The Relationship Between Self-Directedness and Basic Science Process Skills in the Material of the Solar System for Sixth-Grade Elementary School

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Abstract. This study aims to investigate the relationship between self-directedness and basic science process skills in students. This study used the correlation research method to collect and analyze data to understand the relationship between the two variables. This study involved a sample of students, which consisted of 30 sixth-grade students at SD Negeri Karangasem IV, SD Negeri Tunggulsari II, and SD Negeri Kleco I. Data regarding basic science process skills were collected through tests that summarized students' abilities to observe, formulate questions, plan and carry out experiments, collect and analyze data, and communicate experimental results. Data regarding self-directedness were gathered through a questionnaire that evaluated indicators of learning independence. Correlation statistical analysis was employed to evaluate the relationship between self-directedness and basic science process skills. The prerequisite test was performed using the normality and homogeneity tests. Next, the hypothesis was tested using the Pearson Correlation test. Based on the study results, it can be concluded that there was a significant relationship between self-directedness and science process skills in sixth-grade students at SD Negeri Karangasem IV, SD Negeri Tunggulsari II, and SD Negeri Kleco I, with the results of the Spearman rank correlation test of 0.520 and a significant value of 0.001 <0.05.

Keywords: Self-directedness, basic science process skills, relationships, correlation research, science education

1 Introduction

Education is an integral part of the formation of competent and competitive individuals. In the context of education, the development of self-directed skills and abilities is an important factor in shaping students who can face various challenges in the future. Basic education, especially at the elementary school level, equips children with basic skills to help them understand the world around them.

The ability of self-directedness or independence in learning is an essential factor that allows individuals to take an active role in the learning process. Individuals with a high level of self-directedness tend to have initiative, the ability to self-regulate, and be independent in dealing with various learning situations (Alwadaeen, 2022). This

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ability is highly relevant in learning natural sciences, where students should develop an independent understanding of complex concepts. There are two basics of independent learning, including as a learning process that makes a person responsible for implementing, planning, and having full freedom to control the limits of the material being studied and as an evaluation. Moreover, self-directed learning can increase knowledge, expertise, achievement, and individual development independently. Another perspective is independent learning, which is the formation of a person's characteristics to be responsible and active in the learning process (Baharuddin et al., 2022). Self-directed learning also refers to a learning process in which students are involved in setting learning objectives, planning, selecting, and preparing learning resources, and evaluating the learning process itself, as Brockett and Hiemstra (2018) explained. This approach allows students to adjust their learning style and tempo according to their interests and skills and take advantage of the different types of intelligence they possess. With this model, students also have the authority to choose learning materials and tools that are most suitable for their needs. Nevertheless, self-directed learning also has its drawbacks; for example, students who are not yet able to recognize their learning style and tend to be less motivated may find it difficult to take a step forward in the learning process, especially when having to look for teaching materials to understand the subject at hand.

Interesting learning is expected to be realized in implementing natural science teaching because natural science refers to a natural learning concept with broad relevance to human life. Natural science is also one of the scientific disciplines that is the basis for developing advanced technology and the principle of harmony in uniting with nature. The field of natural science further relates to systematic methods for understanding natural phenomena so that natural science is not only about mastering a collection of information in the form of facts, concepts, or principles but also concerning a process of exploration. One of the relatively complex and interesting materials in natural science is the "solar system." This material discusses the planets, celestial bodies, and the relationship between the sun, planets, and other celestial bodies in the solar system. To understand this material in more depth, basic science process skills are required, which involve observing, asking questions, predicting, collecting data, analyzing information, and making conclusions.

Findings from research conducted by Mariasa et al. (2014) indicated that learning models created to develop independent learning in students positively impacted learning achievement. Hence, it can be concluded that learning independence positively and significantly influences learning achievement. Independent learning has also been recognized as a vital factor in predicting academic motivation and student learning outcomes. Schunk (2005) argues that self-directed learning is a situation in which students consistently attempt to manage their learning process without relying on the help of others. In the context of independent learning, most encouragement comes from the initiative and responsibility given to the students.

2 Method

This quantitative research was carried out using correlational research methods. Correlation research was conducted to find relationships between variables. Supardi in Rusyidi (2018: 198) states that correlation can be used to see the level of relationship, the causal relationship between variables, and influence through analysis of the coefficient of determination. The selected samples were SD Negeri Karangasem IV, SD Negeri Tunggulsari II, and SD Negeri Kleco I. The technique chosen to collect data was a non-scale test technique to collect data on classroom management. The validity of the class management questionnaire was tested using expert judgment and calculations with the Product Moment Correlation formula, whereas testing the validity of the math test questions employed expert judgment and calculations with the Product Moment Correlation formula. While testing the reliability of the classroom management questionnaire using Cronbach's Alpha calculations, the reliability of the math test items utilized the Kuder Richardson formula 20. Then, the researchers performed prerequisite tests using the Kolmogorov-Smirnov normality test. Hypothesis testing was then carried out by analyzing simple regression, simple correlation, and coefficient of determination.

3 Results and Discussion

The instrument's validity was obtained from the correlation test with the decision r-count ≥ r-table so that it was said to be valid, while reliability was gained from the Alpha Cronbach and Kuder Richardson formulas 20. The class management questionnaire instrument had a correlation coefficient between -0.079 and 0.786, with r-table at the level error = 0.05, which was 0.374, so 25 items were valid, while 15 items were invalid. In addition, the reliability of the class management questionnaire instrument received r11 of 0.926, which was very highly reliable. Then, the mathematics test instrument obtained a correlation coefficient of -0.348 to 0.692, with a r-table of 0.374, so 20 items were valid, whereas five items were invalid. The reliability of the test instrument attained an r (kr-20) value of 0.86, denoting a very high reliability.

The questionnaire instrument obtained data regarding self-directedness that had been filled in by respondents, with the data obtained revealing that the lowest score was 71, the highest score was 94, the range was 23, the mean was 83.42, the mode was 79, the median was 83, the standard deviation was 4.87, and variance was 23.694. The average total score of self-directedness was included in the medium category. Furthermore, the questionnaire instrument regarding basic science process skills filled out by respondents showed the lowest score of 70, the highest score of 90, a range of 23, a mean of 81.62, a mode of 78, a median of 81, the standard deviation of 4.87, and a variety of 23,694. The average total basic science process skills score belonged to the moderate category.

Table 1. Normality Test

N	Significance	Sig (2-tailed)
66	0.05	0.200

Table 1 reveals the results of the Kolmogorov-Smirnov normality test. With testing guidelines of Asymp Sig (2-tailed) > 0.05, it can be said that the data are normally distributed. The normality test results were obtained by Asymp Sig (2-tailed) of 0.200 > 0.05, so it can be concluded that the data were normally distributed.

Table 2. Results of Simple Regression Analysis

Data	α	b	Equation
Y over X	21.622	0.735	$\hat{Y}$ = 21.622 + 0.735X

Table 2 presents the regression equation obtained $\hat{Y}$= 21.622 + 0.735X. Regression linearity testing was conducted to see a linear relationship between the two variables. The regression linearity test and significance were performed through the regression equation test.

The basic regression linearity test has the decision-making that if F-count < F-table, the two variables can be said to be related linearly. The linearity test between the mathematics learning outcome variable (Y) and class management (X) yielded a Fobs of 1.24. The researchers determined the F-table at the error level = 0.05 and obtained dk(TC) or quantifier dk = 19 and dk(g) or dk denominator = 45, thus attaining an F-table of 1.82. Based on these results, it is stated that F-count (1.24) < F-table (1.82), so it can be concluded that the relationship between X and Y was linear.

Moreover, the significance test is to find out whether the regression coefficient in the linear regression equation is meaningful based on deciding that if the t-test > t-table, the regression coefficient is significant. The calculation results of the regression significance test obtained a t-count of 2.71 and a t-table with dk = 64 at an error level = 0.05, which was 1.67. The comparison of the calculation results revealed that because t-count (2.71) > t-table (1.67), it can be concluded that the regression coefficient was significant.

Table 3. Results of Simple Correlation Analysis

Data	Correlation Coefficient	Category
X with Y	0.521	Low

Table 3 shows the hypothesis testing results using the Pearson Product Moment formula, and a correlation coefficient of 0.321 was obtained. The correlation coefficient obtained was then interpreted and denoted the low category. The large correlation coefficient produced a determination coefficient of 0.103. It indicates that 10.3% of learning outcomes were determined by classroom management. Then, the t-test

was carried out by researchers to determine the significance of the correlation coefficient produced based on deciding that if t-count > t-table, the correlation coefficient is significant. Since the t-test results obtained t-count (2.711) > t-table (1.669), it can be concluded that the correlation coefficient was significant. With a correlation coefficient of 0.521, this value was interpreted at a moderate level.

4 Discussion

The relationship between self-directedness (learning independence) and basic science process skills in the solar system material for sixth-grade students significantly impacted understanding and mastery. Self-directedness refers to students' ability to independently organize and manage the learning process, including identifying learning objectives, gathering information, and evaluating learning outcomes. In the context of basic science process skills, such as observing, classifying, comparing, and describing, self-directedness can play an important role.

As a process in which individuals take the initiative, with or without the help of others, self-directed learning aims to analyze and diagnose their needs and interests in learning, formulate learning goals, identify human and material resources for learning, select and implement learning strategies appropriate, and evaluate learning outcomes. According to Loeng (2020), self-directedness has three aspects: sociological, pedagogical, and psychological. Parasafar (2012) revealed that self-directed learning has characteristics such as self-planning, self-initiative, and independent learning (George Indu, 2021). Self-directed is definitely a multifaceted concept that does not have to be approached from a single perspective. This self-directedness requires individuals to take initiative and responsibility for their learning. Independent learning also frees individuals to set goals and determine what is worth learning. In addition, individuals are directed in learning that can occur both inside and outside the educational institution. Learning is carried out using the student-centered learning model, meaning that the teacher is only a facilitator, giving students freedom in the learning process. In self-directed learning, learning depends not only on chance but also on the ability to make learning decisions.

According to Garrison, a good learning process is collaborative between teachers and students (Loeng, 2020). Zach (2019) linked self-directed to lifelong learning and has been proven by being active, goal-oriented, planned, organized, and self-controlled. Self-directed emphasizes that the learning process is in the hands of students. These researchers uncovered that SDL (self-directed learning) could improve students' thought processes, manage student learning strategies, learn student effectiveness, make students disciplined and responsible, and able to manage study time well (Roberson, 2021). The SDL approach is also one of the right choices as a teaching method to align several competencies. Therefore, SDL in the curriculum has two components: as a goal to become lifelong learning and as a strategy in teaching and learning. The primary objective of SDL is to enable students to acquire knowledge through subject topics to determine learning outcomes.

Several approaches to conducting SDL use several learning methods, such as audio-visuals. Before studying in class, students study the material at home according to the assignments given by the teacher, such as case-based learning, problem-based learning, small group discussions, team-based learning (seminars, journal clubs), and open book exams. One form of SDL exercises is to provide case-based scenarios and guide and facilitate students by asking questions and directing students to use learning resources recommended by the teacher (Charokar & Dulloo, 2022). Claro and Loeb (2019) stated that SDL could increase students' success in learning (Rizkiani & Zamzam, 2022).

Additionally, the term science process skills (SPS) refers to the primary skills scientists use to conduct scientific research, which aims to solve a scientific problem and explain natural phenomena. SPS skills are also fundamental in meaningful learning because learning is carried out throughout life, and each individual must be able to find, interpret, and draw conclusions from existing evidence, even under different conditions (Handayani, 2021). For students to fully develop scientific skills in the 21st century, SPS is a prerequisite (Beichumila, 2022). In this regard, basic science process skills provide a means of answering these questions and delving deeper into complex natural phenomena. However, the development of science skills is considered essential not only for scientists but also for students so that they better understand science content in learning. The development of SPS in students is a substantial matter with the goals of science education, as it has been shown that the involvement of students in it stands as a basis for the development of their understanding of science ideas (Sideri & Skoumios, 2021).

Science skills have several integrated inquiry-based indicators of learning, such as defining problems, formulating hypotheses, and observing and interpreting results. Basic science process skills comprise observing, asking, classifying, measuring, and predicting. The second group is integrated science process skills, which encompass identifying and defining variables, collecting and transforming data, creating data tables and graphs, explaining relationships between variables, interpreting data, manipulating materials, recording data, formulating hypotheses, designing investigations, and making conclusions and generalization (Widdina., 2018).

Therefore, self-directedness could help students become more involved and enthusiastic in learning about the solar system. They could develop a deeper curiosity and ability to ask relevant questions. Overall, integrating self-directedness with basic science process skills in learning materials for the solar system for sixth-grade elementary school students could increase their understanding, mastery of concepts, and enthusiasm for science. It could also help them develop critical and analytical thinking skills, which will be beneficial in lifelong learning contexts.

5 Conclusion

The study results demonstrated a significant relationship between self-directedness, which refers to students' ability to be independent in directing their learning process, and science process skills in sixth-grade students at SD Negeri Karangasem IV, SD

Negeri Tunggulsari II, and SD Negeri Kleco I.. The Spearman Rank Correlation test data showed a correlation coefficient 0.520 between the two variables. These results indicated a relatively strong positive relationship between students' level of self-directedness and their ability in basic science process skills.

Statistical analysis revealed that the significance value obtained was 0.001 <0.05. It suggests that the relationship between self-directedness and science process skills in sixth-grade students at SD Negeri Karangasem IV, SD Negeri Tunggulsari II, and SD Negeri Kleco I. had strong statistical relevance. These results also strengthen the hypothesis that the higher the level of self-directedness students have, the better their science process skills will be.

Thus, the findings of this study provide empirical evidence reinforcing the importance of developing self-directedness in education, especially in the context of learning science process skills. As an implication, schools and educators should focus more on developing students' independent learning abilities to improve their science process skills. In addition, this research proposes the need for a learning strategy that encourages students to take an active role in the learning process to maximize the utilization of science process skills in understanding and exploring scientific concepts.

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