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THE EFFECT OF STEM LEARNING MODEL (SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH) ON THE CRITICAL THINKING SKILLS OF SCIENCE AND TECHNOLOGY STUDENTS IN CLASS IV SDN CIPONDOH 4 TANGERANG CITY

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Abstract

The purpose of the study was the effect of STEM learning model on critical thinking skills of fourth grade students of SDN Cipondoh 4 Tangerang City. This research was conducted at SDN Cipondoh 4 Tangerang City, 2023/2024 school year consisting of two classes, namely class IV A totaling 24 people as the experimental class and class IV B totaling 24 people as the control class with a total of 48 students. This study uses an experimental method with a form of Quasi Experimental design type Nonequivalent Control Group Design with data collection techniques used, namely interviews, observations, documentation and tests. Data analysis techniques in this study include descriptive analysis of data, analysis requirements test (normality and homogeneity test), hypothesis testing to determine the effect of science critical thinking skills of fourth grade students using the STEM learning model. The results of the pre-test and post-test showed that the average value of control class students was 71.16, and the average of experimental class students was 93.25, so the increase was 22.09. The experimental class post-test results showed a t-value of 3.233, a t-table value of 1.677 with a significance level

value of 0.002> 0.05. These results indicate that there is an influence on students' critical thinking skills between students who use the STEM (Science, Technology, Engineering, Mathematics) learning model and students who use conventional learning models. This study concludes that there is an effect of using the STEM learning model on the critical thinking skills of science fourth grade students of SDN Cipondoh 4 Tangerang City.

Keywords: Critical thinking skills, Science learning, STEM

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui pengaruh model pembelajaran STEM terhadap kemampuan berpikir kritis siswa kelas IV SDN Cipondoh 4 Kota Tangerang. Penelitian ini dilaksanakan di SDN Cipondoh 4 Kota Tangerang, tahun ajaran 2023/2024 yang terdiri dari dua kelas, yaitu kelas IV A yang berjumlah 24 orang sebagai kelas eksperimen dan kelas IV B yang berjumlah 24 orang sebagai kelas kontrol dengan jumlah keseluruhan 48 siswa. Penelitian ini menggunakan metode eksperimen dengan bentuk desain Quasi Eksperimental jenis Nonequivalent Control Group Design dengan teknik pengumpulan data yang digunakan yaitu wawancara, observasi, dokumentasi dan tes. Teknik analisis data pada penelitian ini meliputi analisis deskriptif data, uji persyaratan analisis (uji normalitas dan homogenitas), uji hipotesis untuk mengetahui pengaruh keterampilan berpikir kritis IPA siswa kelas IV dengan menggunakan model pembelajaran STEM. Hasil pre-test dan post-test menunjukkan bahwa nilai rata-rata siswa kelas kontrol sebesar 71,16 dan rata- rata siswa kelas eksperimen sebesar 93,25, sehingga terjadi peningkatan sebesar 22,09. Hasil post-test kelas eksperimen menunjukkan nilai t hitung sebesar 3,233, nilai t tabel sebesar 1,677 dengan nilai taraf signifikansi 0,002 >0,05. Hasil tersebut menunjukkan bahwa terdapat pengaruh terhadap kemampuan berpikir kritis siswa antara siswa yang menggunakan model pembelajaran STEM (Science, Technology, Engineering, Mathematics) dengan siswa yang menggunakan model pembelajaran konvensional. Penelitian ini menyimpulkan bahwa terdapat pengaruh penggunaan model pembelajaran STEM terhadap keterampilan berpikir kritis IPA siswa kelas IV SDN Cipondoh 4 Kota Tangerang.

Kata **Kunci:** Keterampilan berpikir kritis, pembelajaran sains, STEM

INTRODUCTION

Natural Science (IPA) is one of the scientific disciplines that studies the surrounding nature and its contents and studies various knowledge about all objects in nature, events, and symptoms that appear in nature. Science learning is carried out by understanding, observing and testing directly, so as to develop 21st century skills to face the era of the industrial revolution 4.0. In order to face the era of the industrial revolution 4.0, science and technology are developing very rapidly. Therefore, humans are required to have individual abilities and skills in order to adapt to the times. One of them in facing the times is to become qualified human resources with 21st century skills such as critical thinking, creativity, collaboration, and communication or commonly referred to as 4C.

One of the 21st century skills is critical thinking skills. According to Norris, critical thinking is a skill that includes clarity, rigor, relevance, logic, consistency and significance to find reasons for thinking, sufficient information, use reliable sources and state these sources (Sani, 2019, p.15). Meanwhile, according to Cristina and Kristin, critical thinking is a person's ability to find information and solve a problem from a problem by asking himself to dig up information about the problem at hand Saputri (2020). According to Lubis (2019) Critical thinking is essential in the 21st century. It is now the age of information and technology. One must respond to changes quickly and effectively, thus requiring flexible intellectual skills, the ability to analyze information, and integrate multiple sources of knowledge to solve problems flexible intellectual skills, the ability to analyze information, and integrate multiple sources of knowledge to solve problems. From the understanding of experts related to critical thinking, we can conclude that critical thinking is a cognitive skill, such as being able to solve problems, formulate conclusions, and express reasons or be logically critical and evaluate statements for decision making before acting consciously controlled.

With critical thinking skills, students can understand the subject matter well so that they can improve their academic grades and knowledge insights. Therefore, critical thinking skills are very suitable to be developed in elementary schools. ccording to Halpern, critical thinking is closely related to cognitive skills and strategies to obtain the desired impact. The following is a statement from Halpern & Dunn (2023): “Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed – the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions, when the thinker is using skills that are thoughtful and effective for the particular context and type of thinking task”. Halpern's theory of critical thinking includes memory, thinking and language, deductive reasoning, argument analysis, hypothesis testing, decision making, problem solving, and creative thinking.

However, looking at the facts, the critical thinking skills of elementary school students in Indonesia are still relatively low, the low critical thinking skills of elementary school students in Indonesia are influenced by several factors. As for some factors that can be seen from the results of observations of researchers in several schools, including; 1) the low critical thinking skills are due to teacher-oriented learning (teacher center), so that students become passive and lack the initiative to ask questions and express their opinions. In research by Meilana et al., (2021) and Sholihah & Amaliyah (2022) stated that problems related to low

critical thinking skills are caused by schools still being teacher-oriented (teacher center) and teachers only focus on book guidelines. 2) in the learning process educators use the lecture method, thus making students feel bored and uninterested during learning. This is as in the research of Hartini (2017) and Novita Chandra et al. (2021) that one of the problems of low critical thinking skills is that in the learning process teachers still use conventional learning models such as lectures, discussions, and assignments so that learning becomes monotonous and the impact is that students become less interested in learning; 3) educators do not use learning models that can hone students' critical thinking skills. According to Fauzi & Anugraheni (2020) There are many students who successfully complete their assignments, do well on tests and get good grades, but they do not learn critically and deeply. In addition, students also do not know the process of obtaining answers. In fact, students are expected to participate in solving the problems they face in everyday life. Similarly, related to Suhada's (2017) research, that the problem that results in low critical thinking skills is that learning takes place conventionally. It can be concluded that students' critical thinking skills in Indonesia are still very minimal and the causes vary.

Likewise, the results of observations and interviews conducted by researchers at SDN Cipondoh 4 in October 2023, researchers obtained information that the critical thinking skills of grade IV students, especially in science subjects, were still relatively low. Factors that influence the lack of critical thinking skills of students are the learning process still implementing teacher-centered activities (teacher center) so that students become passive and lack the initiative to ask questions and express their opinions, inadequate learning facilities, educators still use conventional learning models, learning methods are lectures so that students feel bored and less interested in every learning activity, when at the end of learning educators do not accustom students to conclude the subject matter that has been learned during learning activities, students are not accustomed to identifying a problem in everyday life related to science lessons. So that it does not provide opportunities for students to develop their critical thinking skills.

So as to improve critical thinking skills, teachers are required to be able to create learning activities that are more active, creative, fun, and able to increase student interest in the learning process, and create good communication between teachers and students. One of the learning models that can create active, creative and fun learning activities is the Science, Technology, Engineering, Mathematics (STEM) learning model.

STEM stands for Science, Technology, Engineering, and Mathematics, originally proposed by the Nation Science Foundation (NSF) of the United States in the 1990s to emphasize the importance of these four disciplines in education and society in general (Putra, 2023, p. 1). . STEM aims to create a learning process that has interesting steps in integrating the four subjects in it (Diana et al., 2023, p. 27). STEM is a curriculum that educates learners in four subject areas, science, technology, engineering, math. Integrated STEM education has been identified as a platform for developing essential skills and competencies, both personally and professionally. These include research inquiry, problem solving, critical and creative thinking, entrepreneurship, collaboration, teamwork and communication (Wibowo et al., 2023, p.5). The integration of Science, Technology, Engineering, and Mathematics (STEM) in one learning experience can be developed with project-based learning that is contextualized with real world application. Developing soft skills and technical skills.

Based on the above opinions, it can be concluded that STEM learning is able to provide opportunities for students to develop soft skills and technical skills based on real-life problems by combining four disciplines. With the STEM learning model, researchers hope that the learning model will be able to help students develop creative, innovative, and critical thinking ideas, and become a generation that is ready to face the times, able to solve problems by collaborating with friends.

Based on this background, the problem formulation in this study, namely: How does the use of STEM learning model affect the critical thinking skills of 4th grade students of SDN Cipondoh 4 Tangerang City? With the purpose of the study, namely using the STEM learning model on critical thinking skills of 4th grade students of SDN Cipondoh 4 Tangerang City.

METHODS

This study uses an experimental method with a form of Quasi Experimental design type Nonequivalent Control Group Design. This design consists of two groups, namely the control group and the experimental group which are not randomly selected. then the researcher gives a pretest to the two groups before being subjected to treatment, and gives a posttest after being subjected to treatment in each group and only the experimental group is subjected to treatment.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_3
Control	O_2	-	O_4

Description:

O_1 = Data on pretest results in the experimental group

O_2 = Data on pretest results in the control group

X = Science, Technology, Engineering, and Mathematics (STEM) learning model

O_3 = Data on posttest results in the experimental group

O_4 = Data on posttest results in the control group

This research was conducted at SDN Cipondoh 4 Tangerang City, 2023/2024 school year consisting of two classes, namely class IV A totaling 24 people as an experimental class and class IV B totaling 24 people as a control class with a total of 48 students. The data collection techniques used were interviews, observations, documentation and tests.

Data analysis techniques in this study include descriptive analysis of data, analysis requirements test (normality and homogeneity test), hypothesis testing to determine the effect of science critical thinking skills of grade IV students using the STEM learning model.

RESULTS AND DISCUSSION

In this study, the researchers described that the purpose of this study was to determine the effect of the STEM (Science, Technology, Engineering, and Mathematics) learning model on the critical thinking skills of science fourth grade students of SDN Cipondoh 4 Tangerang City. In the experimental class learning using the STEM (Science, Technology, Engineering, and Mathematics) model with a sample size of 24 students, while for the control class learning using a conventional learning model with 24 students. The following below is a table of pre-test and post-test data analysis results for control classes and experimental classes. Based on the results of the t test, it is known that the mean value (mean) of the experimental pre-test is 63.00 and the mean (mean) of the control pre-test is 79.3, seen from the average pre-test value of the control class before being given treatment gets a greater average than the experimental class which is only 63.00. However, after being given the treatment, the average value of the experimental class was 95.33 and the control class got an average value of 91.17.

The average pre-test of the experimental and control classes was 71.16 while the average post-test of the experimental and control classes was 93.25, so the increase was 22.09 after being given treatment in the experimental class. When not given treatment in the experimental class, there are still many students who do not understand the material of the force so that the smallest pre-test value is 48. However, after being given treatment using the STEM learning model based on making projects, students are able to quickly understand the material so that when doing the post-test, student scores increase.

Table 2. Results of Pre-test and Post-test Data Analysis of Control and Experimental Classes

Statistics

N Valid	24	24	24	24
Missin	0	0	0	0 g
Mean	63.00	95.33	79.33	91.17
Std. Error of Mean	1.430	.953	.857	.867
Median	64.00	96.00	80.00	92.00
Mode	64	100	80	92
Std. Deviation	7.003	4.669	4.198	4.249
Variance	49.043	21.797	17.623	18.058
Range	28	16	16	16
Minimum	48	84	68	84
Maximu m	76	100	84	100
Sum	1512	2288	1904	2188

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Analysis Requirements Test

The results of the normality prerequisite test using the Chi Square formula using the help of the SPSS 23 program, it is known that the data is normal if sig> 0.05 and sig <0.05 it can be said that the data is abnormal. The following is a table of the calculation results obtained, as follows.

Table 3. Chi Square Normality Results

Test Statistic

symp. Sig.	0,072	0,063	0,745	0,105

As for the results of the normality prerequisite test using the Chi Square formula with a standard value of 0.05 where the data is declared normally distributed if sig> 0.05 and the data is not normally distributed if sig <0.05. In this study, it states that the sig. experimental pre-test gets a value of 0.072 and sig. control pre-test gets a value of 0.745 and sig. experimental post-test gets a value of 0.063 and sig. control post-test gets a value of 0.105. So, it can be said that sig. > 0.05 or all data has a value greater than the standard value (0.05) it states that the data contributes normally.

Table 4. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	2.299	3	92	.083
	Based on Median	1.602	3	92	.194
	Based on Median and with adjusted df	1.602	3	70.734	.197
	Based on trimmed mean	2.278	3	92	.085

From the results of the table above, it can be seen that based on the SPSS output in the homogeneity test table based on the average (based on mean) sig value. 0,083 > 0,05. Thus it can be concluded that all data are homogeneous.

Hypothesis Test

Based on the results of the hypothesis test with the help of the SPSS 23 application with the Independent-Sample T-Test analysis with a significance rate of 0.05. The table says that the experimental and control class pre-test data got a t_hitung value of -9.800 with a t_table at df 48 with a sig level of 0.05, which is 1.677. So t_hitung < t_tabel (-9.800 < 1.677)

with a sig level. 0.000 which sig < 0.05 (0.000 < 0.05) then it can be stated that Ho is accepted and H1 is rejected. Thus, at the beginning of learning, there is no difference in students' science critical thinking skills between experimental classes using the STEM (Science, Technology, Engineering, Mathematics) learning model and control class students using conventional learning models. Meanwhile, the experimental and control class post-test data got a t_hitung value of 3.233 with a t_table at df 48 with a sig level of 0.05 which is 1.677. So it can be concluded that t_hitung> t_tabel (3.233> 1.677) and sig value. 0.002 which sig > 0.05 (0.002 > 0.05) then it can be stated that Ho is rejected and H1 is accepted. Thus at the end of learning after being treated there is an influence on students' science critical thinking skills between experimental classes using the STEM (Science, Technology, Engineering, Mathematics) learning model and control class students using conventional learning models.

CONCLUSION

Based on the research and discussion above conducted in class IV SDN Cipondoh 4 Tangerang City in 2023-2024 that this study aims to determine the effect of the STEM (Science, Technology, Engineering, Mathematics) learning model on critical thinking skills of fourth grade students at SDN Cipondoh 4 Tangerang City. This study used class IV A with 24 students with the STEM (Science, Technology, Engineering, Mathematics) learning model as the experimental class and class IV B with 24 students with the conventional learning model as the control class.

The results of the pre-test and post-test showed that the average value of control class students was 71.16, and the average of experimental class students was 93.25, so the increase was 22.09. The experimental class post-test results showed a t-value of 3.233, a t-table value of 1.677 with a significance level value of 0.002> 0.05. These results indicate that there is an influence on students' critical thinking skills between students who use the STEM (Science, Technology, Engineering, Mathematics) learning model and students who use conventional learning models. This study concludes that there is an effect of using the STEM learning model on the critical thinking skills of science fourth grade students of SDN Cipondoh 4 Tangerang City.

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