

Application of STEM-based FUNMATHTOLL Media to Critical Thinking & Collaboration

Andini Wulan Safianti¹, Wahyuni Suryaningtyas², Shoffan Shoffa³

^{1,2,3} Mathematics Education, Universitas Muhammadiyah Surabaya, Indonesia

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ABSTRACT

This research used descriptive research with a quantitative approach. This research applied mathematics learning using FUNMATHTOLL (Fun Mathematics Story Test Drill) based on STEM (Science, Technology, Engineering, and Mathematics) in VII E grade of SMP PGRI 1 Surabaya. The research instruments used test questions on students' critical thinking skills, observation sheets on students' collaboration skills, observation sheets on teachers' skills in managing learning, and student response questionnaires. The research results showed that the application of STEM-based FUNMATHTOLL media improves collaboration skills and critical thinking skills of students in VII E grade of SMP PGRI 1 Surabaya. This is because the results of the critical thinking ability test produce an average N-Gain from the pretest and posttest scores of 0.5 so it can be categorized as moderate. The average percentage results obtained from all students' collaboration skills activities showed an increase of 12%. Apart from that, there are two aspects that meet the criteria, namely the teacher's skill to manage learning, obtaining an average percentage of 94.7%. The results of the student response questionnaire obtained an average percentage of 90.9% for agree and strongly agree answers.

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Corresponding Author:

Andini Wulan Safianti

Mathematics Education, Universitas Muhammadiyah Surabaya, Indonesia

*Email Correspondence: andinisafianti@gmail.com

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1. Introduction

Individuals in the 21st century are expected to live with skills that can be used to create different opportunities as a provision to face challenges or difficulties in the era of information and technological advancement. Individuals who are not prepared are likely to fall during tremendous progress and changes in technology and science that have become a characteristic or sign of globalization itself

Septikasari, (2018) Future generations who have skills in learning need to be prepared to adapt to the demands of the times. The form of skills includes skills in problem-solving, critical thinking, collaboration, and communication. There are characteristics of 21st century learning that are better known by the 4Cs of learning, namely: in the form of Communication, Critical thinking and Problem Solving, Collaboration, and Creativity and innovation Rini, Astriani said in (Agustanti et al., 2021) that the skills that must be possessed for future generations are critical thinking skills with the aim of solving a problem. This can better prepare future generations to face global challenges.

Critical thinking is a skill that everyone has and can be trained, measured, and even developed D. Kurniawati & Ekayanti, (2020) In addition, by learning critical thinking, students can develop other skills, such as deeper analytical skills, increased concentration levels, and better thought processing (Yokhebed, 2019). However, Hadi in (D. Kurniawati & Ekayanti, 2020) said that the results of the Trends in International Mathematics and Science Study (TIMSS) in 2015 stated that the critical thinking skills of students in Indonesia are still lacking. This statement is supported by the results of the Program for International Student Assessment (PISA) which Saputra said in (Girsang et al., 2022) that in the field of mathematics, Indonesia occupies the 72nd position out of a total of 78 candidate countries. Meanwhile, the Type of Program for International Student Assessment (PISA) has criteria for high-level thinking skills. Masullah & Jailani, (2023) said that during the learning process, critical thinking must be applied to encourage students to reach a higher level of thinking. In addition to cognitive skills, there are affective skills that are important for students to have, one of which is collaboration. Agreeing with this opinion, Ananta et al., (2023) stated that not only critical thinking skills but collaboration skills can also have an influence on the results of mathematics education. This results in students needing critical thinking skills and collaboration to face the times.

Collaboration is a skill that includes the ability to work and respect other students Yokhebed, Dooley and Sexton-Finck in (Ulhusna et al., 2020) said that collaboration in research has an influential impact on students' learning and understanding of information. Learning whose goal of collaboration has advantages is to get used to effective task division, increase accountability, unite information from several sources, viewpoints, insights, and strive to improve character and innovation. Mawaddah et al., (2022) said that learning that can foster skills, one of which is collaboration skills, is with the Science, Tehcnology, Engineering, Mathematic (STEM) approach. Agreeing with this idea, Artobatama et al., (2020) said that STEM-based learning is one of the types of learning that has the potential to build 21st century skills.

STEM-based learning is an approach that supports the achievement of 21st century competencies Oktavia, (2018) In accordance with this, STEM is a combination of 4 aspects of learning that are interesting and pose challenges for students Mawaddah et al., (2022) In addition, Nisa et al in (Fadlina et al., 2021) said that the use of STEM approaches in learning can be evaluated to significantly improve students' critical thinking skills in the medium category of 95% and the N-Gain status of 0.63. STEM in teaching materials is also important for students to improve their skills in mathematics learning (Niam et al., 2021).

Mathematics learning helps students develop mathematical concepts according to their abilities. The purpose of learning is to foster student participation and initiative in learning. Meanwhile, mathematics is a tool for thinking, solving problems, and communicating Gusteti & Neviyarni, (2022) However, the initial suspicion of students has been that mathematics is considered a difficult subject. This opinion is an assumption that has been passed down from one generation to the next and makes harmful thoughts Aprilia & Alifatul, (2022) In addition, Mathematics related to numbers, symbols, and graphs can also cause students to dislike mathematics learning, especially in working on story problems (E. Kurniawati & Suparni, 2019)

Math story problems usually use everyday life situations and use language that can be understood clearly. Story questions are not as easy as when students are doing number-based problems, because most of the story questions are non-routine questions. When working on problems, students are required to have numeracy skills and pay attention to the process of solving them as well. In addition, teachers should facilitate and plan learning activities using story exercises so that students can be trained to represent and combine solutions with other mathematical representations Utami et al., in (Yuniati & Suparjono, 2019) said that in working on story problems, what needs to be considered is the process and stages of solving story problems, not just the results of the answers, so that the students' thinking process can be seen. As a teacher, it would be good to develop mathematics learning that contains elements of fun, working or studying in groups. (Aprilia & Alifatul, 2022)

Advances in information and communication technology make teachers must provide learning in accordance with these advances. Learning media has benefits, one of which is to make learning fun and lessons easy to understand (Nurrita, 2018). In accordance with the statement from Nugroho in (Sitorus & Santoso, 2022) that fun and creative learning that can support student achievement can be created by using technology in the form of gamification in the learning process.

Learning media is a medium that directly connects students with the designer of the learning package. In learning, the media plays a big role in influencing students' interests and learning outcomes. On the other hand, the media also strongly supports teachers in delivering learning materials, improving students' understanding, and motivating them to learn. The use of media in mathematics learning can be said to be one way to visualize the abstraction of mathematics material so that it can be easily understood by students and can improve students' memory from the material that has been delivered Srintin et al., (2019) Fun learning media can be one of the influences on students' success and have a positive influence on students in the learning process Purwati & Antari, (2022) However, the success of students can also be done by applying the drill method. This is in accordance with research conducted by Kolipah, (2022) which shows that student learning outcomes increased at 57.1% from cycle I and 85.7% from cycle II.

The drill method is a real exercise that is carried out repeatedly and continuously to easily acquire skills and agility regarding learning materials. The implementation is first given theoretical material. Furthermore, still guided by teachers, students are asked to work directly until they become skilled and capable Fanani, The drill method in its application to mathematics learning is considered quite good (Sutarni, 2020).

In the research that referred to Meityastuti & Wijaya, (2022) the development of a student 's Worksheet for a STEM-based problem-based learning model using the Desmos application to improve critical thinking skills. The lesson applied in this study is mathematics. Furthermore, the research conducted Rohman, (2022) with the development of web-based mathematics learning media with a STEM approach to improve students' critical thinking skills. The lesson applied in this study is mathematics. Meanwhile, (Ilma, 2023) researches the improvement of collaboration skills with a differentiated approach assisted by mathematics e-modules. In this study, electronic modules are used as a medium to find out collaboration skills. In addition, the subject used is mathematics. Based on some of the above studies, researchers want to apply STEM-based media that are applied to story practice in mathematics learning, especially to see the influence of students' critical thinking skills and collaboration skills. The STEM-based media is FUNMATHTOLL (Fun Mathematics Story Test Drill).

The results of observations carried out at SMP PGRI 1 Surabaya and interviews with class mathematics teachers, there is a class that can still be said to lack critical thinking and collaboration. In grade VII, learning using online learning media has also never been carried out. So based on these considerations, researchers will conduct research in the class. The class in question is class VII E.

2. Method

The type of research applied is descriptive research with a quantitative approach. The researcher plans to apply STEM-based FUNMATHTOLL media in grade VII E at SMP PGRI 1 Surabaya in mathematics learning. Furthermore, describe the results of the critical thinking ability test, the results of observation of collaboration skills and teacher abilities, and the results of student response questionnaires.

Research design refers to a research strategy on how data will be collected, analyzed, and managed in a systematic and directed manner. This study will use the Quasi-Experimental one group pretest-posttest design. This design will be done by giving treatment to a group, and then observing the results about collaboration skills. After that, critical thinking skills are seen through tests. The treatment in question is to apply STEM-based FUNMATHTOLL media to mathematics learning.

The stages that need to be carried out in this study to obtain data that can be accounted for. This study has 4 main activity procedures including, planning, acting, observing, and reflecting. Data analysis techniques are a way to analyze the data obtained in research. Data analysis with description analysis will be carried out after the necessary data is collected, this is done to get a conclusion from the research. In the data analysis technique, what is analyzed is test result data (pretest and posttest), student collaboration observation results, observation results of teachers' ability to manage learning, and student questionnaire results.

3. Results and Discussion

Students' critical thinking skills are measured using test questions. The results of the critical thinking ability test that have been calculated using the t test and the Wilcoxon test. The results obtained show that there is a difference in the data of pretest and posttest results. The results obtained are calculated with N-Gain scores

to see how much the average increase in pretest and posttest scores is. The results obtained showed that there were 12 students who met the high criteria, 17 students with medium criteria, and 3 students with low criteria. Based on the data, it was concluded that the average increase in students' pretest and posttest scores of 0.5 was included in the medium criteria.

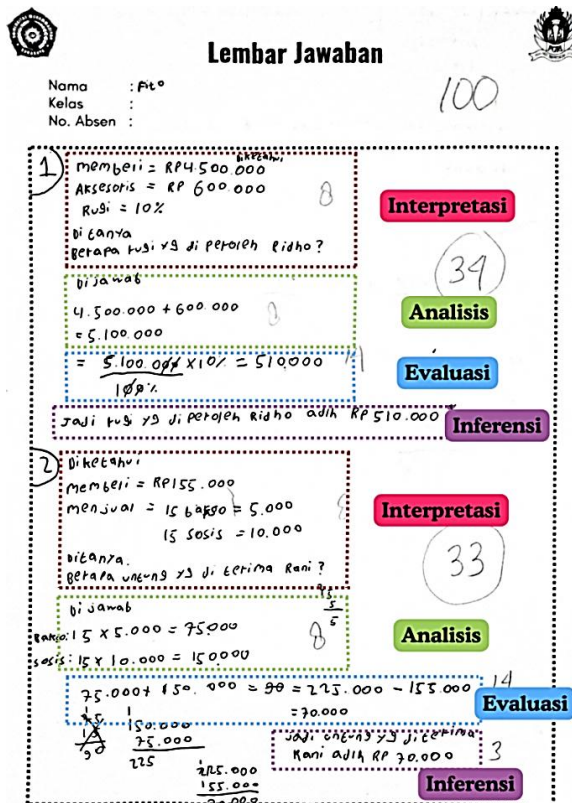


Figure 1 Results of Student Work (High Score)

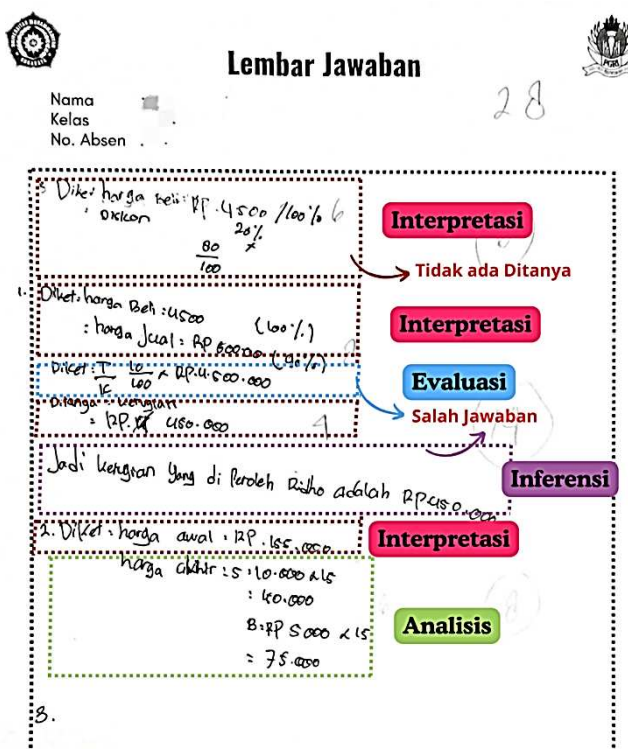


Figure 2 Results of Students' Work (Low Score)

The observed collaboration skills included (1) actively contributing to the group, (2) working productively, (3) showing strong compromise and flexibility in the group, (4) having an attitude of responsibility, and (5) having an attitude of respect for other members of the group. The results of the analysis of students' collaboration skills in learning the first meeting of the most frequent indicators are the attitude of respect for group members and the attitude of responsibility of students. Meanwhile, the second meeting learning indicator of collaboration ability that students most often do at this meeting is a responsible attitude and an attitude of working productively. The average results obtained from all activities of students' collaboration ability in the first meeting were 81% while in the second meeting of 93% there was an increase in ability by 12%. The collaboration ability at both meetings met the criteria very well.



Figure 3 Mutual Respect



Figure 4 Responsible Attitude

The teacher's ability to manage learning in the first and second meetings is presented after summing up all meetings. Furthermore, the percentage of each learning stage will be calculated. The data analysis obtained the average percentage of teachers' ability to manage learning by applying STEM-based

FUNMATHTOOL media was 94.7%. According to the criteria for the results of the teacher's ability to manage learning is categorized as very good.

Responses are responses given by students after implementing learning by applying STEM-based FUNMATHTOOL media. The student response questionnaire was prepared using the answer criteria (SS) Strongly Agree, (S) Agree, (TS) Disagree, and (STS) Strongly Disagree. The highest percentage of scores obtained was 96.9% very positive while the lowest percentage of scores was 71.9% positive. Therefore, the students' responses received an average of 90.9% for yes and strongly agree answers in the very positive category. This makes the students' response to the application of STEM-based FUNMATHTOOL media in learning said to be very positive.

4. Conclusions

The conclusion of the text is that the application of STEM-based FUNMATHTOOL media in grade VII E SMP PGRI 1 Surabaya has succeeded in improving students' critical thinking skills and collaboration in solving math story problems. This success is supported by the ability of teachers to manage learning well, increased student collaboration activities, adequate critical thinking test results, and positive responses from students to the learning carried out.

The suggestion given by the researcher is that teachers should not only focus on one example in teaching but provide repeated exercises in groups to get students used to facing various problems. In addition, teachers can apply the results of this research in mathematics learning, especially in Social Arithmetic material, to improve students' critical thinking skills and collaboration. Schools are expected to support teachers in using the facilities available for learning. In addition, STEM-based learning should be applied more broadly to various subjects, not just mathematics. Other researchers are advised to use the results of this study as a reference to develop STEM-based FUNMATHTOOL media on other materials or subjects, to create more interesting learning innovations.

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