

PAPER NAME

**Implementation of science technology e  
ngineering and mathematics approach in  
learning to critical th**

AUTHOR

**Nelly Astuti**

WORD COUNT

**7398 Words**

CHARACTER COUNT

**41288 Characters**

PAGE COUNT

**19 Pages**

FILE SIZE

**522.2KB**

SUBMISSION DATE

**Sep 5, 2022 1:31 PM GMT+7**

REPORT DATE

**Sep 5, 2022 1:32 PM GMT+7**

### ● 19% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 12% Internet database
- 16% Publications database
- Crossref database
- Crossref Posted Content database
- 14% Submitted Works database

### ● Excluded from Similarity Report

- Bibliographic material
- Manually excluded sources
- Manually excluded text blocks



# Implementation of science technology engineering and mathematics approach in learning to critical thinking skills of fifth-grade elementary school students in Lampung Province

Nelly ASTUTI\*, Riswandi, Ujang EFENDI and Nur Ridha UTAMI

Elementary School Teacher Education, Faculty of Teacher Training and Education,  
University of Lampung, INDONESIA

\*Corresponding Author's E-mail: [nelly.astuti@fkip.unila.ac.id](mailto:nelly.astuti@fkip.unila.ac.id)

Received 19 Oct., 2021

Revised 27 Dec., 2021

---

## 63 Contents

- [Abstract](#)
  - [Introduction](#)
  - [Methods](#)
  - [Results and Discussion](#)
  - [Conclusion](#)
  - [References](#)
- 

## 28 Abstract

Critical thinking skills is an important aspect of the learning process in the 21st-century era. It can be improved with the Science, Technology, Engineering, and Mathematics (STEM) approach in learning. This study aims to analyze the implementation of the STEM approach in learning to the critical thinking skills of fifth-grade elementary school students in the province of Lampung. The benefits of this research are (1) being able to improve students' critical thinking skills through the STEM approach, (2) the integration of the four aspects of the STEM approach can create active, innovative, and logical thinking students, (3) as a renewal and innovation in learning so that learning is oriented to students, and (4) the STEM approach can



be used as an input for learning in elementary school. This study uses a quasi-experimental design with experimental and non-experimental classes. The population of this study amounted to 311 students and the research sample amounted to 59 students. The data is obtained using a test in the form of an essay which consist of 6 questions. Items measure critical thinking skills with six indicators, namely focus, reason, inference, situation, clarity, and overview. The reliability of the items in the high category (0.65) and the validity of the items in the moderate to very high category (0.44-0.95). The difference in the test results of the experimental class is 68.695 and the non-experimental class is 61.250. Data analysis using Kolmogorov Smirnov with the largest  $|FT-FS|$  t-test < table value of  $0.111 < 0.246$ . The results show that the critical thinking skills is significantly higher in the experimental class students than in the non-experimental class. The results of the research on the critical thinking skills of fifth-grade elementary school students in Lampung Province are influence by the STEM approach with a significance level of 0.111 (sig < 5%). Implementation of STEM approach in learning plays an important role in improving the critical thinking skills of fifth-grade students.

**Keywords:** critical thinking skills, elementary school, learning, STEM approach.

## Introduction

21st-century skills in the world of education are skills that must be mastered by every student and even become essential to the progress of education in Indonesia. These skills are being able to think critically and problem-solving, learning and innovating skills, collaboration, communicating effectively, analyzing information, and having life skills (Widana et al., 2018; Wijaya et al., 2016; Zubaidah, 2016). Various skills are pursued by all elements of education so that students can compete with other countries and are ready to face life's challenges (Astutik & Hariyati, 2021; Nuryanti et al., 2018). Students in elementary schools need to be supported to have 21st-century skills such as critical thinking skills.

Critical thinking skills play an important role in today's life aspects (Erikson & Erikson, 2019; Halpern, 2014; Prajapati et al., 2017). Every problem that students encounter will be easily overcome if they can think critically. Critical thinking skills is a person's ability to think that is fundamental, reasonable, and reflective which includes activities to analyze, synthesize, create, identify questions, and be able to make logical conclusions and characterize 21st-century learning (Asyari et al., 2016; Butterworth & Thwaites, 2013; Ennis, 2011; Mahanal et al., 2019; Mardiyah, 2018; Schmaltz et al., 2017). Critical thinking skills are also part of the mental process that teaches how to understand the events and conditions of environment as well as to acquire new knowledges (Doleck et al., 2017; Zubaidah et al., 2018). Students with critical thinking skills looked different compared to others since their curiosity is high. Critical thinking skills are actually required for students to conceptualize themselves being active, skilled, easy to solve problems, able to collect data and make hypotheses, and applying all their learned knowledges (Changwong et al., 2018; Cintamulya, 2019).



Having critical thinking skills, the students can transfer knowledge from one domain to another. Furthermore, the educators teach them how these abilities can develop efficiently and contribute to every field (Zohar et al., 1994). The effectiveness of a person's critical thinking skills needs an indicator to determine the achievement of a predetermined target. There are six indicators of critical thinking skills i.e., Focus, Reason, Inference, Situation, Clarity, Overview (FRISCO) (Ennis, 2011). The six indicators of critical thinking skills provide a broad and useful range of knowledge for students. So, by the six indicators, they are expected to be a reference in measuring students' critical thinking skills.

In fact, the conditions that occur in elementary schools today are that the students have low critical thinking skills. This problem is appeared because the learning activity is still oriented to educators as the center of attention (teacher centered mode). So far, educators have not been able to handle it properly. However, it is already known that critical thinking skills have become a curriculum demand in elementary schools to prepare the students dealing with complex life (Rachmadtullah, 2015; Septikasari & Frasandy, 2018; Sukmana, 2018).

The integration STEM approach into Project Based Learning (PjBL) can be applied to overcome the low critical thinking skills of fifth-grade elementary school students in Lampung Province. Knowledge learned through the STEM approach is most useful in the daily lives of students and gives different meanings in its implementation (Ritz & Fan, 2014). The STEM approach is a learning approach that integrates knowledge of STEM in a student-centered learning environment and teach the student how to investigate engineering-related problems and find solutions and then build evidence-based on explanations relating to real-world phenomena (Changpetch & Seechaliao, 2020; Crotty et al., 2017; Shernoff et al., 2017).

The implementation of the STEM approach is the best way to learn in elementary schools to improve children's critical thinking skills (Yaki et al., 2019). This is because the STEM approach can foster active, meaningful, and creative learning where the four scientific aspects are simultaneously acquire to solve daily life problems. The implementation of learning is under the steps of the STEM approach which consists of reflection, research, discovery, application, communication (Khairiyah, 2019). The STEM approach can create quality learning in student-centered schools so that the output produced is under the learning objectives.

In addition, STEM also implemented in developed countries such as USA has a real impact on the development of students to be active, innovative, creative, productive, and excelling in schools (Kocakaya & Ensari, 2018; Oktapiani & Hamdu, 2020; Permanasari, 2016; Wang & Chiang, 2020). Furthermore, students who get learning with the STEM approach will form a sense of confidence to always contribute to the development of technological literacy (Prismasari et al., 2019; Salar, 2021). The purpose of the STEM approach in learning in elementary schools is to develop cognitive, affective, psychomotor skills and to form awareness of STEM disciplines that create intellectual intelligence and human culture (Haryanti & Suwarma, 2018; Jauhariyyah et al., 2017).



Learning with the STEM approach can be applied to mathematics subjects. Mathematics has an important role in the growth of children's critical thinking skills through learning activities (Hidayati, 2017). The benefits obtained from learning mathematics are that it can form a systematic, logical, critical, and careful mathematical mindset (Acar et al., 2018; Azizah et al., 2018; Karso et al., 2010). When students learn mathematics, they also learn how to construct their thoughts. Based on this, students need to be trained to think highly, namely critical thinking.

The previous research on critical thinking skills, such as the research by (Putranta et al., 2019) shows a difference with our research which lies in the use of PhET simulations to improve critical thinking skills. The results of increasing students' critical thinking skills are obtained an average N-gain value of 0.61 (medium category). In addition, research by (Parno et al., 2021) shows that 7E LC and STEM-Based 7E LC models significantly affect the improvement of participants' critical thinking skills. Furthermore, research by (Selisne et al., 2019) shows that using modules with the STEM approach effectively increases student competence consisting of knowledge, attitudes, and skills. This study aims to determine the implementation of the STEM approach to the critical thinking skills of fifth-grade elementary school students in Lampung Province.

## Methods

The type of research used is experimental research. Experimental research is that researchers deliberately make experimental research and there are controls and conditions regulated by researchers (Triyono, 2013). The research method used is a quasi-experimental design (Sugiyono, 2015). The variables contained in this study consisted of two independent variables (STEM approach) and the dependent variable (critical thinking skills).

The fifth-grade of Tri Sukses Natar elementary school is selected as experimental and non-experimental classes. The experimental class (n = 29 students) uses the STEM approach, while the non-experimental class (n = 30 students) doesn't use the STEM approach. Then, the experimental and non-experimental classes is assessed and compared to see the cause and effect and its effect on the variables given the treatment. Critical thinking skills data is measured using a test instrument. The test refers to an indicator of critical thinking skills known as FRISCO (Davies & Barnett, 2015; Ennis, 2011).

Based on the indicators of critical thinking skills, the authors made six test questions in the form of essays to measure the critical thinking skills of fifth-grade students. The questions are made according to the indicators of critical thinking skills which consist of FRISCO. Previously, the author perform the instrument test on 22 students at Gedong Air 1 elementary school who have the same criteria as the students of elementary school where the main research is conducted. The six questions is declared valid and reliable with the acquisition of  $r_{count} > r_{table}$ . Test the validity of the test instrument using the product moment correlation formula, while the reliability test using the Cronbach Alpha formula (Fraenkel et al., 2012).



It is adjusted to the four aspects of STEM i.e., science, technology, engineering, and mathematics (Guleryuz & Dilber, 2021). Aspects of science are focus learning on shape of objects and force of gravity of the earth which is associated with the subject matter of building cubes and blocks. The students learning outcomes for this aspect are students know and understand that a cube and block is an example of a solid object. The technological aspect is to direct students to apply the knowledge gained into a skill using hardware such as laptops and smartphones to get information that will be useful for designing a product to be produced. This is raised in learning by showing videos about building cubes and blocks using an LCD/projector and laptop.

Following the next aspect is engineering used to trained students to be able in processing and to solve existing problems such as how to design products accurately on it size (Shahali et al., 2017). For example, students make a dice design with the concept of building a cube space and make a pencil box design with the concept of a unit cube. When carrying out engineering aspects in learning, students can indirectly construct their thoughts in designing a project related to their life and also create creativity and improve critical thinking skills. The last for mathematical aspect, student is directed to gain the basic competencies and indicators in learning achievement of fifth-grade that is to analyze the elements of building blocks and cubes. The results are that students become easier to understand the learning of building cubes and blocks, seem more fun by making a project and think logically (Han et al., 2016).

Based on those aspects, the authors started to give pre-test before implementing the STEM approach. So that, the authors treat STEM to the students and at the end of the lesson the authors give a post test to see the results of the STEM approach treatment (Sugiyono, 2015) (see table 1).

**Table 1.** The procedure of a quasi-experimental design.

O1	X1	O2
O3	X2	O4

Note:

- O1 = Pre-test value in the experimental class,
- O2 = Post-test value in the experimental class,
- O3 = Pre-test value in the non-experimental class,
- O4 = Post-test value in the non-experimental class,
- X1 = Treatment using the STEM approach,
- X2 = Treatment without using the STEM approach.

Then the normality test is calculated using the following Kolmogorov Smirnov formula (Razali & Wah, 2011).





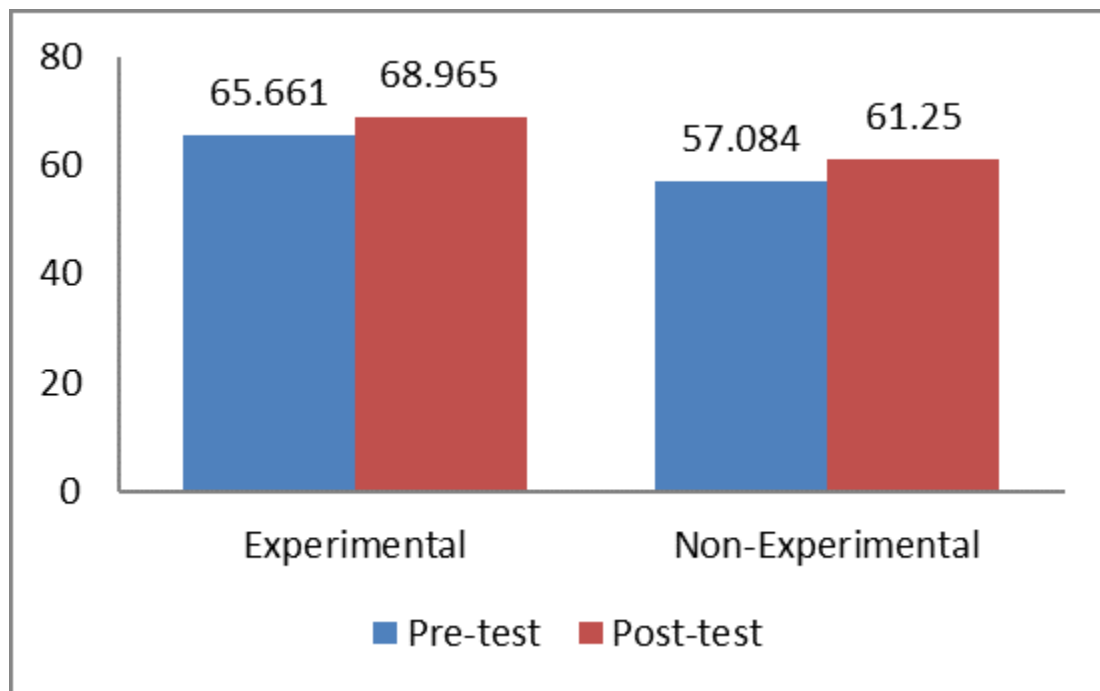
## 61 Results and Discussion

The results of the measurement of the average value of the pre-test and post-test results of students' critical thinking skills in the experimental class and non-experimental class can be seen in Table 2.

89 **Table 2.** Average pre-test and post-test results for the experimental class and the non-experimental class.

No	Aspect description	Experimental		Non-experimental	
		44 Pre-test	Post-test	Pre-test	Post-test
1	Number of students	29	29	30	30
2	Total value	1904.174	2000.08	1712.510	1837.511
3	Averages	65.661	68.965	57.084	61.250

35 Table 2 shows that the average post-test result of the experimental class's critical thinking skills after applying the STEM approach is greater than the average result of the non-experimental class pre-test. The determination of experimental and non-experimental classes is not based on high and low scores on pre test. But it determine those classes have the characteristics of students with the same age in learning needs and same level. In addition, this research focuses on how much the increase in the value given by the STEM approach to those who are not given the STEM approach in classroom learning. Furthermore, when it implements in the experimental class the average value becomes larger. It is clear that there is an increase in the value in both classes (experimental and non-experimental). Eventhough the range of non-experimental is higher than experimental value (post test - pre test), it doesn't mean that the non-experimental students have a good critical thinking skills than the student experimental class. In consequence of the beginning of starting values in pre test. In addition, it depends on actual situation that happened during the research field. If depicted in the graph, the average results of critical thinking skills are shown in Figure 1. The bar chart of the average pre test and post test results for the experimental and non-experimental classes can be seen in Figure 1.



90 **Figure 1.** Bar chart of the average pre-test and post-test scores for the experimental and non-experimental classes.

Students who apply the STEM approach can form an awareness of STEM disciplines that create intellectual intelligence and human culture, so that what students learn at school is easier to absorb (Capraro et al., 2013). Meanwhile, students who did not receive the STEM approach were less able to construct their thoughts, especially in mathematics. This can be seen in the examples of students' answers in the experimental and non-experimental classes shown in Figures 2 and 3. 94





nama: M. Fadhillah A. H

1. jawab = 4 kubus satuan  
 panjang = 4 kubus satuan  
 lebar = 3 kubus satuan  
 tinggi = 3 kubus satuan  
 $V = p \times l \times t$   
 $= 36$  kubus satuan

6. jawab  
 $p \times l \times t$   
 $4 \times 3 \times 2$   
 $= 24$  kubus  
 satuan

2. kubus  
 Kubus memiliki 12 rusuk sama panjang  
 8 titik sudut  
 12 diagonal sisi  
 4 diagonal ruang



Balok

1. mempunyai 6 sisi dengan sisi yang saling berhadapan
2. mempunyai 12 rusuk
3. mempunyai 8 titik sudut

3. jawab =

$$p = 60$$

$$l = 40$$

$$t = 80$$

$$V = 60 \times 40 \times 80 = \frac{192.000}{2} \text{ cm}^3$$

$$= 96.000$$

4. jawab =

$$\text{Volume kubus} = s \times s \times s$$

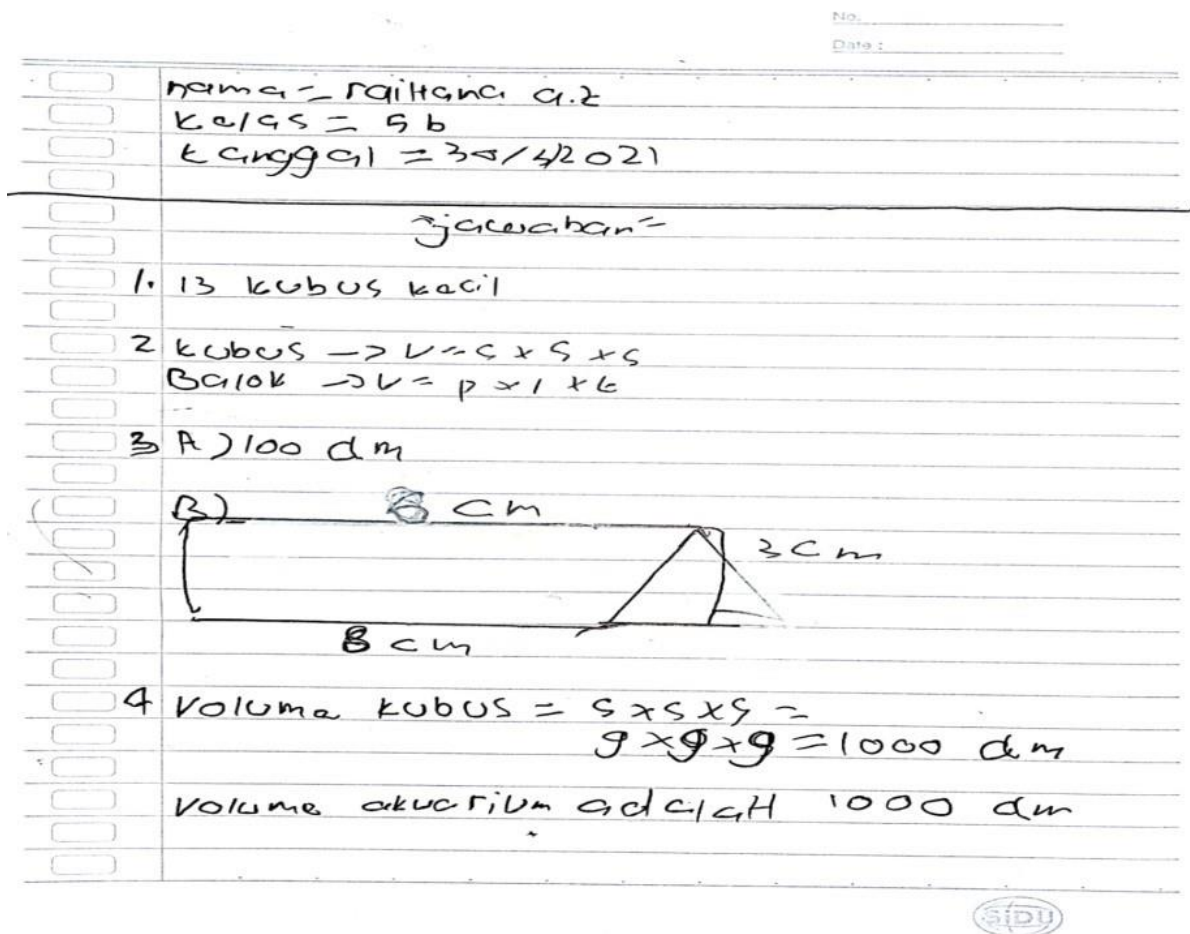
$$= s^3$$

$$= \sqrt[3]{1000}$$

$$= 10 \text{ dm}$$

5. kardus mie instan dan kardus tepung terigu seperti yang ada digambar berbentuk mirip bangun ruang balok yang terdiri dari 6 rusuk, sisi, titik, sudut, diagonal sisi, diagonal ruang dan bidang diagonal. Bentuk kardus yang seperti itu karena balok memiliki ciri yaitu terdapat 3 pasang bidang sejajar

**Figure 2.** Examples of students' answers in the experimental class.



80 **Figure 3.** Examples of students' answers in the non-experimental class. 9

Based on the examples of students' answers between the experimental and non-experimental classes, there are differences, including (1) experimental class students are better at answering the questions given; (2) experimental class students gave detailed answers than the non-experimental class; and (3) experimental class students better understand the questions given than the non-experimental class. These differences indicate that the experimental class students meet the criteria for critical thinking skills. This is relevant to similar research on critical thinking skills by other researchers, namely (Afriana et al., 2016) and (Lestari, 2020).

Normality test is useful to find out whether a data is normally distributed or not. The data tested for normality consisted of initial and final data from the results of the experimental and non-experimental critical thinking skills. Normality test using *Kolmogorov Smirnov* with probability  $\alpha = 0.05$ . The results of the analysis of the normality test on the pre-test data obtained a table value of 0.246. So that the largest  $|FT - FS| < \text{table value}$  ( $0.160 < 0.246$ ) means that the pre-



test data on critical thinking skills of the experimental class is normally distributed (see Table 3).

**Table 3.** The results of the normality test (pre-test) of critical thinking skills

No	$X_i$	$F$	$F_{kum}$	$F_s(x)$	Mean	Deviasi Standar	Z	$F_t(x)$	$F_s(x)-F_t(x)$	$ F_s(x)-F_t(x) $
1	45.5	3	3	0.103	65.661	15.050	-1.339	0.090	0.013	0.013
2	55.5	8	11	0.379	65.661	15.050	-0.675	0.249	0.130	0.130
3	65.5	8	19	0.655	65.661	15.050	-0.012	0.495	0.160	0.160
4	75.5	5	24	0.827	65.661	15.050	0.653	0.743	0.084	0.084
5	85.5	3	27	0.931	65.661	15.050	1.318	0.906	0.025	0.025
6	95.5	2	29	1.000	65.661	15.050	1.982	0.976	0.024	0.024

The results of the analysis of the normality test to the post-test data obtained a table value of 0.246. So that the largest  $|F_t - F_s| < \text{table value}$  ( $0.111 < 0.246$ ) means that the final observation data (post-test) of the experimental class's critical thinking skills is normally distributed (see Table 4).

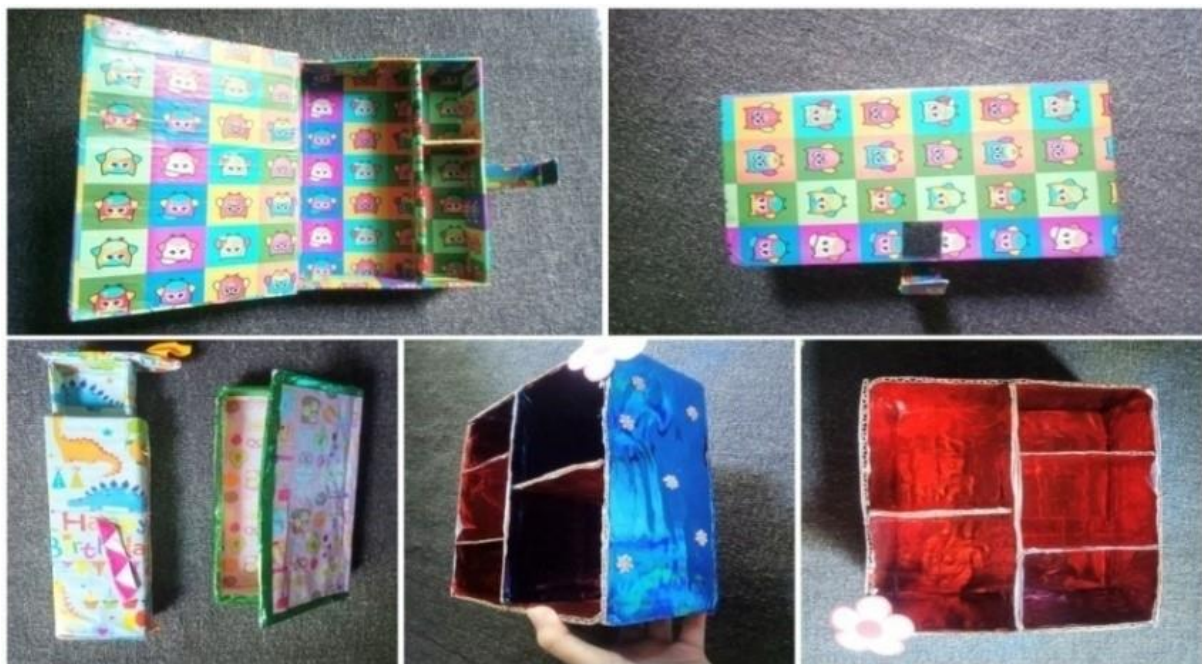
**Table 4.** The results of the normality test (post-test) of critical thinking skills.

No	$X_i$	$F$	$F_{kum}$	$F_s(x)$	Mean	Deviasi Standar	Z	$F_t(x)$	$F_s(x)-F_t(x)$	$ F_s(x)-F_t(x) $
1	45.5	4	4	0.103	68.966	14.502	-1.618	0.052	0.085	0.085
2	55.5	3	7	0.379	68.966	14.502	-0.928	0.176	0.064	0.064
3	65.5	8	15	0.655	68.966	14.502	-0.239	0.405	0.111	0.111
4	75.5	7	22	0.827	68.966	14.502	0.450	0.673	0.084	0.084
5	85.5	5	27	0.931	68.966	14.502	1.140	0.872	0.058	0.058
6	95.5	2	29	1.000	68.966	14.502	1.829	0.966	0.033	0.033

Hypothesis testing is done by using  $r_{table}$ . If  $r_{counts} > r_{table}$  with  $\alpha = 0.05$  then  $H_a$  is accepted, and if  $r_{counts} < r_{table}$  then  $H_a$  is rejected. It was found that  $r_{counts}$  0.685 with  $N = 29$  for  $\alpha = 0.05$  obtained  $r_{table}$  0.367; so that are  $r_{counts} > r_{table}$  ( $0.685 > 0.367$ ) and the hypothesis is accepted.



10 The average post-test score of students after applying learning with the STEM approach was higher than the pre-test score. 25 The implementation of learning with a STEM approach can improve students' critical thinking skills in elementary schools and provide meaningful experiences for their lives in the future (Davidi et al., 2021). In addition, learning with the STEM approach taught in elementary schools can have a positive impact on children's development, one of which is the result of creativity by making various crafts as a result of learning the STEM approach in the form of a pencil box by applying the concept of building cubes and blocks as shown in Figure 4.



**Figure 4.** The results of students' work through STEM approach learning.

Through the STEM approach, students will automatically form a collaborative spirit and creativity in the learning process that integrates four disciplines of STEM to think critically and solve problems (Falentina et al., 2018). The benefits obtained by applying learning with the STEM approach in elementary schools are that it can support the skills of students in the 21st-century through the learning process, students are able to solve problems well, and can improve students' critical thinking skills through project-based digital literacy (Maula & Fatmawati, 2020).

The hallmark of learning with the STEM approach is that students are required to be actively involved in the learning process and require students to be able to integrate various STEM knowledge which then constructs their thinking so that they can think critically (Han et al., 2015; Sasmita & Hartoyo, 2020). The STEM approach needs to be taught through concrete and contextual things. Because the level of thinking elementary school age students has not been





able to think abstractly. The four aspects of STEM in learning are able to improve critical thinking skills. The achievement of increasing critical thinking skills is due to a predetermined indicator. The indicator consists of six, i.e., focus, reason, inference, situation, clarity, and overview (FRISCO) which is manifested in the form of pre-test and post-test questions. Where *F* (focus) is to introduce students to what should be discussed and identify problems. Furthermore, students need to provide rationally supporting reasons for the existing problems, this is part of the *R* (reason). *I* (inference) is the process of making conclusions based on appropriate arguments that investigated and evidence that has been obtained. *S* (situation) defined as belief in thinking process and making decision that supported by physical and social environment. Where *C* (clarity) is to convey the message to the decisions made. And the last indicator is *O* (overview) is to review and verify the problems that have been found previously. Those indicators are used to measure the extent of students' critical thinking skills and their resulting product with STEM approach as shown in Figure 4.

Students in the experimental class show higher pre test and post test scores, while the non-experimental class without STEM is actually growing but still lower in scores. Then the findings show that the STEM approach has been good associated to critical thinking skills. In addition, it has been proved that it can increase students' critical thinking skills as a part of 21st-century skills.

The STEM approach globally is a necessity and required by the world of education today, especially to increase students critical thinking skills of elementary schools. This approach direct students to involve, to motivated and to have a positive impact on their lives in acquiring knowledge since they are learning at a young age to support their future achievements (Lee et al., 2019; Taylor, 2018; Thibaut et al., 2018; Trúchly et al., 2019). Based on finding of this research and the results of a systematic review of the existing literature. This research is contributed to solve the learning problem in the 21st-century by implementing and providing a clear definition of the framework of the STEM approach in learning with the critical thinking skills of fifth grade elementary school students. The framework of this research has beneficial for learning implementation with student-oriented in elementary schools, which are the students become more active and innovative. However, further research is recommended to know the implementation of the STEM approach to other 21st-century skills i.e., creativity, collaboration, and problem solving.

The increase in students' critical thinking skills indicates the success of the application of the integrated project-based learning (PjBL) STEM approach. This needs to be maintained through a learning process in which educators must be able to foster students to work independently, creatively, innovatively against the various challenges of life. The STEM approach taught in schools provides a learning innovation for the world of education that aims to develop students' critical thinking patterns (Ulfa et al., 2019). Although there are some short comings in the implementation of learning, for example, educators are not familiar with the STEM approach. The advantages are that students are more enthusiastic about learning, active, and creative.



## Conclusion

The skills to think critically<sup>18</sup> has an important role to improve the way students thinking<sup>79</sup> which aims to develop the perspective of collecting various information obtained during learning process. It is an essential need of every student<sup>65</sup> in the 21st-century in order to achieve superior education. The problem that occurs today is the low critical thinking skills<sup>6</sup> of students in elementary schools. The solution that can be made to improve students' critical thinking skills<sup>81</sup> in elementary schools are implementing the STEM approach in learning. Because through the STEM in the classroom the learning become more active, creative, joyful, and meaningful.

In brief, this research concluded<sup>9</sup> that the STEM approach in learning influence the critical thinking skills of fifth-grade students in Lampung Province.<sup>52</sup> The results show that there is a significant effect between learning by the STEM approach on critical thinking skills, it prove that the average final result of critical thinking skills of students in the experimental class is greater than the non-experimental class. The experimental class (68.695) and the non-experimental class (61.250). The data analyze using Kolmogorov Smirnov with the largest  $|FT-FS|$  t test < table value of  $0.111 < 0.246$ . The students who have been given the STEM approach in learning more careful and detail in understanding and answering the questions than students who do not receive the STEM approach. The implication is the students critical thinking skills<sup>12</sup> are increased by the STEM approach involved in learning.<sup>24</sup>

## 38 Acknowledgements

The authors would like to thank the University of Lampung and Tri Sukses Natar elementary school, which has permitted to research<sup>30</sup> the effect of STEM approach learning on the critical thinking skills of fifth grade elementary school students.

## References

- Acar, D., Tertemiz, N., & Taşdemir, A. (2018). The effects of STEM training on the academic achievement of 4th graders in science and mathematics and their views on stem training teachers. *International Electronic Journal of Elementary Education*, 10(4), 505–513. <https://doi.org/10.26822/iejee.2018438141>
- Afriana, J., Permanasari, A., & Fitriani, A. (2016). Project based learning integrated to stem to enhance elementary school's students scientific literacy. *Jurnal Pendidikan IPA Indonesia*, 5(2), 261–267. <https://doi.org/10.15294/jpii.v5i2.5493>
- Astutik, P., & Hariyati, N. (2021). Peran guru dan strategi pembelajaran dalam penerapan keterampilan abad 21 pada pendidikan dasar dan menengah. *Jurnal Inspirasi Manajemen Pendidikan*, 9(3), 619–638.



- Asyari, M., Muhdhar, M. H. I. Al, Susilo, H., & Ibrohim. (2016). Improving critical thinking skills through the integration of problem based learning and group investigation. *International Journal for Lesson and Learning Studies*, 5(1), 36–44. <https://doi.org/10.1108/IJLLS-10-2014-0042>
- Azizah, M., Sulianto, J., & Cintang, N. (2018). Analisis Keterampilan Berpikir Kritis Siswa Sekolah Dasar pada Pembelajaran Matematika Kurikulum 2013. *Jurnal Penelitian Pendidikan*, 35(1), 61–70.
- Butterworth, J., & Thwaites, G. (2013). *Thinking Skills Critical Thinking and Problem Solving* (Second Edi). Cambridge University Press.
- Capraro, R. M., Capraro, M. M., & Morgan, J. R. (2013). *STEM project-based learning an integrated science, technology, engineering, and mathematics (STEM) approach* (Second). Sense Publishers.
- Changpetch, S., & Seechaliao, T. (2020). The propose of an instructional model based on stem education approach for enhancing the information and communication technology skills for elementary students in thailand. *International Education Studies*, 13(1), 69–75. <https://doi.org/10.5539/ies.v13n1p69>
- Changwong, K., Sukkamart, A., & Sisan, B. (2018). Critical thinking skill development: Analysis of a new learning management model for Thai high schools. *Journal of International Studies*, 11(2), 37–48. <https://doi.org/10.14254/2071-8330.2018/11-2/3>
- Cintamulya, I. (2019). Analysis of students' critical thinking skills with reflective and impulsive cognitive styles on conservation and environmental knowledge learning. *Asia-Pacific Forum on Science Learning and Teaching*, 20(1), 1–14.
- Crotty, E. A., Guzey, S. S., Roehrig, G. H., Glancy, A. W., Ring-Whalen, E. A., & Moore, T. J. (2017). Approaches to integrating engineering in STEM units and student achievement gains. *Journal of Pre-College Engineering Education Research*, 7(2), 1–14. <https://doi.org/10.7771/2157-9288.1148>
- Davidi, E. I. N., Sennen, E., & Supardi, K. (2021). Integrasi Pendekatan STEM (Science, Technology, Engineering and Mathematic) untuk peningkatan keterampilan berpikir kritis siswa sekolah dasar. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, 11(1), 11–22.
- Davies, M., & Barnett, R. (2015). *The palgrave handbook of critical thinking in higher education* (First). Palgrave Macmillan.





- Doleck, T., Bazelais, P., Lemay, D. J., Saxena, A., & Basnet, R. B. (2017). Algorithmic thinking, cooperativity, creativity, critical thinking, and problem solving: exploring the relationship between computational thinking skills and academic performance. *Journal of Computers in Education*, 4(4), 355–369. <https://doi.org/10.1007/s40692-017-0090-9>
- Ennis, R. H. (2011). *The nature of critical thinking: outlines of general critical thinking dispositions and abilities* (pp. 1–11).
- Erikson, M. G., & Erikson, M. (2019). Learning outcomes and critical thinking—good intentions in conflict. *Studies in Higher Education*, 44(12), 2293–2303. <https://doi.org/10.1080/03075079.2018.1486813>
- Falentina, C. T., Lidinillah, D. A. M., & Mulyana, E. H. (2018). Mobil bertenaga angin : media berbasis STEM untuk siswa kelas IV sekolah dasar. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 5(3), 152–162.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (1-642 (ed.); eight). The McGraw-Hill Companies.
- Guleryuz, H., & Dilber, R. (2021). STEM activities made with 3rd printer; the effect on awareness of teacher candidates regarding its use in science lessons. *International Journal of Research - GRANTHAALAYAH*, 9(10), 366–378. <https://doi.org/10.29121/granthaalayah.v9.i10.2021.4351>
- Halpern, D. F. (2014). Thought and knowledge: An introduction to critical thinking, Fifth Edition. In *Thought and Knowledge: An Introduction to Critical Thinking, Fifth Edition* (Fifth). Psychology Press. <https://doi.org/10.4324/9781315885278>
- Han, S., Rosli, R., Capraro, M. M., & Capraro, R. M. (2016). The effect of science, technology, engineering and mathematics (STEM) project based learning (PBL) on students' achievement in four mathematics topics. *Journal of Turkish Science Education*, 13(Special issue), 3–30.
- Han, S., Yalvac, B., Capraro, M. M., & Capraro, R. M. (2015). In-service teachers' implementation and understanding of STEM project based learning. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(1), 63–76.
- Haryanti, A., & Suwarma, I. R. (2018). Profil Keterampilan Komunikasi Siswa Smp Dalam Pembelajaran Ipa Berbasis Stem. *WaPFI (Wahana Pendidikan Fisika)*, 3(1), 49–54.
- Hidayati, A. U. (2017). Melatih keterampilan berpikir tingkat tinggi dalam pembelajaran matematika pada siswa sekolah dasar. *Terampil: Jurnal Pendidikan Dan Pembelajaran Dasar*, 4(2), 143–156.
-



- Jauhariyyah, F. R., Suwono, H., & Ibrohim. (2017). Science, Technology, Engineering and Mathematics Project Based Learning (STEM-PjBL) pada pembelajaran sains. *Prosiding Seminar Pendidikan IPA Pascasarjana UM*, 2, 432–436.
- Karso, Suyadi, G., Muhsetyo, G., Chadra, T. D., Widagdo, D., & Priatna, N. (2010). *Pendidikan Matematika I* (S. Atmana (ed.); Kesatu). Universitas Terbuka.
- Khairiyah, N. (2019). *Pendekatan Science, Technology, Engineering dan Mathematics (STEM)* (Guepedia (ed.); kesatu). Guepedia.
- Kocakaya, S., & Ensari, Ö. (2018). Physics pre-service teachers' views on STEM activities. *Asia-Pacific Forum on Science Learning and Teaching*, 19(1), 1–15.
- Lee, Y., Capraro, R. M., & Bicer, A. (2019). Affective mathematics engagement: a comparison of STEM PBL versus non-STEM PBL instruction. *Canadian Journal of Science, Mathematics and Technology Education*, 19(3), 270–289. <https://doi.org/10.1007/s42330-019-00050-0>
- Lestari, A. T. A. (2020). Pengembangan LKPD Berbasis STEM Pada Sub Tema Indahny Persatuan dan Kesatuan Negeriku (Pokok Bahasan Gaya Gravitasi dan Gaya Gesek) untuk Peserta Didik Kelas IV Sekolah Dasar. *Skripsi*.
- Mahanal, S., Zubaidah, S., Sumiati, I. D., Sari, T. M., & Ismirawati, N. (2019). RICOSRE: A learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction*, 12(2), 417–434. <https://doi.org/10.29333/iji.2019.12227a>
- Mardliyah, A. A. (2018). Budaya literasi sebagai upaya peningkatan keterampilan berpikir kritis di era industri revolusi 4.0. *Seminar Nasional Penelitian Dan Pengabdian Masyarakat*, 171–176.
- Maula, N. R., & Fatmawati, L. (2020). Pengembangan media pembelajaran kayaku (kayanya alam negeriku) berbasis STEM kelas IV sekolah dasar. *Jurnal Ilmiah Sekolah Dasar*, 4(1), 97–105.
- Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa Kelas IX. *Jurnal Pendidikan; Teori, Penelitian, Dan Pengembangan*, 3(2), 155–158.
- Oktapiani, N., & Hamdu, G. (2020). Desain pembelajaran STEM berdasarkan kemampuan 4C di sekolah dasar. *Jurnal Ilmiah Pendidikan Dasar*, 7(2), 99–108.



- Parno, Supriana, E., Widarti, A. N., & Ali, M. (2021). The effectiveness of STEM approach on students' critical thinking ability in the topic of fluid statics. *Journal of Physics: Conference Series*, 1882(1), 1–8. <https://doi.org/10.1088/1742-6596/1882/1/012150>
- Permanasari, A. (2016). STEM education: inovasi dalam pembelajaran sains. In *Prosiding SNPS (Seminar Nasional Pendidikan Sains)n Prosiding SNPS (Seminar Nasional Pendidikan Sains)*, 23–34.
- Prajapati, R., Sharma, B., & Sharma, D. (2017). Significance of life skills education. *Contemporary Issues in Education Research (CIER)*, 10(1), 1–6.
- Prismasari, D. I., Hartiwi, A., & Indrawati. (2019). Science, technology, engineering and mathematics ( Stem ) pada pembelajaran IPA SMP. *Seminar Nasional Pendidikan Fisika 2019 “Integrasi Pendidikan, Sains, Dan Teknologi Dalam Mengembangkan Budaya Ilmiah Di Era Revolusi Industri 4.0,”* 4(1), 43–45.
- Putranta, H., Jumadi, & Wilujeng, I. (2019). Physics learning by PhET simulation-assisted using problem based learning (PBL) model to improve students' critical thinking skills in work and energy chapters in MAN 3 Sleman. *Asia-Pacific Forum on Science Learning and Teaching*, 20(1), 1–44.
- Rachmadtullah, R. (2015). Kemampuan berpikir kritis dan konsep diri dengan hasil belajar pendidikan kewarganegaraan siswa kelas V sekolah dasar. *Jurnal Pendidikan Dasar*, 6(2), 287–298. <https://doi.org/10.21009/jpd.062.10>
- Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, 2(1), 21–33.
- Ritz, J. M., & Fan, S. C. (2014). STEM and technology education: international state-of-the-art. *International Journal of Technology and Design Education*, 25(4), 429–451. <https://doi.org/10.1007/s10798-014-9290-z>
- Salar, R. (2021). Awareness and self-efficacy of pre-service science teachers about stem education: A qualitative study. *Asia-Pacific Forum on Science Learning and Teaching*, 20(1), 1–21.
- Sasmita, P. R., & Hartoyo, Z. (2020). pengaruh pendekatan pembelajaran STEM project based learning terhadap pemahaman konsep fisika siswa. *Silampari Jurnal Pendidikan Ilmu Fisika*, 2(2), 136–148.



- Schmaltz, R. M., Jansen, E., & Wenckowski, N. (2017). Redefining critical thinking: teaching students to think like scientists. *Frontiers in Psychology*, 8(459), 1–4. <https://doi.org/10.3389/fpsyg.2017.00459>
- Selisne, M., Sari, Y. S., & Ramli, R. (2019). Role of learning module in STEM approach to achieve competence of physics learning. *Journal of Physics: Conference Series*, 1185(1), 1–6. <https://doi.org/10.1088/1742-6596/1185/1/012100>
- Septikasari, R., & Frasandy, R. N. (2018). Keterampilan 4C Abad 21 dalam Pembelajaran Pendidikan Dasar. *Tarbiyah Al-Awlad*, 8(2), 107–117.
- Shahali, E. H. M., Halim, L., Rasul, M. S., Osman, K., & Zulkifeli, M. A. (2017). STEM learning through engineering design: Impact on middle secondary students' interest towards STEM. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(5), 1189–1211. <https://doi.org/10.12973/eurasia.2017.00667a>
- Shernoff, D. J., Sinha, S., Bressler, D. M., & Ginsburg, L. (2017). Assessing teacher education and professional development needs for the implementation of integrated approaches to STEM education. *International Journal of STEM Education*, 4(1), 1–16. <https://doi.org/10.1186/s40594-017-0068-1>
- Sugiyono. (2015). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. CV Alfabeta.
- Sukmana, R. W. (2018). Implementasi pendekatan STEM (science, technology, engineering and mathematics) untuk meningkatkan keterampilan berpikir kritis siswa sekolah dasar. *Primaria Educationem Journal*, 1(2), 113–119.
- Taylor, P. C. (2018). Enriching STEM with the arts to better prepare 21st century citizens. *AIP Conference Proceedings*. <https://doi.org/10.1063/1.5019491>
- Thibaut, L., Ceuppens, S., Loof, H. De, Meester, J. De, Goovaerts, L., Struyf, A., Pauw, J. B., Dehaene, W., Deprez, J., Cock, M. De, Hellinckx, L., Knipprath, H., Langie, G., Struyven, K., Velde, D. Van de, Petegem, P. Van, & Depaepe, F. (2018). Integrated STEM education: a systematic review of instructional practices in secondary education. *European Journal of STEM Education*, 3(1), 1–12. <https://doi.org/10.20897/ejsteme/85525>
- Triyono. (2013). *Metodologi Penelitian Pendidikan (Pertama)*. Penerbit Ombak.
- Trúchly, P., Medvecký, M., Podhradský, P., & Mawas, N. El. (2019). STEM education supported by virtual laboratory incorporated in self-directed learning process. *Journal of Electrical Engineering*, 70(4), 332–344. <https://doi.org/10.2478/jee-2019-0065>
-



- Ulfa, F. M., Asikin, M., Dwidayati, & Karomah, N. (2019). Membangun kemampuan berpikir kreatif matematis siswa dengan pembelajaran PjBL terintegrasi pendekatan STEM. *Prosiding Seminar Nasional Pascasarjana UNNES*.
- Wang, L., & Chiang, F. K. (2020). Integrating novel engineering strategies into STEM education: APP design and an assessment of engineering-related attitudes. *British Journal of Educational Technology*, 0(0), 1–22. <https://doi.org/doi:10.1111/bjet.13031>
- Widana, I. W., Parwata, I. M. Y., Parmithi, N. N., Jayantika, I. G. A. T., Sukendra, K., & Sumandya, I. W. (2018). Higher order thinking skills assessment towards critical thinking on mathematics lesson. *International Journal of Social Sciences and Humanities (IJSSH)*, 2(1), 24–32. <https://doi.org/10.29332/ijssh.v2n1.74>
- Wijaya, E. Y., Sudjimat, D. A., & Nyoto, A. (2016). Transformasi pendidikan abad 21 sebagai tuntutan pengembangan sumber daya manusia di era global. *Prosiding Seminar Nasional Pendidikan Matematika 2016*, 1, 263–278.
- Yaki, A. A., Saad, R. M., Sathavisam, R. V., & Zulnaidi, H. (2019). Enhancing science achievement utilising an integrated STEM approach. *Malaysian Journal of Learning and Instruction*, 16(1), 181–205.
- Zohar, A., Weinberger, Y., & Tamir, P. (1994). The effect of the biology critical thinking project on the development of critical thinking. *JOURNAL OF RESEARCH IN SCIENCE TEACHING*, 31(2), 183–196.
- Zubaidah, S. (2016). Keterampilan abad ke-21: keterampilan yang diajarkan melalui pembelajaran. *Seminar Nasional Pendidikan Dengan Tema “Isu-Isu Strategis Pembelajaran MIPA Abad 21, Desember*, 1–17.
- Zubaidah, S., Mahanal, S., Rosyida, F., Kurniawati, Z. L., Sholihah, M., & Ismirawati, N. (2018). Using remap-TmPS learning to improve low-ability students’ critical thinking skills. *Asia-Pacific Forum on Science Learning and Teaching*, 19(1), 1–28.

## ● 19% Overall Similarity

Top sources found in the following databases:

- 12% Internet database
- 16% Publications database
- Crossref database
- Crossref Posted Content database
- 14% Submitted Works database

### TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	<b>Lailatus Suroiha, Galuh Kartika Dewi, Satrio Wibowo. "Pengembangan ...</b>	<1%
	Crossref	
2	<b>media.neliti.com</b>	<1%
	Internet	
3	<b>University of Sydney on 2021-11-26</b>	<1%
	Submitted works	
4	<b>Shindy Lestari, Aninditya Sri Nugraheni. "The Effect of Google Classroo...</b>	<1%
	Crossref	
5	<b>Ilma Aulia Mufidah. "THE IMPLEMENTATION OF SCIENCE, TECHNOLO...</b>	<1%
	Crossref	
6	<b>e-iji.net</b>	<1%
	Internet	
7	<b>eprints.hamzanwadi.ac.id</b>	<1%
	Internet	
8	<b>Parno, D A Nur'aini, S Kusairi, M Ali. "Impact of The STEM approach wit...</b>	<1%
	Crossref	

9	<b>ejournal.radenintan.ac.id</b>	Internet	<1%
10	<b>A. Sri Puji Retno, Nur Khoiri, Bunga Ihda Norra. "The Effectiveness of C...</b>	Crossref	<1%
11	<b>mulok.library.um.ac.id</b>	Internet	<1%
12	<b>journal.uinsgd.ac.id</b>	Internet	<1%
13	<b>researchgate.net</b>	Internet	<1%
14	<b>"QASEE: A Potential Learning Model to Improve the Critical Thinking S...</b>	Crossref	<1%
15	<b>N Indrawatiningsih, Purwanto, A R As'ari, Dwiyana, Sudirman, R Rahar...</b>	Crossref	<1%
16	<b>Edith Cowan University on 2010-12-13</b>	Submitted works	<1%
17	<b>stemeducationjournal.springeropen.com</b>	Internet	<1%
18	<b>Hobri, R Oktavianingtyas, D Trapsilasiwi, R P Murtikusuma, Q A'yun. "A...</b>	Crossref	<1%
19	<b>Supriyono Koes-H., Fenudya Sanding Putri, Endang Purwaningsih, Afifa...</b>	Crossref	<1%
20	<b>ejournal.unesa.ac.id</b>	Internet	<1%



- 21 **Curmi, Teresa. "Investigative Decision Making and Its Association with ..."** <1%  
Publication
- 
- 22 **M Widyasmah, Abdurrahman, K Herlina. "Implementation of STEM Ap..."** <1%  
Crossref
- 
- 23 **Suryaratri, Ratna Dyah. "Why Don't I Ask for Help? Examining Factors In..."** <1%  
Publication
- 
- 24 **Western Governors University on 2015-04-14** <1%  
Submitted works
- 
- 25 **journal.walisongo.ac.id** <1%  
Internet
- 
- 26 **U. Hijriyah, E. Pratiwi, A. Susanti, W. Anggraini, A. P. Febriani. "The Effe..."** <1%  
Crossref
- 
- 27 **Universitas Negeri Surabaya The State University of Surabaya on 2018-...** <1%  
Submitted works
- 
- 28 **Y Sukma, N Priatna. "The effectiveness of blended learning on student..."** <1%  
Crossref
- 
- 29 **etheses.uin-malang.ac.id** <1%  
Internet
- 
- 30 **tojet.net** <1%  
Internet
- 
- 31 **Ayşe Çiftçi, Mustafa Sami Topçu. "Pre-service Early Childhood Teacher..."** <1%  
Crossref
- 
- 32 **Ida Fiteriani, Rahma Diani, Athi' Hamidah, Chairul Anwar. "Project-base..."** <1%  
Crossref

- 33 N Aini, T Jalmo, Abdurrahman. "The prospective of STEM education: s... <1%  
Crossref
- 
- 34 Ulfiana Ulfiana, Minarni R. Jura, Tahril Tahril. "Influence of Problem-Ba... <1%  
Crossref
- 
- 35 Universidad Internacional de la Rioja on 2022-01-26 <1%  
Submitted works
- 
- 36 Universitas Negeri Surabaya The State University of Surabaya on 2019-... <1%  
Submitted works
- 
- 37 University of St Andrews on 2022-08-12 <1%  
Submitted works
- 
- 38 docplayer.net <1%  
Internet
- 
- 39 journal.ummat.ac.id <1%  
Internet
- 
- 40 journal.unnes.ac.id <1%  
Internet
- 
- 41 link.springer.com <1%  
Internet
- 
- 42 Associatie K.U.Leuven on 2016-01-08 <1%  
Submitted works
- 
- 43 E Elhefni, Z Zulela, S Sumantri. "Critical reading skill and discovery lear... <1%  
Crossref
- 
- 44 Lilik Ariyanto, S. Supandi, Widya Kusumaningsih, Putri Novitasari. "Impl... <1%  
Crossref

- 45 LopezGomez, Juan R.. "Barriers and Supporting Factors for Latino Mal... <1%  
Publication
- 
- 46 Muncarno Muncarno, Nelly Astuti, Nelly Astuti. "PENGARUH MODEL PE... <1%  
Crossref
- 
- 47 Northcentral on 2019-10-16 <1%  
Submitted works
- 
- 48 Qi Wang, Yan Peng, Huimin Wang. "A Curation Activity-Based Self-Reg... <1%  
Crossref
- 
- 49 SUNY, New Paltz on 2019-10-13 <1%  
Submitted works
- 
- 50 Westminster International University in Tashkent on 2017-06-12 <1%  
Submitted works
- 
- 51 Y R Sari, Dafik, Suparti. "The analysis of implementation of multy sour... <1%  
Crossref
- 
- 52 ojs.unimal.ac.id <1%  
Internet
- 
- 53 deboni.he.com.br <1%  
Internet
- 
- 54 Amiruddin B, A S Budi, M S Sumantri. "Enhancing science literacy capa... <1%  
Crossref
- 
- 55 Andrade Cervantes, Petronilo. "Identifying and Examining the Essential... <1%  
Publication
- 
- 56 Karisma Anggun Surya, Ika Candra Sayekti, Siti Rahaimah Binti Ali. "An... <1%  
Crossref

57	<b>Leeds Trinity and All Saints on 2015-11-12</b>	<1%
	Submitted works	
58	<b>N Hermita, R Dewi, M Alpusari, E Noviana, O Kurniaman, Z Antosa, I K S...</b>	<1%
	Crossref	
59	<b>Syamsul Huda, Muhamad Yasin, Adhenia Fitri, Muhamad Syazali, Nana...</b>	<1%
	Crossref	
60	<b>University of Newcastle upon Tyne on 2020-04-28</b>	<1%
	Submitted works	
61	<b>Yulia Pratiwi, Sri Rahma Yulia, Ramli Ramli. " Needs analysis in develop...</b>	<1%
	Crossref	
62	<b>Yustina. "The Effectiveness of Constructivism-based STEM Learning o...</b>	<1%
	Crossref	
63	<b>academic.oup.com</b>	<1%
	Internet	
64	<b>alhikmah.edu.ng</b>	<1%
	Internet	
65	<b>ejournal.uin-malang.ac.id</b>	<1%
	Internet	
66	<b>eprints.utm.my</b>	<1%
	Internet	
67	<b>flex.flinders.edu.au</b>	<1%
	Internet	
68	<b>inased.org</b>	<1%
	Internet	

69	<b>journal.iainkudus.ac.id</b>	Internet	<1%
70	<b>pt.scribd.com</b>	Internet	<1%
71	<b>jurnal.unsyiah.ac.id</b>	Internet	<1%
72	<b>Collins, Anthony R.. "The Impact of Language-Mathematics Instruction ...</b>	Publication	<1%
73	<b>Herisa Hardiyanti Sholeha, Pratiwi Pujiastuti, Asih Mardati. "Analysis of...</b>	Crossref	<1%
74	<b>Ida Yuyu Nurul Hizqiyah, Ari Widodo, Siti Sriyati, Wawan Setiawan. "The...</b>	Crossref	<1%
75	<b>M Selisne, Y S Sari, R Ramli. "Role of learning module in STEM approac...</b>	Crossref	<1%
76	<b>Nita Priyanti, Jhoni Warmansyah. "Improving Critical Thinking Skills of ...</b>	Crossref	<1%
77	<b>S. Muslim, A. Fathoni, N. Kusumawati, E. Rahmadyanti. "Critical study o...</b>	Crossref	<1%
78	<b>Universitas Pendidikan Indonesia on 2019-07-31</b>	Submitted works	<1%
79	<b>Giacomazzi, Mauro. "A Contextualised Approach to Understanding and...</b>	Publication	<1%
80	<b>H Arianti, C M Zubainur, Hizir. "Students' ability to convert a situation i...</b>	Crossref	<1%

81	<b>Nora Indrasari, Parno Parno, Arif Hidayat, Endang Purwaningsih, Herlin...</b>	<1%
	Crossref	
82	<b>SASTRA University on 2014-03-22</b>	<1%
	Submitted works	
83	<b>Silvia Tabah Hati. "Social Studies Education Responding to the Challen...</b>	<1%
	Crossref	
84	<b>Syiah Kuala University on 2022-02-11</b>	<1%
	Submitted works	
85	<b>Universitas Negeri Semarang on 2022-08-10</b>	<1%
	Submitted works	
86	<b>Universiti Malaysia Sabah on 2021-12-23</b>	<1%
	Submitted works	
87	<b>University of Lincoln on 2022-02-09</b>	<1%
	Submitted works	
88	<b>Fauzi Bakri, Nur Devi Vani, Handjoko Permana, Dewi Mulyati. "Textboo...</b>	<1%
	Crossref	
89	<b>Syiah Kuala University on 2022-02-18</b>	<1%
	Submitted works	
90	<b>University of Wales Swansea on 2021-04-27</b>	<1%
	Submitted works	
91	<b>dergipark.org.tr</b>	<1%
	Internet	
92	<b>e-aje.net</b>	<1%
	Internet	

- 93 Dafid Slamet. "The Application of Mathematics Learning Model to Stim... <1%  
Crossref
- 
- 94 I. Made Astra, Eneng Ita Rosita, Raihanati. "Effect of project based lear... <1%  
Crossref
- 
- 95 Kekang He. "Semantic Perception Theory", Springer Science and Busin... <1%  
Crossref
- 
- 96 Universitas PGRI Palembang on 2022-07-05 <1%  
Submitted works



**● Excluded from Similarity Report**

- Bibliographic material
- Manually excluded text blocks
- Manually excluded sources

## EXCLUDED SOURCES

**SMA Alfa Centauri on 2021-11-26**

Submitted works

**5%****eduhk.hk**

Internet

**5%****repository.lppm.unila.ac.id**

Internet

**5%****eric.ed.gov**

Internet

**5%****ejournal.undiksha.ac.id**

Internet

**5%****ijrrjournal.com**

Internet

**5%****files.eric.ed.gov**

Internet

**4%****Universitas Negeri Jakarta on 2019-04-21**

Submitted works

**4%****iopscience.iop.org**

Internet

**3%****journal.unj.ac.id**

Internet

**3%**

<b>Soongsil University on 2022-01-26</b>	<b>3%</b>
Submitted works	
<b>Edith Cowan University on 2010-11-19</b>	<b>2%</b>
Submitted works	
<b>eu-jer.com</b>	<b>2%</b>
Internet	
<b>sciencegate.app</b>	<b>2%</b>
Internet	
<b>Farida Puput, Farid Ahmadi, Rochmad Rochmad. "The Implementation of Mat...</b>	<b>2%</b>
Crossref	
<b>prosiding.unirow.ac.id</b>	<b>2%</b>
Internet	
<b>e-journal.unipma.ac.id</b>	<b>2%</b>
Internet	
<b>journal.staihubbulwathan.id</b>	<b>2%</b>
Internet	
<b>Fida Rahmantika Hadi. "Efektifitas Model Pbl Terintegrasi STEM Terhadap Ke...</b>	<b>2%</b>
Crossref	
<b>ejournal.uksw.edu</b>	<b>2%</b>
Internet	
<b>S A Hadi, E Susantini, R Agustini. "Training of Students' Critical Thinking Skills...</b>	<b>2%</b>
Crossref	
<b>Rukayah Rukayah, Joko Daryanto, Idam Ragil Widiyanto Atmojo, Roy Ardiansya...</b>	<b>2%</b>
Crossref	

<b>A Thahir, C Anwar, A Saregar, L Choiriah, F Susanti, A Pricilia. "The Effectivene...</b>	<b>2%</b>
Crossref	
<b>Gustina Gustina, Ardimen Ardimen, Zakirman Zakirman, Cut Afrina. "The Effec...</b>	<b>1%</b>
Crossref	
<b>D Yulianti, E Handayani. "Enhancement of communication skills through physi...</b>	<b>1%</b>
Crossref	
<b>journal.uny.ac.id</b>	<b>1%</b>
Internet	
<b>journal.gmpionline.com</b>	<b>1%</b>
Internet	
<b>journal.staihubbulwathan.id</b>	<b>&lt;1%</b>
Internet	
<b>M Taufiq, S Muntamah, P Parmin. "Remediation of misconception on straight l...</b>	<b>&lt;1%</b>
Crossref	
<b>Pabutoy Flores, Peluchi. "Seventh Graders' Construction of Novel Insights in I...</b>	<b>&lt;1%</b>
Publication	
<b>apsce.net</b>	<b>&lt;1%</b>
Internet	
<b>University of Michigan, Dearborn on 2007-03-06</b>	<b>&lt;1%</b>
Submitted works	
<b>Western Governors University on 2006-05-26</b>	<b>&lt;1%</b>
Submitted works	
<b>Western Governors University on 2006-04-27</b>	<b>&lt;1%</b>
Submitted works	

**University of Brighton on 2012-12-13**

<1%

Submitted works

---

**Bath Spa University College on 2012-12-07**

<1%

Submitted works

---

**jasstudies.com**

<1%

Internet

---

**Taban, Tugce Gorkemli. "Fen Bilimi Öğretmen Adaylarının Sivil Basıncı Konusunda Yaşadıkları Sorunlar ve Çözüm Önerileri"**

<1%

Publication

---

**scirp.org**

<1%

Internet

---

EXCLUDED TEXT BLOCKS

**Nur Ridha**

repository.lppm.unila.ac.id

---

**Nur Ridha**

repository.lppm.unila.ac.id

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume 10**

www.eduhk.hk

---

**Nur Ridha**

repository.lppm.unila.ac.id

---

**critical thinking skills of fifth-grade elementary school students in**

iopscience.iop.org

---

**critical thinking skills of fifth-grade elementary school students in**

iopscience.iop.org

---

**critical thinking skills**

journal.unj.ac.id

---

**Implementation of science technology engineering and mathematics**

journal.gmpionline.com

---

**Copyright (C) 2021 EdUHK APFSLT.Volume**

www.eduhk.hk

---

**Volume**

Western Governors University on 2006-04-27

---

**Volume**

Western Governors University on 2006-05-26

---

**Itcan be**

ejournal.undiksha.ac.id

---

**that the students have**

files.eric.ed.gov

---

**Volume**

Bath Spa University College on 2012-12-07

---

**on the critical thinking skills of fifth-gradeelementary school students**

ijrrjournal.com

---

**critical thinking skills of fifth-grade elementary school students**

ijrrjournal.com

---

**Implementation of science technology engineering and mathematics**

Pabutoy Flores, Peluchi. "Seventh Graders' Construction of Novel Insights in Interdisciplinary Learning", Mer...

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Brighton on 2012-12-13

---

**test in the form of**

eprints.hamzanwadi.ac.id

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Brighton on 2012-12-13

---

**approach in learning to critical thinking skills of**

files.eric.ed.gov

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Sydney on 2021-11-26

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Sydney on 2021-11-26

---

**Examples of students' answers**

University of Maine on 2021-05-03

---

**Implementation of science technology engineering and mathematics**

Yildiz, Sevda Goktepe. "Tasarim Temelli Matematik Uygulamalarinin Farkli ogrenme Yaklasimlarina Sahip og...

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Sydney on 2021-11-26

---

**approach in learning to critical thinking skills of**

www.eu-jer.com

---

**the critical thinking skills of**

eprints.hamzanwadi.ac.id

---

**et al., 2017**

ejournal.radenintan.ac.id

---

**STEM approach can**

journal.uny.ac.id

---

## Asia-Pacific Forum on Science Learning and Teaching, Volume

University of Sydney on 2021-11-26

---

### focus, reason, inference, situation, clarity, and overview. The

N Indrawatiningsih, Purwanto, A R As'ari, Dwiyan, Sudirman, R Rahardi. "The ability of high school student...

---

### to overcome the low critical thinking skills of fifth-grade elementary school

Soongsil University on 2022-01-26

---

### Implementation of science technology engineering and mathematics

www.journal.staihubbulwathan.id

---

### Normality test is

Ade Putri, Kartini Kartini, Putri Yuanita. "The Effectiveness of Learning Tools Based on Discovery Learning T...

---

### pre-test and post-test

University of St Andrews on 2022-08-12

---

### thinking skills are

journal.walisongo.ac.id

---

### of students

journal.uinsgd.ac.id

---

### Implementation of science technology engineering and mathematics

www.journal.staihubbulwathan.id

---

### students' critical thinking skills in the experimental

eprints.hamzanwadi.ac.id

---

### of critical thinking

N Indrawatiningsih, Purwanto, A R As'ari, Dwiyan, Sudirman, R Rahardi. "The ability of high school student..."

---

### non-experimental class; and

Western Governors University on 2015-04-14

---

**Implementation of science technology engineering and mathematics**

journal.staihubbulwathan.id

---

**Implementation of science technology engineering and mathematics**

journal.staihubbulwathan.id

---

**students' critical thinking skills through**

journal.staihubbulwathan.id

---

**implementation of the STEM approach to the critical thinking skills of**

S. Muslim, A. Fathoni, N. Kusumawati, E. Rahmadyanti. "Critical study of stem-based learning in order to dev..."

---

**pre test and post test**

U Farihah, S N Fadilah. "The effect of Islamic interactive media by using adobe flash CS6 on students' learni..."

---

**need to be**

Toto. "STEM-based Science Learning Design in the 2013 Curriculum", Journal of Physics: Conference Series,...

---

**Asia-Pacific Forum on Science Learning and Teaching, Volume**

University of Sydney on 2021-11-26

---

**four aspects of STEM**

ppjp.ulm.ac.id

---

**Elementary School Teacher Education, Faculty of Teacher Training and Education, ...**

ijmmu.com

---

**Corresponding Author**

Muncarno Muncarno, Nelly Astuti, Nelly Astuti. "PENGARUH MODEL PEMBELAJARAN BLENDED LEARNING ..."

---

**Then the normality test**

N Hermita, R Dewi, M Alpusari, E Noviana, O Kurniaman, Z Antosa, I K Sari, E A Mulyani, E Elvina, E D Putra. "I..."

---

**of critical thinking skills, the**

Universidad Internacional de la Rioja on 2022-01-26

---



**students have**

Y R Sari, Dafik, Suparti. "The analysis of implementation of multy source based learning media to improve t...

---

**x)Fs(x)-Ft(x) Fs(x)-Ft(x) 1**

pt.scribd.com

---

**Implementation of science technology engineering and mathematics approach**

media.neliti.com

---

**The results of the normality test**

www.e-iji.net

---

**O1 = Pre-test**

General Sir John Kotelawala Defence University on 2019-09-16

---

**This study uses a quasi-experimental design with**

dergipark.org.tr

---

**7E LC and STEM-Based 7E LC models**

eprints.utm.my

---

**Implementation of science technology engineering and mathematics approach**

media.neliti.com

---

**has an important role**

www.ejmanager.com

---