International Journal of Contextual Science Education (IJCSE)
e-ISSN: 3046-8876
Vol. 2, No. 2, June 2025
pp. 60-67

Independent Curriculum: Correlation Between Science Process Skills and Cognitive Abilities with Students' Caring Attitudes in Junior High Schools

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Accepted: May 21st 2025, Approved: June 10th 2025, Published: June 30th 2025

Abstract— This study aims to explore the relationship between science process skills, cognitive abilities, and students' caring attitudes in the context of project-based learning in the Independent Curriculum era. The project implemented is the processing of plastic waste into eco-friendly bricks stools, which is also part of the Pancasila Student Profile Strengthening Program with the theme of a sustainable lifestyle. This study uses a quantitative approach with a correlational design. Data were obtained from 86 seventh grade students at SMP Negeri 16 Mataram. The research instruments included a science process skills test, a cognitive ability test, and a caring attitude questionnaire. The results of the Pearson Correlation test showed that science process skills had a significant relationship with cognitive ability (r = 0.992). The results of the Kendall's tau-b Correlation test showed that science process skills had a significant relationship with caring attitude (τb = 0.798) and caring attitude had a significant relationship with cognitive ability (τb = 0.889). In other words, it can be said that project-based learning can improve science process skills and cognitive ability while building a character of caring attitude towards the environment. Therefore, it can be concluded that the implementation of project-based learning in the Independent Curriculum, such as making stools from eco-friendly bricks, has a positive impact on developing science process skills and cognitive abilities as well as students' caring attitudes. Project-based learning can be an alternative innovative model to be implemented at various levels of education so that efforts are needed to train teachers in implementing this learning model, and support from schools and government policies to improve the sustainability of environmental-based education.

Keywords— Independent Curriculum; science process skills; cognitive; environmental attitude
How to Cite— Hikmawati, H., Doyan, A., Supriadi, & Rohani. (2025). Independent Curriculum: Correlation Between Science Process Skills and Cognitive Abilities with Students' Caring Attitudes in Junior High Schools. International Journal of Contextual Science Education, 2(2), 60–67. https://doi.org/10.29303/ijcse.v2i2.1023

1. Introduction

In the era of the Independent Curriculum, education in Indonesia is directed to develop the profile of Pancasila students, which includes 21st-century competencies such as critical thinking, creativity, collaboration, and communication. One of the strategic steps to realize this vision is through the Pancasila Student Profile Strengthening Project. This project integrates experiential learning that is relevant to real life, so that students not only understand the concept in theory but are also able to apply it in everyday life [1]. The theme Sustainable Lifestyle is one of the leading themes in the implementation of the Pancasila Student Profile Strengthening Project. In this project, students are involved in environmental-based activities, such as processing plastic waste into useful products through the eco-friendly bricks method. One of the products produced is a dingklik (small bench) made from plastic bottles filled with plastic waste. This activity provides direct experience for students to manage waste while honing creativity and teamwork [2].

In the context of science education, the eco-friendly bricks project offers a unique opportunity to develop science process skills. These skills include the ability to observe, classify, formulate hypotheses, design experiments, and analyse and interpret data. Science process skills are not only relevant to classroom learning but are also important for dealing with everyday life challenges, especially in solving environmental problems [3], [4]. Cognitive abilities are also one of the main focuses in science learning. These abilities include knowledge, understanding, and application of the science concepts learned. In the eco-friendly bricks project, students are invited to apply physics concepts, such as density, force, and pressure, so that learning becomes more meaningful and contextual [5]. Caring for the environment is one of the main values that we want to instill through this project. In the process of making eco-friendly bricks, students are expected to realize the importance of waste management as a form of responsibility towards the surrounding environment. In addition, this activity also aims to increase students' awareness of global environmental issues, such as plastic pollution and climate change [6].

This project was implemented in science learning for grade VII in junior high school during the odd semester of the 2024/2025

academic year. The learning topics covered four main contents: 1) measurement and science objects, 2) substances and their forms, 3) temperature and heat, and 4) motion and force. These four topics were designed to support the development of science process skills, cognitive understanding, and students' caring attitudes towards environmental issues. On the topic of measurement and science objects, students are invited to understand the basic concepts of measurement, accuracy, and measurement errors, which are very relevant to the data collection process in the eco-friendly bricks project. Furthermore, on the topic of substances and their forms, students learn the properties of materials, including plastic, as the main material in making eco-friendly bricks [7]. The topic of temperature and heat provides students with an understanding of the transfer of heat energy, which is relevant when discussing the thermal effects in the plastic waste processing process. Meanwhile, the topic of motion and force involves basic concepts such as density and compressive force used in making and testing the strength of eco-friendly bricks stools. By linking this learning to the project, students can understand the concept more applicatively [8].

The Pancasila Student Profile Strengthening Project also integrates a project-based learning model that is recognized as one of the effective learning models in the Merdeka Curriculum. This learning model provides space for students to develop Higher Order Thinking Skills (HOTS) while solving real problems. In the context of the eco-friendly bricks project, students not only learn about science but also about social responsibility and sustainability [9]. This study aims to explore the correlation between science process skills, cognitive abilities, and students' caring attitudes in the context of implementing an eco-friendly bricks project. By understanding the relationship between variables, this study is expected to contribute to the development of more inclusive and contextual science learning [10].

The results of this study are expected to provide new insights for educators in designing science learning that not only focuses on academic achievement but also on the formation of student character. By integrating the values of the Pancasila student profile, science learning can be a means to instill an attitude of caring and environmental awareness from an early age [11], [12]. In addition, the results of this study are also expected to be a reference for the development of educational policies at the school level, especially in the implementation of the Pancasila Student Profile Strengthening Project more effectively. By linking science learning with global issues such as sustainability and waste management, schools can contribute to efforts to create a society that cares more about the environment [13]. Through this research, it is expected that learning strategies can be found that not only improve the skills and knowledge of students but also form a generation that has social and environmental concerns. Thus, education does not only function as a means of transferring knowledge but also as a tool to build a society that has character and is responsible [14], [15], [16].

2. Method

This study is a correlational study that aims to examine the relationship between science process skills, cognitive abilities, and students' caring attitudes. Pearson's Correlation Test is used to see the relationship between science process skills and cognitive abilities. Kendall's tau-b Correlation Test is used to see the relationship between science process skills and caring attitudes. Kendall's tau-b Correlation Test is also used to see the relationship between cognitive abilities and caring attitudes. The research was conducted at SMP Negeri 16 Mataram in the odd semester of the 2024/2025 academic year, namely from July to December 2024. The research population included all grade VII students who took science lessons at the junior high school. The total population was 86 students. The research sample was selected using the total sampling technique, so that all students became research respondents.

This study involved three variables, namely: 1) Science Process Skills, measured using an observation rubric that includes aspects of observing, classifying, formulating hypotheses, conducting experiments, and concluding skills; 2) Cognitive Ability, measured using a descriptive-based test designed in accordance with science learning materials, including measurements and objects of science, substances and their forms, temperature and heat, and motion and force; 3) Caring Attitude, measured using a questionnaire based on a Likert scale, with the following descriptions: Starting to Develop (scale 1), Developing (scale 2), Developing According to Expectations (scale 3), Very Developing (scale 4).

Research procedures include planning, implementation, and data analysis. The first stage, Planning: 1) Compiling research instruments, including science process skills observation rubrics, cognitive ability tests, and caring attitude questionnaires; 2) Validating the instruments with the help of science education experts. The second stage, Implementation: 1) Learning activities involve a project based on the Pancasila Student Profile Strengthening Project with the theme "Sustainable Lifestyle". This project includes making stools from eco-friendly bricks as a form of plastic waste processing; 2) Science process skills data are obtained through direct observation during the project; 3) Cognitive ability data are taken through a written test after learning is complete; 4) Caring attitude data are collected through a questionnaire filled out by students after the project is completed. The third stage, Data Analysis: 1) Data are analysed using descriptive statistics to see the distribution of scores; 2) The correlation between variables was analysed using parametric statistics (Pearson's Correlation test) for the science process skills and cognitive ability variables, and non-parametric statistics (Kendall's tau b Correlation test) for the caring attitude with the process skills variable and the caring attitude with the cognitive ability variable.

The research instruments used are: 1) Observation Rubric: Assessing students' Science Process Skills during the implementation of the project; 2) Cognitive Ability Test: Involving descriptive questions based on science material studied by students; 3) Environmental Attitude Questionnaire: Consisting of 20 statements with a Likert scale to measure students' awareness of the environment.

3. Result and Discussion

The results of this study are described in the form of information on the Mean, Median, Variance, Std. Deviation, Minimum,

and Maximum values for each research variable. The variables referred to in this study are science process skills, cognitive ability, and caring attitude. The results of the study also describe the correlation between research variables. Descriptive data for science process skills can be seen in Table 1. Descriptive data for cognitive ability can be seen in Table 2. Descriptive data for caring attitude can be seen in Table 3.

Table 1. Descriptive data for science process skills

Descriptives				
			Statistic	Std. Error
science process skills	Mean		77.05	0.252
	95% Confidence Interval for Mean	Lower Bound	76.55	
		Upper Bound	77.55	
	5% Trimmed Mean		77.01	
	Median		77.00	
	Variance		5.457	
	Std. Deviation		2.336	
	Minimum		71	
	Maximum		84	
	Range		13	
	Interquartile Range		3	
	Skewness		0.288	0.260
	Kurtosis		0.282	0.514

Table 2. Descriptive data for cognitive ability

Descriptives				
			Statistic	Std. Error
Cognitive	Mean		87.73	0.254
	95% Confidence Interval for Mean	Lower Bound	87.23	
		Upper Bound	88.24	
	5% Trimmed Mean		87.69	
	Median		88.00	
	Variance		5.563	
	Std. Deviation		2.359	
	Minimum		83	
	Maximum		94	
	Range		11	
	Interquartile Range		3	
	Skewness		0.136	0.260
	Kurtosis		-0.313	0.514

Table 3. Descriptive data for caring attitude

Descriptives				
			Statistic	Std. Error
caring attitude	Mean		2.79	0.098
	95% Confidence Interval for Mean	Lower Bound	2.60	
		Upper Bound	2.99	
	5% Trimmed Mean		2.82	
	Median		3.00	
	Variance		0.826	
	Std. Deviation		0.909	
	Minimum		1	
	Maximum		4	
	Range		3	
	Interquartile Range		1	
	Skewness		-0.339	0.260
	Kurtosis		-0.636	0.514

The assumptions of the Pearson correlation test (between the variables of science process skills and cognitive ability) in this study have been met, namely: both variables are measured on an interval scale, the two continuous variables can be paired, there is independence of observations, there are no significant outliers, they are normally distributed, homoscedasticity (residuals are evenly distributed), and the relationship between the two variables is linear.

The results of the linearity assumption test are shown in Figure 1. Based on the resulting scatterplot, science process skills have a linear relationship with cognitive abilities.

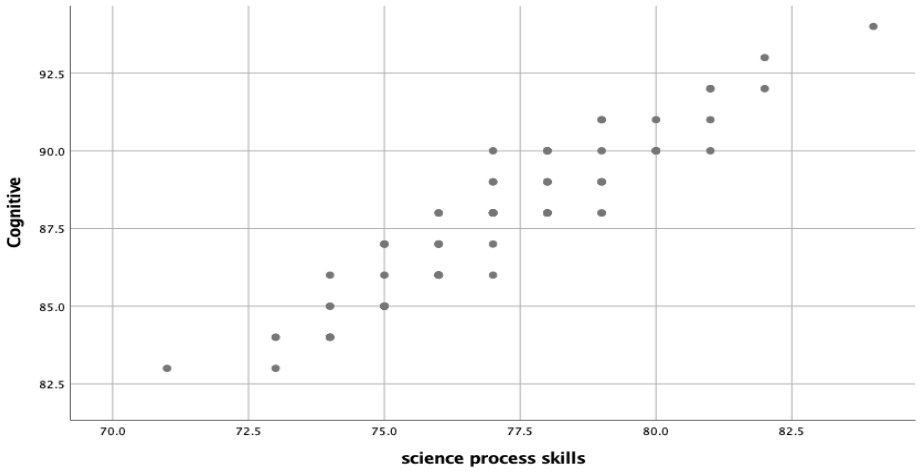

Figure 1. Scatterplot of linearity test

The assumption of homoscedasticity is fulfilled based on the scatter plot produced between the regression standardized predicted value variables and the regression standardized residual. The scatter plot of homoscedasticity is shown in Figure 2.

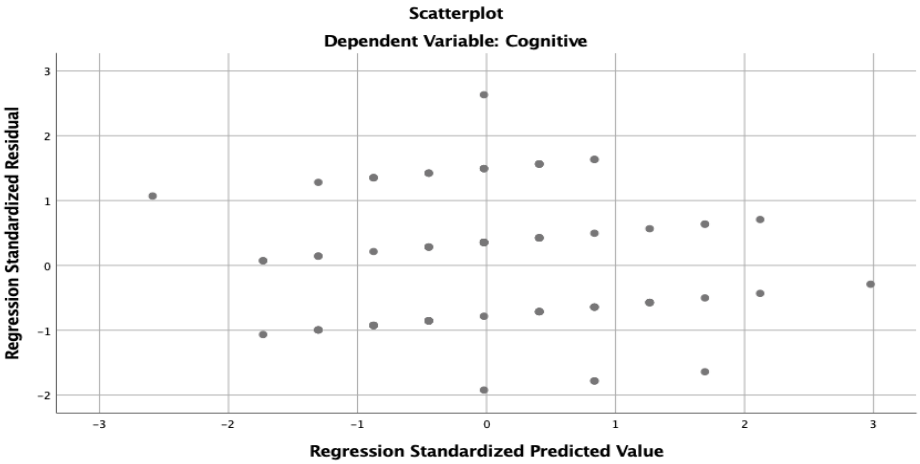

Figure 2. Scatterplot of homoscedasticity

The results of the Shapiro-Wilk test indicate that data science process skills [D(86) = 0.979, p = 0.176] and data cognitive ability [D(86) = 0.975, p = 0.093] are normally distributed. The results of the data normality test are shown in Table 4.

Table 4. Tests of Normality using Shapiro-Wilk

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
science process skills	0.979	86	0.176
Cognitive	0.975	86	0.093

The results of the Pearson Correlation test show that science process skills have a significant relationship with cognitive ability, r = 0.992, p < 0.001, N = 86. The Pearson Correlation is shown in Table 5.

Table 5. Correlation between science process skills and cognitive ability

Correlations			
		science process skills	Cognitive
science process skills	Pearson Correlation	1	.929**
	Sig. (2-tailed)		0.000
	N	86	86
Cognitive	Pearson Correlation	.929**	1
	Sig. (2-tailed)	0.000	

	N	86	86
**. Correlation is significant at the 0.01 level (2-tailed).			

Science process skills, which include activities such as observing, classifying, formulating hypotheses, conducting experiments, and concluding, are essential in science learning. In the context of physics learning, measurement is the main foundation. Students who are able to use measuring instruments correctly, such as a triple-beam balance or thermometer, have a better understanding of the basic concepts of physics. These skills contribute to improving their cognitive abilities because students not only make measurements but also analyse the results to understand the relationships between variables [17]. Cognitive skills play a vital role in science learning. At the analytical level, students need to understand how changes in state of matter (such as evaporation or freezing) occur under certain conditions. In the ecobrick-making project, students use these principles to evaluate the physical and chemical properties of plastic materials. This activity not only reinforces their understanding of matter and its states, but also hones important science process skills, such as classification and inference [18]. The relationship between science process skills and cognitive abilities can also be explained through the concept of active learning. In this project, students use physical manipulatives, such as plastic bottles and pressure devices, to understand the basic principles of force and motion. This activity provides students with the opportunity to explore and construct their own knowledge, thereby enhancing cognitive understanding [19].

The non-parametric correlation of science process skills with caring attitude was analysed using Kendall's tau-b correlation. Likewise, the correlation of cognitive ability with caring attitude was also analysed using Kendall's tau-b correlation. The results of the Kendall's tau-b correlation test showed that caring attitude had a significant relationship with science process skills, $\tau b = 0.798$, $p < 0.001$, $N = 86$. The correlation between science process skills and caring attitude is shown in Table 6.

Table 6. Correlation between science process skills and caring attitude

Correlations				
			caring attitude	science process skills
Kendall's tau_b	caring attitude	Correlation Coefficient	1.000	.798**
		Sig. (2-tailed)		0.000
		N	86	86
	science process skills	Correlation Coefficient	.798**	1.000
		Sig. (2-tailed)	0.000	
		N	86	86
**. Correlation is significant at the 0.01 level (2-tailed).				

Caring, especially for the environment, is an important aspect of project-based education. The eco-friendly bricks project teaches students to understand the impact of plastic waste on the environment. This is relevant to the concept of motion and force in physics, where students can analyse how the distribution of mass in an eco-friendly bricks affects the stability of the structure when used. This interaction between theory and practice strengthens the relationship between science process skills and students' environmental awareness [18]. The science process skills possessed by students can develop optimally through social interaction. In this project, students work together to solve problems, such as determining the ideal weight of plastic to produce a solid eco-friendly bricks. This process reflects how science process skills are a bridge to understanding more complex science concepts, including temperature and heat. For example, students learn how the heat generated when pressing plastic can affect the final shape of the product [20].

The non-parametric correlation of cognitive ability with caring attitude is shown in Table 7. The results of the Kendall's tau-b correlation test show that caring attitude has a significant relationship with cognitive ability, $\tau b = 0.889$, $p < 0.001$, $N = 86$.

Table 7. Correlation between cognitive ability and caring attitude

Correlations				
			caring attitude	Cognitive
Kendall's tau_b	caring attitude	Correlation Coefficient	1.000	.889**
		Sig. (2-tailed)		0.000
		N	86	86
	Cognitive	Correlation Coefficient	.889**	1.000
		Sig. (2-tailed)	0.000	
		N	86	86
**. Correlation is significant at the 0.01 level (2-tailed).				

The information from Table 7 means that the analytical and evaluation skills enable students to understand the impact of their decisions on the environment. In this project, students who understand the basic principles of heat, such as thermal conductivity, can evaluate the plastic materials used for eco-friendly bricks, ensuring that they are not only environmentally friendly but also safe to use under various conditions [21]. In the context of caring attitudes, character education theory emphasizes that direct

experience in solving real problems, such as plastic waste management, can shape students' moral values. The eco-friendly bricks project provides this experience, where students learn about the importance of preserving the environment through meaningful activities. This activity is also relevant to science content such as temperature and heat, where students learn how high temperatures can cause changes in the properties of plastic materials, which affect their usefulness [22].

From the analysis results, the relationship between cognitive ability and caring attitude shows that better conceptual understanding allows students to make more responsible decisions. This is reflected in the eco-friendly bricks project, where students who understand the concept of pressure and density can evaluate the plastic materials used, ensuring the final product is safe and effective [23]. The significant positive correlation between science process skills and caring attitudes also shows the importance of project-based learning in shaping students' characters. The project not only teaches scientific skills but also integrates ethical values, such as responsibility and concern for the environment. This is relevant to the constructivist approach, which emphasizes that learning should be student-centered and relevant to their real lives [24].

In the context of motion and forces, students who understand the relationship between compressive force and the density of the eco-friendly bricks demonstrate a deeper understanding of this physics concept. This activity also encourages students to think critically. By analyzing how the distribution of forces affects the final outcome, students develop higher-order thinking skills that are essential for academic success and everyday life [25]. The importance of science process skills in supporting cognitive understanding is also emphasized by the results of this study. Through measurement activities, students learn to validate their data, which is an important step in the scientific process. In the eco-friendly bricks project, students measured the mass of plastic and the volume of bottles, allowing them to understand the relationship between these concepts and their practical applications in everyday life [26].

This project also reflects the relevance of the scientific approach in the Independent Curriculum, which encourages students to explore, ask questions, and experiment. By studying temperature and heat, students understand how temperature changes can affect the physical properties of plastic, which is an important aspect in making eco-friendly bricks. This process not only improves their scientific skills but also strengthens their caring attitude towards the environment [27]. The students' caring attitude, demonstrated through their active participation in the project, reflects the positive impact of project-based learning. Such hands-on experiences help students understand the relationship between their actions and their impact on the environment. The project provides real-world, relevant experiences, allowing students to integrate ethical values into their daily lives [28].

4. Conclusion

This study shows that science process skills have a positive and significant relationship with students' cognitive abilities and caring attitudes. This indicates that project-based learning, such as processing plastic waste into eco-friendly bricks stools, can be an effective means to improve scientific thinking skills while forming students' caring attitudes towards the environment. In addition, cognitive abilities also have a positive correlation with caring attitudes, indicating that a deep understanding of science can encourage students to behave more responsibly towards environmental issues. Overall, the results of this study emphasize the importance of a project-based approach in science learning to prepare students to face the challenges of the 21st century, both in terms of mastery of science and character formation.

Based on the findings of this study, further efforts are needed to expand the implementation of project-based learning at various levels of education, especially those related to environmental sustainability issues. Teachers are expected to continue to develop learning models that are relevant to students' daily lives, such as plastic waste management projects, in order to improve their science process skills and environmental awareness. Support from schools is also very much needed, both in the form of providing learning facilities and integrating sustainability values into school programs. Furthermore, the government and education policy makers can encourage teacher training in the implementation of project-based learning that is integrated with the scientific approach and the Independent Curriculum. Further research is recommended to examine the effectiveness of project-based learning in various educational contexts and other variables, such as creativity or problem-solving skills, in order to broaden insights into the potential of this approach in building a caring and competent young generation to face global challenges.

Acknowledgment

The author would like to thank SMP Negeri 16 Mataram for the support of facilities and infrastructure. The author would also like to thank the guardians of class VII students who have supported the Pancasila Student Profile Strengthening Project in the form of processing plastic waste into stools from eco-friendly bricks.

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