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Psychological Factors Influencing Elementary Students' Science Learning Difficulties: An Explanatory Study

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ABSTRACT

This study examines the psychological determinants of science learning difficulties among elementary school students by integrating multiple dimensions within a single analytical framework. The research is motivated by the persistent issue of low science achievement, which is often addressed in a fragmented manner. This study addresses the limited integrative analysis of multiple psychological dimensions in explaining science learning difficulties at the elementary level. Accordingly, the objective is to analyze both the simultaneous and partial effects of cognitive, affective, psychomotor, social, and emotional factors on students' science learning outcomes. An explanatory survey design was applied involving 115 students from two elementary schools in Kuningan, West Java, Indonesia. Data were collected using validated questionnaires and analyzed through normality testing and multiple linear regression. The results indicate that all psychological dimensions collectively have a significant effect on science learning outcomes. However, partially, affective, psychomotor, and emotional factors demonstrate significant positive influences, whereas cognitive and social factors do not show significant individual effects. These findings highlight the dominant role of non-cognitive psychological aspects in shaping students' science achievement. This study contributes by offering a holistic perspective on psychological influences in science learning, emphasizing the need for instructional strategies that strengthen motivation, emotional regulation, and active engagement to reduce learning difficulties and improve academic performance.

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1. INTRODUCTION

Science education plays a pivotal role in fostering students' critical thinking, creativity, and scientific literacy, which are essential competencies in the 21st century.

Scientific literacy enables individuals to make informed decisions, engage in socio-scientific discussions, and adapt to rapid technological developments [1]. At the elementary level, science learning is expected not only to deliver conceptual knowledge but also to cultivate scientific attitudes and inquiry skills, including curiosity, objectivity, and responsibility [2]. However, in practice, science instruction often remains dominated by rote learning and teacher-centered approaches, limiting students' opportunities to actively construct understanding through meaningful experiences [3].

This condition contributes to persistent difficulties in science learning among elementary school students. Previous studies have identified several contributing factors, including limited prior knowledge, difficulties understanding scientific language, and less interactive instructional strategies [4], [5]. These difficulties are categorized as academic learning problems, which are closely related to students' developmental characteristics, including attention, memory, and reasoning processes [6]. While these studies provide valuable insights, they tend to emphasize instructional and cognitive dimensions, leaving other psychological aspects less explored.

From a theoretical perspective, learning difficulties can be understood through an integrative psychological framework encompassing cognitive, affective, psychomotor, social, and emotional domains. Cognitive theory highlights the role of information processing and problem-solving abilities in learning. In contrast, affective theory emphasizes motivation, attitudes, and self-efficacy as key determinants of student engagement. Psychomotor theory underlines the importance of physical interaction and hands-on activities in constructing knowledge, particularly in science learning. Meanwhile, social and emotional theories stress the influence of interpersonal interaction, emotional regulation, and learning environment on students' academic performance [7]. These dimensions are interconnected and collectively shape students' learning experiences, especially at the elementary level, where learners are in the concrete operational stage.

Despite the growing body of research on science learning difficulties, prior studies have generally examined these psychological factors in isolation. Only a limited number of studies have investigated their combined effects within a single analytical model, particularly in the context of elementary science education. This gap indicates the need for a more comprehensive approach that captures both the simultaneous and partial contributions of multiple psychological dimensions. Therefore, this study addresses the lack of integrative analysis by examining cognitive, affective, psychomotor, social, and emotional aspects within a unified explanatory framework.

The novelty of this research lies in its holistic approach to analyzing psychological determinants of science learning outcomes, providing a more nuanced understanding of how different dimensions interact and contribute to learning difficulties. Theoretically, this study enriches the literature by integrating multiple psychological perspectives into a single model. Practically, it offers evidence-based insights for educators to design more responsive instructional strategies that accommodate students' psychological needs.

Accordingly, the objectives of this study are: (1) to analyze the simultaneous influence of psychological aspects on elementary students' science learning outcomes, and (2) to identify the most dominant factors affecting these outcomes. It is expected that the

findings will contribute to the development of more effective and psychologically informed science instruction, ultimately improving students' learning achievement and reducing learning difficulties.

2. METHOD

2.1 Research Design

This study employed a quantitative approach using an explanatory survey design. The explanatory design was selected to examine the simultaneous and partial effects of psychological aspects on elementary students' science learning outcomes. Quantitative explanatory research is appropriate for identifying causal relationships between variables through statistical testing.

2.2 Population and Sample

The population consisted of 165 active students from SDN 1 Cigugur Kuningan and SDIT Binaul Ummah, Kuningan, West Java, Indonesia. The sample size was determined using the Slovin formula with a 5% error tolerance level:

$$n = \frac{N}{1 + N\ (e^2)}$$

Where n is the sample size, N is the population size, and e is the margin of error. Based on the calculation, the required sample size was 115 students.

A simple random sampling technique was applied to ensure that each member of the population had an equal probability of being selected. No additional inclusion criteria were imposed other than active enrollment at the time of data collection. This procedure minimized selection bias and enhanced representativeness.

2.3 Research Procedure

The research procedure was conducted chronologically as follows:

1. Identifying research variables (cognitive, affective, psychomotor, social, and emotional aspects as independent variables; science learning outcomes as the dependent variable).
2. Developing and validating questionnaire instruments.
3. Determining the sample using the Slovin formula.
4. Distributing questionnaires to selected respondents.
5. Collecting and tabulating data.
6. Testing instrument validity and reliability.
7. Conducting classical assumption tests (normality, multicollinearity, heteroscedasticity).
8. Performing multiple linear regression analysis.
9. Interpreting results and drawing conclusions.

2.4 Instrumentation and Data Collection

Data were collected using structured questionnaires designed to measure psychological aspects influencing science learning difficulties. The instrument consisted of

25 items, equally distributed across five psychological dimensions. Each dimension contained five items.

Table 1. Questionnaire Instrument Grid

No	Psychological Aspect	Description	Number of Items
1	Cognitive	Understanding and thinking ability in studying science	5
2	Affective	Feelings, interests, and attitudes toward science lessons	5
3	Psychomotor	Physical skills in conducting practical activities or experiments	5
4	Social	Social interaction with teachers and peers in science learning	5
5	Emotional	Emotional reactions when facing challenges in science learning	5

The questionnaire instrument was developed based on established theoretical frameworks in educational psychology, particularly those addressing cognitive, affective, psychomotor, social, and emotional domains in learning. Item construction was adapted from previous validated studies on learning difficulties and psychological factors in education [8], [9], [10]. Prior to data collection, the instrument was reviewed by education experts to ensure content relevance and clarity, and a pilot test was conducted to refine item wording and structure.

2.5 Instrument Validity and Reliability

Validity testing was conducted using Pearson Product-Moment correlation with the hypotheses:

- H_0: $\rho \leq 0$ (item is invalid)
- H_0: $\rho > 0$ (item is valid)

All questionnaire items showed Sig. (2-tailed) values below 0.05 and positive Pearson correlation coefficients, indicating that all items were valid.

Reliability testing was performed using Cronbach's Alpha. The obtained value was 0.68, exceeding the minimum threshold of 0.60, indicating acceptable internal consistency reliability. Although the Cronbach's Alpha value of 0.68 is considered moderate, it is still acceptable for exploratory research in social sciences, where values above 0.60 are deemed sufficient to indicate internal consistency.

2.6 Data Analysis Technique

Data analysis was conducted using IBM SPSS Statistics Version 27. The analytical procedures included:

1. Normality Test using Kolmogorov–Smirnov and Shapiro–Wilk tests to determine data distribution.
2. Multicollinearity Test using Tolerance and Variance Inflation Factor (VIF) values.
3. Heteroscedasticity Test using significance testing of residuals.
4. Multiple Linear Regression Analysis to examine the simultaneous (F-test) and partial (t-test) effects of psychological aspects on science learning outcomes.

The regression model used in this study is formulated as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \in$$

Where:

Y = Science learning outcomes
X_1 = Cognitive aspect
X_2 = Affective aspect
X_3 = Psychomotor aspect
X_4 = Social aspect
X_5 = Emotional aspect
ε = Error term

This analytical framework allows the identification of both collective and individual contributions of psychological dimensions to students' science learning outcomes. Despite its strengths, this study is limited by its survey-based design, which relies on self-reported data that may be subject to response bias. Additionally, the cross-sectional nature of the data restricts the ability to establish definitive causal relationships among variables. Future research is recommended to incorporate longitudinal or mixed-method approaches to provide deeper insights into the dynamics of psychological factors in science learning.

2.7 Ethical Considerations

This study adhered to ethical standards in educational research. Permission to conduct the study was obtained from the respective schools prior to data collection. Informed consent was secured from participants and their guardians, ensuring voluntary participation. Respondents were assured of the confidentiality and anonymity of their data, and all information collected was used solely for research purposes.

3. RESULTS AND DISCUSSION

3.1. Results

Information Technology Adoption in Government Services Normality Test

The results of the normality test with the graph method can be seen in the following Figure:

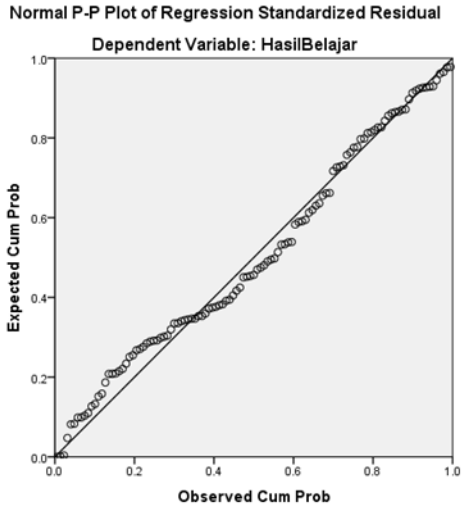


Figure 1. Normality Test Results

Based on Figure 1, the normal probability plot shows a normal pattern. This can be seen in the point spread around the normal chart, which follows a diagonal line. In addition, the results of the normality test using the SPSS application are shown in Table 2 for the Kolmogorov-Smirnov One-Sample test.

Table 2. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		115
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	6.22487834
Most Extreme Differences	Absolute	.072
	Positive	.060
	Negative	-.072
Test Statistic		.072
Asymp. Sig. (2-tailed)		.199[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Based on the output above, the significance value is 0.199. Because the significance is more than 0.05 (0.199 > 0.05), it can be concluded that the data in the research conducted are normally distributed. If the data has been distributed normally, then a regression model can be used because it meets the assumption of normality.

Multicollinearity Test

The results of the multicollinearity test using SPSS statistical tests are shown in Table 3.

Table 3. Multicollinearity test

Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.770	.750		2.481	000		
X1K	332	266	.127	.248	215	831	1.204
X2A	387	270	.140	.437	153	915	1.093
X3P	795	499	.272	.593	114	296	3.373
X4S	.859	668	.285	1.286	201	176	5.676
X5E	130	498	.043	260	795	318	3.141

a. Dependent Variable: Hasil Belajar

Based on the table above in the "Collinearity Statistics" section, it is known that the Tollerance value for the cognitive aspect variable (X1) is 0.831 > 0.10, the affective aspect variable (X2) is 0.915 > 0.10, the psychomotor aspect variable (X3) is 0.296 > 0.10, the social aspect variable (X4) is 0.176 > 0.10, and the emotional aspect variable (X5) is 0.318> 0.10. While the VIF value for the cognitive aspect variable (X1) is 1.204 < 10.00, the affective aspect variable (X2) is 1.093 < 10.00, the psychomotor aspect variable (X3) is 3.373 < 10.00, the social aspect variable (X4) is 5.676 < 10.00, and the emotional aspect variable (X5) is 3.141 < 10.00. Based on the basis of the multicollinearity test, it can be concluded that there are no symptoms of multicollinearity in the regression model.

Heteroscedasticity test

The results of the heteroscedasticity test using statistical tests on the SPSS application can be seen in Table 4 of the heteroscedasticity test.

Table 4. The heteroscedasticity test

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	5.353	3.562		.503	136
X1K	.074	.165	.047	452	652
X2A	-.036	.167	-.022	.218	828
X3P	.018	.309	.010	058	954
X4S	.429	.414	.233	.037	302
X5E	-.523	.309	-.283	1.694	093

a. Dependent Variable: Abs_RES

Based on the output above, it is known that the significance value (Sig.) for the cognitive aspect variable (X1) is 0.652. Meanwhile, the significance value (Sig.) for the affective aspect variable (X2) is 0.828, the significance value (Sig.) for the psychomotor aspect variable (X3) is 0.954, the significance value (Sig.) for the social aspect variable (X4) is 0.302, and the significance value (Sig.) for the emotional aspect variable (X5) is 0.093. Because the value of Sig. > is 0.05, in accordance with the basis of decision-making in the glacier test, it can be concluded that there are no heteroscedasticity symptoms in the regression model.

Pearson Bivariate Correlation Test

The results of the Pearson bivariate correlation test using the statistical test on the SPSS application can be seen in Table 5 of the Pearson bivariate correlation test. Based on the table above, the results of the significance value of Sig. (2-tailed) between the cognitive aspect variable (X1) and the learning outcome (Y) is 0.000 < 0.05, which can be concluded that there is a significant correlation between the cognitive aspect variable (X1) and the learning outcome (Y). Meanwhile, the affective aspect variable (X2) with learning outcomes (Y) is 0.000 < 0.05, which can be concluded that there is a significant correlation between the affective aspect variable (X2) and learning outcomes (Y). The psychomotor

aspect variable (X3) with learning outcomes (Y) was 0.000 < 0.05, which can be concluded that there is a significant correlation between the psychomotor aspect variable (X3) and learning outcomes (Y). The social aspect variable (X4) with learning outcomes (Y) was 0.000 < 0.05, which can be concluded that there is a significant correlation between the social aspect variable (X4) and learning outcomes (Y). The variable of emotional aspect (X5) with learning outcomes (Y) is 0.000 < 0.05, which can be concluded that there is a significant correlation between the variable of emotional aspect (X5) and learning outcomes (Y).

Table 5. The Pearson bivariate correlation test

Correlations							
		X1K	X2A	X3P	X4S	X5E	HasilBelajar
X1K	Pearson Correlation	1	016	474**	473**	474**	1**
	Sig. (2-tailed)		869	000	000	000	.000
	N	115	15	15	15	15	115
2A	Pearson Correlation	.016		330**	339**	328**	.452**
	Sig. (2-tailed)	.869		000	000	000	.000
	N	115	15	15	15	15	115
3P	Pearson Correlation	.474**	330**	1	860**	803**	.771**
	Sig. (2-tailed)	.000	000		000	000	.000
	N	115	15	15	15	15	115
4S	Pearson Correlation	.473**	339**	860**		912**	.801**
	Sig. (2-tailed)	.000	000	000		000	.000
	N	115	15	15	15	15	115
5E	Pearson Correlation	.474**	328**	803**	912**		.820**
	Sig. (2-tailed)	.000	000	000	000		.000
	N	115	15	15	15	15	115
Hasil	Pearson Correlation	.421**	452**	771**	801**	820**	1
Belaja	Sig. (2-tailed)	.000	000	000	000	000	
r	N	115	15	15	15	15	115
**. Correlation is significant at the 0.01 level (2-tailed).							

Multiple Linear Regression Analysis

Simultaneous F test in regression analysis

Simultaneous F test in regression analysis

Table 6. F test results

ANOVA[a]					
Model	Sum of Squares	f	Mean Square	F	Sig.
Regression	4864.067		972.813	61.916	.000[b]
Residual	1712.577	9	15.712		
Total	6576.643	14			
a. Dependent Variable: Hasil Belajar (Learning Outcomes)					
b. Predictors: (Constant), X5E, X2A, X1K, X3P, X4S					

Based on the output results above, a significance value of 0.00 was obtained. The results show that the value of sig. 0.00 < 0.05, which can mean that cognitive aspect variables (X1), affective aspect variables (X2), psychomotor aspect variables (X3), social aspect variables (X4), and emotional aspect variables (X5) simultaneously affect student

learning outcomes (Y). Table 6 illustrates the distribution of students' psychomotor learning difficulties in science, showing varying levels of skill mastery during experimental and hands-on activities.

Regression test (regression coefficient)

The regression test results are in the following table

Table 7. Regression Test Results (Regression Coefficient)

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	35.078	.982		1.765	000
X1K	.139	187	.043	743	459
X2A	.588	164	.190	.578	001
X3P	.809	327	.242	.472	015
X4S	.266	478	.078	557	579
X5E	1.667	425	.472	.924	00

Dependent Variable: Study Results

Based on the table above, the significance value of the cognitive aspect variable (X1) was obtained as 0.459. Because the significance is more than 0.05 (0.459 > 0.05), it can be concluded that the cognitive aspect variable (X1) has an insignificant influence on student learning outcomes (Y). The significance value of the affective aspect variable (X2) was 0.001. Because the significance is less than 0.05 (0.001 < 0.05), it can be concluded that the affective aspect variable (X2) has a significant influence on student learning outcomes (Y). The significance value of the psychomotor aspect variable (X3) was 0.015. Because the significance is less than 0.05 (0.015 < 0.05), it can be concluded that the psychomotor aspect variable (X3) significantly influences student learning outcomes (Y). The significance value of the social aspect variable (X4) is 0.579. Because the significance is more than 0.05 (0.579 > 0.05), it can be concluded that the social aspect variable (X4) has an insignificant influence on student learning outcomes (Y). The significance value of the variable of the emotional aspect (X5) was 0.000. Because the significance is less than 0.05 (0.000 < 0.05), it can be concluded that the emotional aspect variable (X5) has a significant influence on student learning outcomes (Y). As shown in Figure 7, the multiple linear regression results indicate that affective, psychomotor, and emotional aspects have the strongest influence on students' science learning outcomes.

The results of the normality test indicated that the data were normally distributed, allowing for further regression analysis. Multicollinearity and heteroscedasticity tests showed no violations of regression assumptions. The multiple linear regression analysis revealed that cognitive, affective, psychomotor, social, and emotional aspects simultaneously had a significant influence on students' science learning outcomes. Partial

analysis demonstrated that affective, psychomotor, and emotional aspects significantly influenced learning outcomes, whereas cognitive and social aspects did not.

3.2. Discussion

The findings of this study demonstrate that psychological factors collectively play a significant role in shaping elementary students' science learning outcomes. This result confirms that learning difficulties cannot be attributed to a single dimension but rather emerge from the interaction of multiple psychological components. Such an integrative effect suggests that science learning is a multidimensional process in which cognitive readiness, emotional stability, motivation, and behavioral engagement operate simultaneously to influence academic achievement [11].

A key finding of this study is that affective, psychomotor, and emotional aspects exert significant influences, whereas cognitive and social aspects do not show significant partial effects. This pattern provides an important insight: at the elementary level, students' success in learning science is more strongly driven by non-cognitive factors than by purely cognitive abilities. This can be explained by the developmental characteristics of elementary learners, who are still in the concrete operational stage and rely heavily on motivation, emotional support, and direct experience in constructing understanding [12].

The insignificant effect of cognitive aspects suggests that cognitive ability alone is insufficient to predict science learning outcomes. One possible explanation is that cognitive processes such as reasoning and information processing may not directly translate into achievement without the support of motivation and engagement. This finding aligns with studies indicating that cognitive strategies require mediation through affective and environmental factors to influence learning outcomes effectively [13], [14]. In this context, students with adequate cognitive abilities may still experience learning difficulties if they lack interest, confidence, or emotional readiness.

In contrast, the strong influence of affective aspects highlights the central role of motivation, attitudes, and interest in science learning. Students who demonstrate positive attitudes and intrinsic motivation are more likely to participate in learning activities actively, persist in solving problems, and achieve better academic outcomes. This finding reinforces the view that affective engagement functions as a driving force that activates cognitive processes, making learning more meaningful and effective [15], [16].

The significant effect of psychomotor aspects indicates that hands-on experiences and active involvement are essential in elementary science learning. Science concepts, which are often abstract, become more accessible when students engage in practical activities such as experiments and observations. This explains why psychomotor skills contribute significantly to learning outcomes, as they bridge the gap between abstract concepts and concrete experiences [17]. This finding emphasizes the importance of experiential learning approaches in primary education.

Furthermore, the emotional aspect emerges as a strong predictor of learning outcomes, suggesting that students' emotional regulation plays a critical role in academic success. Positive emotions, such as curiosity and enthusiasm, enhance attention and engagement, while negative emotions, such as anxiety, can disrupt concentration and

reduce learning effectiveness. This result confirms that emotional stability is not merely a supporting factor but a core component of the learning process [18], [19].

On the other hand, the non-significant effect of social factors suggests that social interaction may not directly affect learning outcomes in this context. However, this does not imply that social factors are unimportant. Instead, their role may be indirect, functioning through emotional support, motivation, or classroom climate. This finding suggests that the impact of social dimensions is more complex and may be mediated by other psychological variables, as indicated in previous studies [20].

The novelty of this study lies in its integrative analysis of multiple psychological dimensions within a single explanatory model. Unlike prior research, which tends to examine these factors separately, this study demonstrates how different psychological factors interact and vary in their relative contributions to learning outcomes. The results reveal that non-cognitive dimensions, particularly affective, psychomotor, and emotional factors, play a more dominant role than cognitive aspects in elementary science learning. This provides a new perspective that challenges the conventional emphasis on cognitive ability as the primary determinant of academic success [21], [22].

These findings have important practical implications. They suggest that improving science learning outcomes requires more than strengthening students' cognitive skills. Educators need to design learning environments that foster motivation, emotional well-being, and active participation. Instructional strategies such as inquiry-based learning, collaborative activities, and emotionally supportive teaching practices can help address learning difficulties more effectively [23], [24], [25].

Overall, this study confirms that science learning difficulties among elementary students are multidimensional in nature. Addressing these challenges requires a holistic approach that integrates cognitive, affective, psychomotor, social, and emotional considerations, with particular emphasis on strengthening non-cognitive aspects as key drivers of student success.

4. CONCLUSION

This study demonstrates that science learning difficulties at the elementary level are influenced by the interaction of multiple psychological dimensions rather than solely by cognitive factors. The findings highlight that affective, psychomotor, and emotional aspects play a more dominant role in shaping students' learning outcomes, indicating the importance of non-cognitive elements in the learning process. These results reinforce the need to view science learning from a holistic psychological perspective that considers the complexity of students' developmental characteristics.

The main contribution of this research lies in its integrative approach, which examines cognitive, affective, psychomotor, social, and emotional aspects simultaneously within a single analytical framework. This approach provides a more comprehensive understanding than previous studies, which tend to analyze these factors separately. In practice, the findings imply that educators should prioritize instructional strategies that enhance students' motivation, emotional well-being, and active participation, particularly

through experiential and student-centered learning methods, to reduce science learning difficulties.

However, this study is limited by its reliance on survey data and a relatively small sample from two schools, which may limit the generalizability of the findings. In addition, reliance on self-reported data may introduce bias in responses. Future research is recommended to involve broader, more diverse samples and to adopt longitudinal or mixed-methods approaches better to capture the complexity of psychological influences on learning. Overall, this study contributes to the development of more responsive and psychologically informed science education practices that can benefit educators, researchers, and policymakers.

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