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RELATIONSHIP BETWEEN ATTITUDE TOWARD STEM AND COMPUTATIONAL THINKING ABILITY IN MATHEMATICS LEARNING OF ELEMENTARY SCHOOL STUDENTS

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Abstract

Computational Thinking (CT) is essential in Science, Technology, Engineering, and Mathematics (STEM) fields. However, whether Attitude toward STEM is related to CT skills is still unknown. The study aimed to determine whether there is a relationship between Attitude Toward STEM and Computational Thinking skills in mathematics learning of elementary school students. This research is correlational quantitative research that measures the relationship between two variables. The study was conducted at SDN Gandaria Utara 03 in the IVA and IVB classes. A simple random sampling technique was used to determine the research sample. The instruments in this study used a questionnaire to measure attitude Towards STEM and a test instrument to measure computational thinking ability. The instruments in this study were measured for validity and reliability before use data analysis techniques using linear regression statistical tests. The results showed that Attitude toward STEM is related to Computational Thinking ability. From the results of the data analysis, the regression model equation is $Y = 19.635 + 0.387x$. The coefficient of determination or R2 of 0.805 means that the Attitude Toward STEM variable simultaneously influences 80.5% of the Computational Thinking ability variable.

Keywords: Relationship, STEM, Computational Thinking

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INTRODUCTION

The rapid development of technology raises new demands in primary Education, especially in learning mathematics. The introduction of computational thinking as an ability to think algorithmically and logically is becoming increasingly important in the context of Education. The educational paradigm change that leads to technology integration makes computational thinking relevant to the real world (Kemendikbudristek, 2020). Students' ability to understand, design and apply solutions with an algorithmic approach provides a strong foundation for dealing with mathematical problems and stimulates interest and motivation to learn. In addition, integrating computational thinking can improve the global competitiveness of human resources in the future amid the Industrial Revolution 4.0 (Grover & Pea, 2013). Through this approach, primary Education can play a crucial role in preparing a generation that can adapt to the demands of an increasingly digitized world of work in accordance with the direction of an independent curriculum that emphasizes the development of 21st-century competencies.

One of the fundamental differences in the current independent curriculum at the elementary school level is the integration of computational thinking in the Indonesian language, mathematics, and IPAS. The integration of computational thinking in the elementary school curriculum has a significant positive impact on student development. Computational thinking ability plays a crucial role in improving students' problem-solving skills. (Cansu & Cansu, 2019; Jeannette M. Wing LISA, 2018). Students can overcome challenges more effectively by utilizing a systematic and logical approach. (Selby, 2013). In addition, this concept also develops students' logical thinking skills, abstract thinking, and creativity. Collaborative learning is emphasized, allowing students to share ideas and work together in solving problems. (Maharani, 2020; Tang et al., 2020). In addition to cognitive benefits, integrating computational thinking prepares students for the ever-evolving digital world, increases literacy, and teaches responsibility in using technology (Y. et al., 2022; Kong et al., 2022). As such, this approach enriches students' technical skills and builds a foundation of generic skills relevant to future challenges.

Computational thinking (CT) is an approach to thinking and problem-solving that involves concepts and strategies typically associated with computer programming. (Jeannette M. Wing LISA, 2018; Selby, 2013). Computational thinking involves the ability to formulate problems in a form that a computer can solve, understand and design algorithms to solve problems, recognize patterns and abstractions in data, and develop logical thinking to construct practical solutions (Bakala et al., 2021). Computational thinking is not only limited to the world of technology but also has wide applications in solving problems in various disciplines and daily life situations. (Lodi & Martini, 2021). This concept includes critical skills such as problem decomposition, pattern recognition, algorithmic thinking, abstraction, and solution evaluation, which can be applied in various contexts to enhance understanding and critical thinking skills. (Ezeamuzie & Leung, 2022; Y. B. Kafai & Proctor, 2022; Li et al., 2020b).

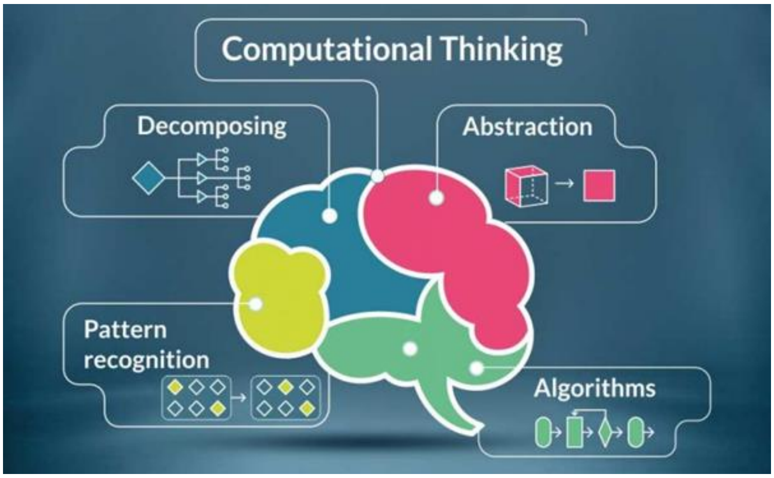

Figure 1: Indicators of Computational Thinking

Integrating computational thinking in mathematics learning creates a dynamic and up-to-date learning atmosphere (Lee & Malyn-Smith, 2020). Every lesson invites students to understand mathematical concepts and develop analytical thinking and problem-solving skills (Li et al., 2020a). Through problem decomposition, students learn to break down complex tasks into steps that are easier to understand and overcome (Tsai et al., 2021). Pattern recognition is crucial, allowing students to see the relationships and rules underlying number sequences or other math problems. Algorithmic thinking is honed by formulating structured steps to solve various math problems, thereby improving logic and problem-solving skills (Shahin et al., 2021). Abstraction is essential in identifying general concepts and helping students see commonalities or patterns in diverse mathematical contexts (Lodi & Martini, 2021). Using technology, such as math software and apps, enriches learning and provides real-world experience in applying computational thinking concepts. Project-based learning adds a practical dimension, allowing students to apply computational thinking in authentic problem-solving and expanding their understanding of mathematics in everyday life (Fidai et al., 2020; Li et al., 2020b). Thus, the integration of computational thinking in mathematics learning is about achieving concepts and shaping students into critical and innovative thinkers ready to face complex challenges in this modern era.

The computational thinking abilities of primary school children are influenced by several factors that form the foundation of their cognitive development. First, the learning environment at home has a significant impact (Bakala et al., 2021). Children exposed to activities encouraging logical thinking, such as board games or family discussions about simple problems, tend to develop better computational thinking skills. Secondly, the role of the teacher in providing engaging learning experiences that support computational concepts is also very influential (Y. Kafai et al., 2020). Teaching methods that involve problem-solving and concrete use of algorithms can improve children's computational skills. In addition, children's access to and active use of technology at home and school are also important factors. (Cansu & Cansu, 2019; Nouri et al., 2020). Using software or educational games that promote algorithmic thinking can boost computational thinking skills (Città et al., 2019). Finally, parental support in providing opportunities for children to explore and experiment with computational concepts outside the formal school environment can be a determining factor (Shin et al., 2022).

Today, learning with STEM in mathematics in the 21st century presents a new paradigm that goes beyond simply understanding traditional mathematical concepts. In this atmosphere, students learn mathematical formulas and theories and understand how these concepts are integrated into the real world (Astri et al., 2022). This concept is applied through contextualized learning, allowing students to see the relevance of math in science, technology, and their daily lives (Kayan-Fadlelmula et al., 2022). Problem-solving becomes a multidisciplinary experience where students are simultaneously empowered to solve complex challenges using math, science and technology skills. (Shahin et al., 2021). Technology, such as software and digital tools, becomes an integral part of the learning process, facilitating the visualization of mathematical concepts and interactive interaction (Paramita et al., 2021). Collaboration and communication are emphasized, creating a learning environment where students learn together and communicate mathematical solutions. Project-based learning bridges theory and practice, allowing students to apply math to real-world projects (Baran et al., 2019). This approach also builds critical and creative thinking skills and enhances students' understanding of the interconnectedness of mathematics with various careers in science, technology, and engineering (Li et al., 2020b). Overall, STEM integration in mathematics learning creates an educational experience that engages students holistically, equipping them with relevant skills and understanding to face the challenges of the 21st century.

Attitude toward STEM (Science et al.) refers to an individual's attitude or view toward fields of study and careers related to science, technology, engineering, and mathematics. This attitude includes various aspects, such as interests, beliefs, and perceptions of the value of STEM in daily life, Education, and careers (Ching et al., 2019; Grover & Pea, 2013; Thahir, 2020; Wieselmann et al., 2020). People with a positive attitude toward STEM tend to show high interest and motivation in studying, teaching, or working in STEM fields (Lin et al., 2019). These attitudes can be influenced by learning experiences, social environment, and perceptions of the relevance and value of STEM contributions in solving real-world problems (Li et al., 2020b). Increased positive attitudes towards STEM are expected to encourage active participation in STEM education and expand career opportunities in related fields.

In this context, attitude toward STEM is identified as a factor that can influence the mathematics learning process, especially in developing computational thinking skills. Active engagement in STEM requires an understanding of concepts and technical skills and a positive attitude towards the discipline. Therefore, this study wants to see if there is a relationship between attitude toward STEM and computational thinking ability.

METHOD

This research is correlational quantitative research. According to Creswell (2014), Correlational quantitative research uses statistical methods that measure the influence between two or more variables. This study has a population of all students at SDNara 03 South Jakarta. The sample co-students consisted of classes IVA and IVB, selected using simple random sampling. The data collection instruments used tests and questionnaires, where the test questions and questionnaires had been tested for validity and reliability beforehand. The test measured computational thinking ability, while the questionnaire measured attitude toward STEM. Data from the test and questionnaire results were tested for normality and linearity using SPSS. After ensuring that the data were usually and linearly distributed, hypothesis testing was conducted using a simple linear regression test.

RESULT AND DISCUSSION

Based on the results of simple linear regression statistical tests using SPSS using IBM SPSS 24, the following results/outputs are obtained:

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2460.802	1	2460.802	95.831	.000[b]
	Residual	1335.291	52	25.679		
	Total	3796.093	53			

a. Dependent Variable: Computational_Thinking

b. Predictors: (Constant), Attitude_Toward_STEM

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Figure 2. SPSS Output Results Linear Regression Test

From the output, it is known that the significance value is 0.000 <0.05, meaning reject Ho. There is a relationship between attitude toward STEM and computational thinking skills in elementary school students. Furthermore, the following figure shows the regression model equation through the SPSS output.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.635	5.989		3.279	.002
	Attitude_Toward_STEM	.387	.040	.805	9.789	.000

a. Dependent Variable: Computational_Thinking

Figure 3. SPSS Coefficient Output Results in Regression Equation

From the output above, it can be seen that the linear regression equation is Y = 19.635 + 0.387X. The constant of 19.635 means that the consistent value of the computational thinking ability variable is 19.635. The regression coefficient X of 0.387 states that for every 1% increase in the value of attitude toward STEM, the value of computational thinking ability increases by 0.387. The regression coefficient is positive, so the influence of variable X on Y is positive. Furthermore, the coefficient of determination can be seen in the following figure.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.805[a]	.648	.641	5.067

a. Predictors: (Constant), Attitude_Toward_STEM

Figure 4. SPSS Output Results R Square value or Coefficient of Determination

Based on the output above, it is known that the R Square value is 0.805; this means that the effect of the attitude towards the STEM variable simultaneously on the computational thinking variable is 80.5%. Moreover, the remaining 29.5% is influenced by other factors.

The statistical analysis showed a significant relationship between attitude toward STEM and computational thinking ability in elementary school students, with a significance value of 0.000, which is smaller than the significance level set (α = 0.05). This finding consistently supports previous literature suggesting that a positive attitude towards STEM fields can be an essential predictive factor in developing computational thinking ability at the primary education level.

In the context of learning, this finding has important implications for the design of learning strategies that can increase attitudes toward STEM or positive attitudes toward STEM so that it can indirectly improve students' computational thinking skills. A holistic approach is needed to support the development of these two aspects, given the strong relationship between these attitudes and abilities.

Several psychological and educational factors can explain the relationship between attitude toward STEM and computational thinking aptitude towards STEM, increasing an individual's motivation to learn and engage in STEM-related activities. High interest in a field tends to increase learning effort, so individuals are more likely to develop computational skills (Khan A, S., Shah, A., Makhdoom, S., Mahmood, Z., & Zareen, 2012; Thahir, 2020; Wieselmann et al., 2020). A positive attitude towards STEM can increase an individual's confidence in understanding computational concepts. A strong belief in personal abilities can encourage individuals to face challenges in learning computational thinking.

Positive attitudes towards STEM are likely to increase individual engagement in computational learning. Active engagement in learning, such as participating in computational projects or problem-solving, can strengthen computational thinking skills. Attitude toward STEM can be influenced by environmental and cultural factors, such as family, school and community support (Ching et al., 2019; Li et al., 2020b; Thahir, 2020). A supportive and motivating environment in terms of STEM can create better conditions for developing computational thinking skills.

A positive attitude towards STEM can help individuals see computational concepts' relevance and practical value in everyday life. Seeing the immediate benefits of computational thinking can provide additional incentives to understand and develop these skills. A positive attitude towards STEM can help individuals deal with difficulties and challenges in understanding computational concepts (Grover & Pea, 2013). When individuals have a positive attitude towards challenges and accept mistakes as part of learning, they are more likely to develop computational skills more effectively.

Thus, attitude toward STEM can act as a motivational factor and driver for the development of computational thinking skills, creating a learning environment conducive to the growth and development of these skills. However, the discussion also needs to consider external factors that might influence this relationship, such as parental support, learning environment or practical experiences outside the classroom. Recognizing this variability may provide additional insights into the optimal way to support the development of computational skills at an elementary level.

CONCLUSION

From the study results, it is concluded that there is a significant relationship between attitude toward STEM and computational thinking skills in elementary school students. Attitude Towards STEM variables simultaneously influences 80.5% of the variable computational thinking ability.

So the Attitude Toward STEM variable gives a significant influence in shaping the ability of computational thinking. Learning that focuses on forming Attitude Toward STEM can indirectly improve computational thinking ability.

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