in enhancing students' scientific understanding and suggest that educational interventions aimed at boosting self-confidence may effectively improve science literacy outcomes. Consequently, teachers and curriculum designers should prioritize strategies that foster students' confidence alongside content mastery to support more meaningful and effective science learning.

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