International Journal of Education, Humaniora, and Social Studies
Vol. 1, No. 1, pp. 01-05, 2024
e-ISSN 3032-1271 | p-ISSN 3032-4467
https://journal.dpipublish.com/index.php/ijehss/

The Implementation of STEM Learning to Improve Critical Thinking Skills and Students Learning Outcome on Force and Motion

***Surahman Rudin, Anang Wahid Diah & Purnama Ningsih**
Science Education/Postgraduate – Universitas Tadulako, Palu – Indonesia 94119

Received 03 December 2023 | Revised 08 January 2024 | Accepted 14 February 2024
doi: 10.63895/j30321271.2024.v1.i1.pp01-05

Abstract

This study aims to (1) improve students' critical thinking skills through the application of STEM learning to force and motion material in class IV SD Negeri 4 Parigi, (2) improve student learning outcomes through the application of STEM learning to force and motion material in class IV SD Negeri 4 Paris. The sample used in this study were all students of SD Negeri 4 Parigi, totaling 25 students consisting of 12 female students and 13 male students. The type of research used in this research is classroom action research (CAR) using the STEM approach with the 5E type cycle model. The results obtained showed that there was an increase in the critical thinking skills of SD Negeri 4 Parigi students through the application of the STEM approach, for pre-cycle completeness presentations of 16%, in cycle I the presentation of completeness was 52%, and in cycle II the presentation of completeness was 88%.

Keywords: Students' critical thinking, STEM, classroom action research.

Email corresponding author: surahmanrudin21@gmail.com
HOW TO CITE: Rudin, S., Diah, A. W., & Ningsih, P. (2024). The implementation of STEM learning to improve critical thinking skills and students learning outcome on force and motion. *International Journal of Education, Humaniora, and Social Studies, 1*(1), 01-05.

Introduction

Education is an effort made to prepare students through learning activities that aim to help students actively develop their potential, abilities, and talents. Permendikbud Number 65 of 2013 concerning process standards for primary and secondary education has stated the importance of the learning process using the principles of a scientific/scientific approach. In line with this, learning in the world of education must improve students' processes and social skills, which follow the curriculum used (Sianipar, 2018).

Factually, there are still many elementary schools that apply classical learning that focuses on rote concepts, using only textbooks without any innovation from the teacher. In addition, learning is always dominated by the teacher (teacher-centered learning). Sometimes the teaching materials used are not by the student's environment. As a result, students lack insight into the state of nature in their surroundings and are less interested in following the lessons taught by the teacher. The motivation of students to try to understand what has been taught by the teacher becomes less.

The fact that learning is still teacher-centered and the lack of innovation in the learning process is also experienced by fourth-grade students at SD Negeri 4 Parigi. The learning process carried out in the Even Semester of the 2020/2021 Academic Year has implications for low student learning outcomes. Based on data obtained from grade IV teachers with a total of 25 students, 9 students passed (36%), which means they achieved the minimum completeness criteria (KKM) of 65%, and 16 other students (64%) whose scores were below the KKM.

One of the studies conducted in class IV SD Negeri 4 Parigi showed low student learning outcomes due to a lack of curiosity about the material of style and motion. Students are less focused on thinking and busy with recording explanations of the material presented by the teacher. The students' critical thinking does not work because they only focus on recording the teacher's explanation. Aspects of critical thinking are not channeled such as deep curiosity, sharp thinking, perseverance to develop reason, and the need for reliable information (Facione, 2011).

Science, technology, engineering, and mathematics (STEM)-based learning is based on learning concepts found in students' daily lives associated with technology, engineering, and mathematics by the times. STEM-based learning helps students to collect, analyze, solve problems, and be able to understand the relationship between one problem and another (Prasadi, 2020).

The application of STEM-based learning is believed to be able to help improve students' critical thinking skills. This STEM learning approach integrates several disciplines, namely science, technology, engineering, and mathematics which are mixed into one learning component capable of producing useful mental activities to help bring out students' critical thinking skills. This is characterized by the ability to solve problems, make decisions, analyze assumptions, evaluate, and conduct investigations (Khoiriyah, et al, 2018). Critical thinking is a process of using the ability to think rationally and effectively which aims to make decisions about what to believe or do (Mahmuzah, 2015).

Some research results show that the STEM approach can make students think critically (Makhmudah, et al., 2021; Imeysa, et al., 2021). Students with good critical abilities correlate with good learning outcomes (Ramdani & Badriah. 2018; Kurnianto, et. al, 2020). Therefore,

one of the efforts that will be made to overcome the low learning outcomes of fourth-grade students at SD Negeri 4 Parigi in the material of style and motion is to improve students' critical thinking skills through the application of the STEM approach in learning so that it is expected to improve their learning outcomes.

Methods

The type of research applied in this research is classroom action research. The research was conducted through two cycles, each cycle consisting of four stages, namely planning, implementing actions, observing, and reflecting (Afandi, 2014; Juhji, 2016)

This research was conducted at SD Negeri 4 Parigi, Parigi Moutong District, Central Sulawesi Province in April-June for the 2022/2023 school year.

The subjects of this study were fourth-grade students with a total of 25 students consisting of 12 girls and 13 boys. The research material that is the subject of learning is force and motion, in cycle 1 the application of the concept of force and motion to a parachute that falls to the surface of the earth and in cycle 2 describes force and motion in a toy car mode using the concept of triangles or rectangles

The instrument in this study was the observation sheet for teacher activity consisting of 10 statement items from 7 components, namely pretest presentation, student goals and motivation, information presentation, organizing and guiding students in class, as well as evaluation and follow-up. Student activity related to student responses to the learning process facilitated by the teacher was measured using student observation sheets consisting of 10 statement items from 3 components, namely pretest, study group, and posttest (evaluation). Observation is carried out during the learning process. The formula used is (Murtikusuma, 2016):

$$NP = \frac{R}{SM} X\ 100\ \%$$

where
NP is the percent value sought, R is the raw score obtained, SM is the maximum score, 100%: Fixed number

The critical thinking ability variable used a questionnaire consisting of 20 statement items from 7 indicators namely analyzing arguments, being able to ask questions, being able to answer questions, solving problems, making conclusions, evaluating skills, and assessing the results of observations. Each student chooses one of the 4 choices consisting of strongly agree (SS), agree (S), ordinary (B), disagree (TS), and strongly disagree (STS) with scoring using a Likert scale, critical thinking ability questionnaire. given after the learning cycle is complete, the formula used is (Murtikusuma, 2016):

NP=R/SM x 100 %

Observation of students using formulas

Information: • NP: Percent value sought; R: Raw score obtained; SM: Maximum score; 100%: Fixed number

Variable student learning outcomes are measured using 5 items in the form of essays, each item is worth 20, the test instrument is given after the learning cycle is complete, then the data is analyzed to assess the completeness of the study by category if it reaches a score of 65 then complete (Irawati & Susetyo, 2017).

Results and Discussion

Implementation of Cycle I

The researcher determines the competency standards and basic competencies used for learning Style and Movement at Meeting 1. Learning tools in the form of lesson plans, and worksheets that use the STEM approach are not available in the previous learning process. Learning is carried out related to basic competence 3.3, namely connecting the types of force (muscle, gravity, friction, electricity, and magnetism) and motion and their influence on events in the surrounding environment. In cycle 1 of the learning scenario, the core activity stage is carried out with the 5E cycle type (Engagement, Exploration, Explanation, Elaboration, and Evaluation). The elements of science, technology, engineering, and mathematics (STEM) are integrated with the core activities with the student's main project, namely making a toy parachute prototype.

During the learning process in cycle 1, observations were made of the learning process carried out by the teacher and it was found that in general, the teacher's activities had an activity percentage of 60%, which means quite good (See Figure 1). This observation was carried out by filling in the critical thinking observation sheet that had been made. The observation process is carried out when students finish experimenting with the STEM approach.

Student responses in the learning process in cycle 1 are in a good category. This can be seen from the results of observations which show an average score of 72.5% (Figure 2). Student activities that were still in the sufficient category in cycle 1 were device readiness and attention to the teacher's explanation. While other activities are good, and what is very good is student discipline items.

Table 2 shows that aspects of students' critical thinking abilities in Cycle 1 showed that there were 1 student (4%) with very good criteria, there were 3 students (12%) with good criteria, there were 4 students (16%) with sufficient criteria, and still many students, namely as many as 17 students (68%) with less criteria. Overall the data on students who have good and very good critical abilities are only 4 people (16%), the rest have sufficient critical abilities and are lacking as many as 21 people (84%).

Evaluation of student learning outcomes carried out in cycle 1 showed that there were 13 students (52%) who had completed and 12 students (48%) who had not completed (see Table 3). Their classical average score is 68. There are still many students who do not complete the first cycle because the students' ability to answer the questions given does not match the indicators requested. Student understanding is still lacking because student activity in learning is still not optimal. The critical ability of students from various activities in class is also not good. Therefore, researchers will make improvements in the learning process developed through Cycle II.

Implementation of Cycle II

In the second cycle of action, the steps taken are almost the same as those in cycle I. The difference

between cycle I and cycle II is the planning and implementation. Planning for cycle II is based on the reflection results of cycle I so that the deficiencies and weaknesses in cycle I do not occur in cycle II. The scenario used is still the 5E cycle type (Engagement, Exploration, Explanation, Elaboration, and Evaluation). Elements of science, technology, engineering, and mathematics (STEM), but integrated into the toy car prototype project.

The learning process carried out by the teacher at the introductory stage further strengthens student motivation based on the cycle I process so that students have better learning enthusiasm. Students' perception is strengthened by questions related to games that they often do, namely public transportation or their daily toy cars.

At the Core Activity stage, the teacher gives examples with visual media pictures and toy cars. Students are also more grouped in heterogeneous groups to cooperate with facilitation by the teacher. LKPD which is circulated to students becomes a reference for group work with teacher guidance. At this stage, it appears that group performance has become more active as a whole. Active students both observe pictures and design schematic drawings of toy prototypes from used cardboard materials. Students discuss results and present, even come to conclusions with the guidance and direction of the teacher.

For students to be more motivated and study more actively, the teacher pays attention and rewards with praise to students or groups of students who respond according to directions or assignment questions. The role of the teacher here is further enhanced. Figure 1 shows an increase in teacher activity from Cycle I to Cycle II with an increase in activity to 85%, namely the very good category.

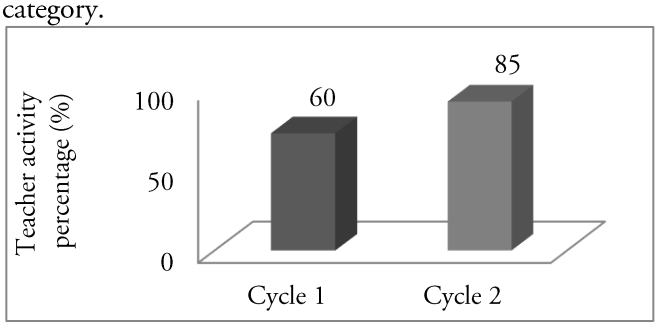

Figure 1. Percentage of teacher activity

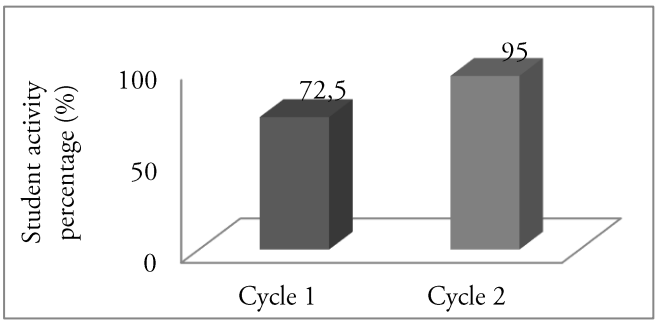

Figure 2. Percentage of student activity

Teachers have tried to facilitate students better. This was also followed by student responses to the learning process which increased. Figure 2 shows an increase in activity from Cycle I by 72.5% to 95%, and is included in the very good category (Figure 2). Directions from the teacher by collaborating between existing science, technological developments, and engineering science through designs designed by students with calculations that students do make the learning process more interesting and students become more enthusiastic. Each group makes prototypes of toy cars using materials that are easily available. After the prototype was successfully made, each group presented the features and advantages of their product.

Student activity shown during learning cycle I has increased in learning in Cycle II. In general, student participation in study groups increased in learning in Cycle II. The activity observed was that students interacted and collaborated more with other students during group discussions. Students are more courageous in expressing opinions and presenting the results of group discussions in front of the class. Students can answer questions given by the teacher orally or in writing. In general, students have been able to carry out all aspects of the STEM approach to the learning process.

Data Table 2 shows a comparison of students' critical thinking abilities in cycle II there were 9 students (36%) with very good criteria and 5 students (20%) with good criteria. Then there were 8 students (32%) with sufficient criteria, and only 3 students (12%) with less criteria. The three students who were in the less category were then given remedial for their learning completeness. Based on this data, in Cycle II there was an increase in students who had good and very good critical abilities, namely increasing to 14 people (56%), and there was a decrease in the number of students who had sufficient and less critical abilities by 11 people (44%).

Table 2. Students' critical thinking skills

Skill Level	The number of students		Percentage %	
	Cycle 1	Cycle 2	Cycle 1	Cycle 2
Very good	1	9	4	36
Good	3	5	12	20
Moderate	4	8	16	32
Low	17	3	68	12

Student learning outcomes carried out in Cycle II also experienced an increase. Table 3 shows the number of students who have completed as many as 22 students (88%) and who have not completed as many as 3 students (12%). Learning in Cycle II showed an increase in student learning outcomes and mastery from 52% in Cycle I to 88% in Cycle II which was completed. The average value of their classical learning outcomes also increased from 68.0 to 80.8.

Table 3. Student learning outcomes cycles I and II

KKM	Cycle		%		Inf.	Average	
	I	II	I	II		I	II
>70	13	22	52	88	Complete		
<70	12	3	48	12	Not Complete	68	80.8
Total	25		100				

The application of the STEM approach in Cycle II by improving teacher activity can reduce student learning difficulties. This indicates that the application of STEM-based learning can be used as one of the innovative learning methods for being creative, acting actively, exchanging ideas, asking questions, discussing, arguing, exchanging information, and solving problems that exist between students and their discussion groups.

Learning with the STEM approach in Cycle II is more able to build critical thinking skills. This is to the previous opinion which is an integrated approach in the educational process that focuses on solving problems in real everyday life as well as in professional life (Bahrum, et al., 2018; Ngabekti, et al., 2019). The application of STEM-based learning is a suitable strategy for students if the teacher wants them to have 21st-century skills. According to the needs of 21st-century skills, namely critical thinking and problem-solving; creativity and innovation; communications; and collaboration (Izati, et al., 2018; Kembara, et al, 2018). The use of STEM-based learning in this study was able to encourage students to think critically and find solutions to a problem in addition to trying to make students not only learn to memorize and imagine but can make it real with the creativity, innovation, and collaboration they do.

Student learning outcomes during the learning process both before treatment, Cycle I, and Cycle II can be seen in the comparison of the percentage scores of critical thinking skills and the number of students. Based on Figure 3, it can be seen that the number of students who experienced an increase in critical abilities with a score of 86-100 totaled 36% while in cycle I it was as much as 4% in the material for force and motion in class IV SD Negeri 4 Parigi which was completed in cycle II

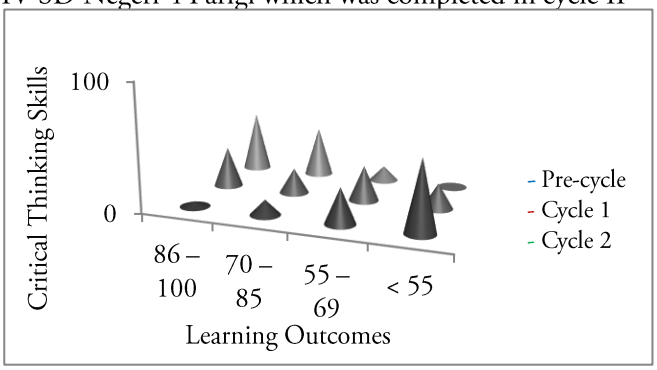

Figure 3. Value of critical thinking skills and learning outcomes of grade IV students between Pre-cycle, Cycle 1, and Cycle 2.

Based on Figure 3, it can be concluded that the action of student learning outcomes in the application of learning with the STEM approach to improve critical thinking skills and student learning outcomes on style and motion material in class IV SD Negeri 4 Parigi was completed in cycle II.

Conclusions

Based on research data regarding the application of learning with the STEM approach to improve critical thinking skills and student learning outcomes on style and motion material in class IV SD Negeri 4 Parigi, the following conclusions are obtained students' critical thinking skills through the application of the STEM approach to style and motion material in class IV SD Negeri 4 Parigi, namely being able to improve students' critical thinking skills, seen from the results of observations of initial conditions 32% to the end of 88%, namely skills in issuing ideas, skills in making media toys for cars - toy cars and parachutes, skills in designing media, and skills in presenting the results of the media that are made. Improving student learning outcomes through the application of the STEM approach to the material of style and motion in class IV SD Negeri 4 Parigi, which can encourage students to think creatively, and imaginatively, introduce new ideas, and encourage students to gain self-confidence.

Acknowledgments

The authors would like to thank and appreciate several parties who have helped in the research process, in particular the head school.

Conflicts of Interest

All authors declare that they have no conflicts of interest.

References

Afandi, M. (2014). Pentingnya penelitian tindakan kelas bagi guru dalam pembelajaran di sekolah dasar. *Jurnal Ilmiah Pendidikan Dasar*, 1(1),1-19.

Bahrum, Wahid, & Ibrahim. (2018). Integration of STEM education in Malaysia and why to STEAM. *International Journal of Academic Research in Business and Social Sciences*, *7*(6), 645–654.

Facione, P. A. (2011). *Measured reasons and critical thinking. Lillbrae*, CA The California Academic Press.

Imeysa, Y., Farida., Suherman., & Agnesa, T. (2021). Pendekatan science, technology, engineering, and mathematics (STEM): Dampaknya terhadap kemampuan pemahaman konsep matematis dan literasi al-qur'an. *Jurnal Pendidikan matematika*, 9(4), 350-372.

Irawati, E., & Susetyo, W. (2017). Implementasi Undang-Undang Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional Di Blitar. *Jurnal Supremasi*, *7*(1), 3-3.

Izati, S. N., Wahyudi, & Sugiyarti, M. (2018). Project based learning berbasis literasi untuk meningkatkan hasil belajar tematik. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(9), 1122-1127.

Juhji, J. (2016). Peningkatan keterampilan proses sains siswa melalui pendekatan inkuiri terbimbing. *Jurnal Penelitian dan Pembelajaran IPA*, *2*(1), 58-70.

Kembara, Rozak, & Hadian. (2018). Research-based lectures to improve students' 4C (communication, collaboration, critical thinking, and creativity) Skills. *Proceedings of the Second Conference on*

Language, Literature, Education, and Culture (ICOLLITE), *1*(1).

Khoiriyah, N., Abdurrahman, A., &Wahyudi, I. (2018). Implementasi pendekatan pembelajaran STEM untuk meningkatkan kemampuan berpikirkritis siswa SMA pada materi gelombang bunyi. *Jurnal Riset dan Kajian Pendidikan Fisika, 5*(2), 53-62.

Kurnianto, B., Wiyanto, and Haryani, S., 2020, Critical thinking skills and learning outcomes by improving motivation in the model of flipped classroom, *Journal of Primary Education*, *9*(3), 282-291.

Mahmuzah, R. (2015). Peningkatan kemampuan berpikir kritis matematis siswa SMP melalui pendekatan problem posing. *Jurnal Peluang*, 4(1).

Makhmudah, S., H. Suyitno., & A. Rusilowati. (2021). Mathematics critical thinking ability reviewing from gender and independent learning students in stem problem-based learning assisted by web e-learning school. *UJMER*, *10*(2), 211-219.

Ngabekti, Prasetyo, Hardianti, & Teampanpong. (2019). The development of STEM mobile learning package ekosistem. *Jurnal Pendidikan IPA Indonesia,* 8(1), 81–88

Murtikusuma, R. P. (2016). Pengembangan Lembar KerjaSiswa Matematika Model Problem-Based Learning untuk SMK Perkebunan Bertemakan Kopi dan Kakao.

Prasadi, A. H. (2020). *Pengembangan lembar kerja peserta didik berbasis stem (science, technology, engineering, mathematics) dan kearifan lokal untuk meningkatkan kemampuan berpikirkritis peserta didik kelas IV SD* (Doctoral dissertation, Universitas Negeri Semarang).

Ramdani, D & L. Badriah. (2018). Korelasi antara kemampuan berpikir kritis dengan hasil belajar siswa melalui model pembelajaran inkuiri terbimbing berbasis blended learning pada materi sistem respirasi manusia. *Jurnal Bio Education*, 3(2), 37-44.

Sianipar, V. M. B. (2018). Pembelajaran literasi informasi terhadap menulis karangan argumentasi. Lembaga penelitian dan pengabdian kepada masyarakat Universitas Muslim Nusantara Al Washliyah Medan, *9*(10), 128.

International Journal of Education, Humaniora, and Social Studies, March 2024 Volume 1 Number 1, pp 01-05