Improving Science Learning Outcomes in Water Clearance Material with Science, Technology, Engineering, and Mathematics (Stem) Approaches

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Abstract: This study aims to improve the Learning Outcomes of Science, Technology, Engineering, and Mathematics (STEM) Water Purification Materials for Class IX Junior High School Students. This research is a Classroom Action Research (CAR). The Research Procedure includes two cycles. The instruments used for the assessment of learning outcomes are teacher and student observation sheets. From the analysis of the assessment of student learning outcomes, there is an increase in learning outcomes after using the Science, Technology, Engineering, and Mathematics (STEM) approach to Water Purification material, namely from 21 students there are 4 (19.05%) students have high learning outcomes in the cycle category. 1 while in cycle 2 there were 18 (85.71%) students. From the analysis of teacher observations in cycle 1 of the medium category and cycle 2 of the high category. Meanwhile, from the analysis of student activities in cycle 1 for aspects of interest, attention, participation, and presentation in the moderate category and cycle 2 in all these aspects in the high category Based on the research, it can concluded that there is an increase in science learning outcomes in water purification material with the Science, Technology, Engineering and Mathematical, (STEM) approach in class IX students of SMP.

Keywords: IPA, Science Technology Engineering and Mathematics (STEM), Learning Outcomes

INTRODUCTION

As an educator, the teacher has duties, among others, as a source of information, as an assessor of student learning outcomes, and as a mentor, coach, and director in the learning process. which can be stored for a long time Marlina *et al*., (2020) mentioned that teachers play a very important role in the teaching and learning process. In current learning activities the teacher focuses on what good teaching looks like, the teacher should also think more about how to make students better understand the material taught by the teacher so that the teaching and learning process goes well so that what is expected in learning will be achieved. Learning will run well if the teacher can understand the needs of

students in learning, for example how to make learning interesting so that students are motivated to continue to improve their competencies because learning does not only provide knowledge but also what is expected is a change in behavior, attitudes, or skills. Bechter *et al*., (2019) emphasize that the role of the teacher as a facilitator is very supportive of the delivery of learning objectives that have been determined as learning outcomes will be achieved. Setyaningsih, S., & Suchyadi (2021) mentioned that one of the forms of understanding of teachers towards students, namely through the provision of learning process facilities.

Learning Natural Sciences (IPA) improve human resources to think scientifically and be able to solve problems with natural scientific concepts Panggabean *et al*., (2021). Learning Natural Sciences (IPA) has goals, among others, being able to be scientific, using scientific methods, and understanding science concepts so that they can solve problems faced Another opinion says that Learning Natural Sciences (IPA) relates to natural phenomena (Ismiyanti, 2020). One of the objectives of learning Natural Sciences (IPA) makes students capable develop skills and be able to solve problems, be creative, innovative, and able to think critically For these goals to be achieved, an innovative, creative teacher is needed to design appropriate strategies, including the expected learning now is contextual learning and the right method where the involvement or activeness of students in the learning process is prioritized while the teacher is only a facilitator who can direct students. Harris and Budiarti (2021) mentioning teachers as education personnel in any condition must be able to carry out their role properly. In this regard, the role of teachers in science learning (IPA) supports the process of teaching and learning activities that make students creative and active (Sulthon, 2017).

The teacher plays a role in determining the final grades of students (Nurhayati 2020). Based on this, one of the problems that students often face at school is science learning outcomes that have not reached the KKM (Minimum Completeness Criteria). This is partly because students still think that science subjects are difficult and unattractive. to the lack of teacher ability in designing interesting, challenging, and fun learning methods or strategies for students, learning that is only teacher-centered without involving student activity causes boring learning and this has an impact on low student learning outcomes Hatuti (2019) states that one of the efforts of teachers to improve student learning outcomes, namely by using varied methods.

In this regard, Learning Natural Sciences (IPA) in junior high schools (SMP) needs the role of teachers in using various methods to be able to achieve learning outcomes that involve students (Maison et al., 2020). One of the schools that requires the role of teachers in choosing the right method, namely Currently, the learning process at SMPN 1 Astambul is still using traditional learning methods or approaches. Where teachers in the learning process still use the lecture method, learning that is only teacher-centered

causes the teaching and learning process to be less attractive to students and this will affect student learning outcomes which are still low. Seeing this condition, I was a teacher at SMPN 1 Astambul to try to improve student learning outcomes in various ways, including using an interesting learning approach, in which students are expected to be active in learning activities. One approach that can stimulate student activity is the Science, Technology, Engineering, and Mathematics (STEM) approach. Engineering and Mathematics (STEM), the author hopes that student learning outcomes in science subjects at SMPN 1 Astambul will increase.

Technology, Engineering, and Mathematics (STEM) by combining different fields of science into one subject (Nasrah *et al*., 2021). This method can improve the results of students' final grades at l (Darsani, 2019). Prismasari *et al*., (2019) have proven improved student learning outcomes at the junior high level (SMP) subject Science, Technology, Engineering, and Mathematics (STEM) is a learning approach that integrates natural knowledge, technology, engineering, and mathematics in one student learning experience. Yusuf and Asrifan (2020) explain The Science, Technology, Engineering, and Mathematics (STEM) approach does not mean only the practical strengthening of education in the fields of Science, Technology, Engineering, and Mathematics (STEM) separately, but rather develops an educational approach that integrates science, technology, engineering, and mathematics, with focuses the educational process on solving real problems in everyday life and professional life. The Science, Technology, Engineering, and Mathematics (STEM) approach provides opportunities for teachers to show students how concepts, principles, and techniques from science, technology, engineering, and mathematics are used in an integrated manner in the development of products, processes, and systems used in their daily life. STEM is widely used by the state as a form of learning innovation in supporting the 21st era. (Herak, 2021)

This STEM will affect students' understanding of the lesson more critically and is fun, integrated, and easy (Singgih *et al*., 2018). Student understanding will have an impact on learning outcomes (Rahmadani *et al*., 2022). Important students are involved in the learning process not only as the object of the recipient so that they will be able to build a better level of self-confidence and knowledge (Safnowandi 2020). Through methods that engage students by connecting subject matter based on daily life and science, Engineering, and others, it will be expected that students have increased knowledge and motivation (Kritis and Redhana, 2013)

Based on the above problems, it is necessary to research efforts to improve student learning outcomes in science subjects on Water Purification material with a Science, Technology, Engineering, and Mathematics (STEM) Astri *et al*., (2022) approach. Therefore, the authors conducted a study that aims to improve the Learning Outcomes of Science, Technology, Engineering,

and Mathematics (STEM) Water Purification Materials for Class IX Junior High School Students.

METHOD

This research is a quantitative descriptive study. Quantitative description is research that describes a phenomenon that occurs in the object of study. Khaerunnisah, *et.al.* (2022) This research is a research and development used in developing science-based teaching materials STEM Nisa and Nugroho (2021) This research was conducted SMP, starting from January to April 2021. The research includes class Action research divided into two cycles. With descriptive quantitative research methods. The cycles used are planning, implementing, observing, and reflecting the implementation stage of the research includes treatment by applying the Science, Technology, Engineering, and Mathematics (STEM) approach. Singgih *et al*., (2018) Where the results after the treatment studied are the results of learning water purification material. Data collection in this study used a mastery test of water purification material.

This study used analysis in the form of learning outcomes, and observational analysis Suardi (2020) (student and teacher activities), this is useful for determining how much the application of the Science, Technology, Engineering, and Mathematics (STEM) approach can improve learning outcomes in Water Purification material. (Nuraini, 2020)

The categories of the division of student learning outcomes can be described in the following Table 1

Table 1. Student Learning Outcomes Category

Category	Average Score Range (%)
High	66,68 – 100
Medium	33,34 – 66,67
Low	0 – 33,33

The criteria for the success of student learning outcomes is an increase in scores on student learning outcomes so that there are no students who have low learning outcomes and there are students who are in the high learning outcomes category with a minimum success indicator of 80% of the total research subjects. (Suriti, 2021)

The division of categories in the assessment of the results of observations of teacher (researcher) activities can be seen in the following table:

Table 2. Category assessment of teacher activities and student activities

Category	Average Score Range (%)
High	76 – 100
Medium	51 – 75
Low	25 – 50

RESULTS AND DISCUSSION

The results of the analysis of student learning outcomes on water purification material with the Science, Technology, Engineering, and Mathematics (STEM) approach in cycle 1, and cycle 2 can be seen in the following table

Based on table 3, in cycle 1 there were only 4 (19.05%) students who were in the high category, while in cycle 2 there were no students whose learning outcomes were in the low category. While students are in the medium category there are only 3 (14.28%) students. In this cycle, there were many students whose learning outcomes were in the high category, as many as 18 (85.71%) students.

Based on the observations from the observer on the activities of teachers and students during the implementation of CAR in cycle 1, and cycle 1, cycle 2, it can be seen in table 4 and table 5 below :

Table 3 Comparison of Student Learning Outcomes Analysis in Cycles 1 and 2

Cycles					
Category Cycles 1			Category Cycles 2		
Low	Medium	High	Low	Medium	High
6	11	4	-	3	18

Based on Table 3, in cycle 1 there were only 4 (19.05%) students who were in the high category, while in cycle 2 there were no students whose learning outcomes were in the low category. While students are in the medium category there are only 3 (14.28%) students. In this cycle, there were many students whose learning outcomes were in the high category, as many as 18 (85.71%) students.

Based on the observations from the observer on the activities of teachers and students during the implementation of CAR in cycle 1 and cycle 2, it can be seen in table 4 and table 5 below:

Table 4. Teacher Activities Using Science, Technology, Engineering, and Mathematics (STEM) Approaches on Water Purification Materials in Cycles 1 and 2

	Cycles	
	1	2
Total Score on Cycle	47	55
Average (%)	73,44	85,94
Category	Medium	High

Table 5. Student Activities Using Science, Technology, Engineering, and Mathematics (STEM) Approaches to Water Purification Material in Cycles 1 and 2

	Cycles							
	Interest	Attention	Participation	Presentation	interes	Attention	participation	Presentation
Score	50	51	49	52	66	71	70	74
Average	59,52	60,71	58,33	61,9	78	84,52	83,33	88,1
Category	Medium	Medium	Medium	Medium	High	High	High	High

Based on the table above, it can be seen in the first cycle of water purification learning activities with the Science, Technology, Engineering, and Mathematics (STEM) approach has been done quite well, but still needs improvement, where the assessment score obtained by the teacher from observer observations is still in the medium category. , which is 47 (73.44%) in cycle 2 it has been done better than in cycle I, where the assessment score obtained by the teacher from observer observations is in the high category, which is 55 (85.94%).

Based on the observer's observations of student activities using the Science, Technology, Engineering, and Mathematics (STEM) approach to water purification material, it is known that the average student in all aspects observed is in the medium category. It can be seen in the interesting aspect that it scores 50 (59.52%), in the attention aspect it reaches a score of 51 (60.71%), in the participation aspect it reaches a score of 49 (58.33 %), and in the presentation aspect. achieved a score of 52 (61.9%). While in cycle 2 the average student experienced an increase from the previous cycle in each aspect of observation. Where the average student in all aspects of observation is in the high category, namely in the attention aspect it reaches a score of 71 (84.52%), then the participation aspect reaches a score of 70 (83.33%), and in the presentation aspect, it reaches a score of 74 (88.3%). The aspect of interest reached a score of 66 (78.57%).

Some other similar studies, among them Widowati *et al*., (2021) with the research title Problem-Based Learning with Science, Technology, Engineering, and Mathematics (STEM) Approach to Improve Critical Thinking Skills and Conceptual Understanding of Junior High School Students indicate improvement in the critical thinking skills of high category students (N-Gain value is70.78%). The application of PBL STEM can increase concept acquisition with an N-Gain value of 69.56%. Conclusions of the learning-based STEM approach are feasible to apply to junior high school students of class VIII schools. In addition, student responses show positive results can be seen from the increased interest, activeness, and motivation, in learning the STEM field.

Based on the results of the analysis above, it can be concluded that the activities of teachers and students have increased in a better direction, where the categories achieved by both teachers and students in their activities are in the high

category. The improvement in student learning outcomes can be seen from the results of the analysis of the assessment of student learning outcomes during the implementation of CAR, as shown in the following diagram:

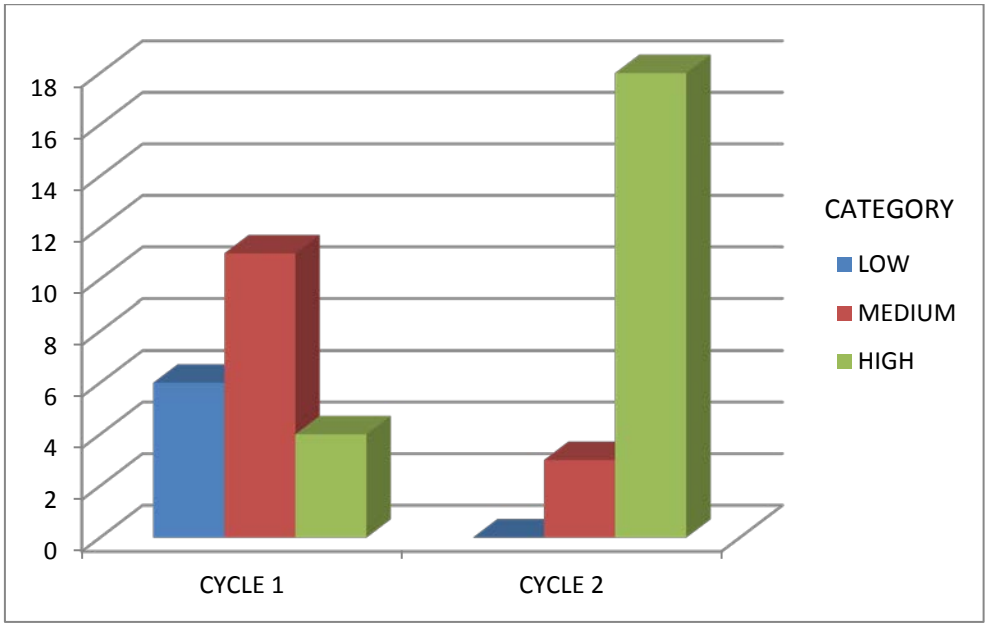

Figure 1. Diagram of the Results of the Analysis of Student Learning Outcomes

The results of the analysis of the assessment of student learning outcomes, it shows that there is an increase in student learning outcomes after using the Science, Technology, Engineering, and Mathematics (STEM) approach to water purification material, namely from the 21 students who were given the initial action there were 6 students who had low learning outcomes in the category of the cycle I, then reduced to no more students with low learning outcomes in cycle 2. In cycle I there was 4 students with high learning outcomes, then in cycle 2 increased to 18 students with high learning outcomes. So that this research is considered successful because the expected increase in learning outcomes has reached a minimum success indicator of 80% of the number of research subjects.

In line with the increase in student learning outcomes, teacher and student activities on water purification by applying the Science, Technology, Engineering, and Mathematics (STEM) approach have also increased. This can be seen from the results of the analysis in the following diagrams .2 and 3rd diagrams:

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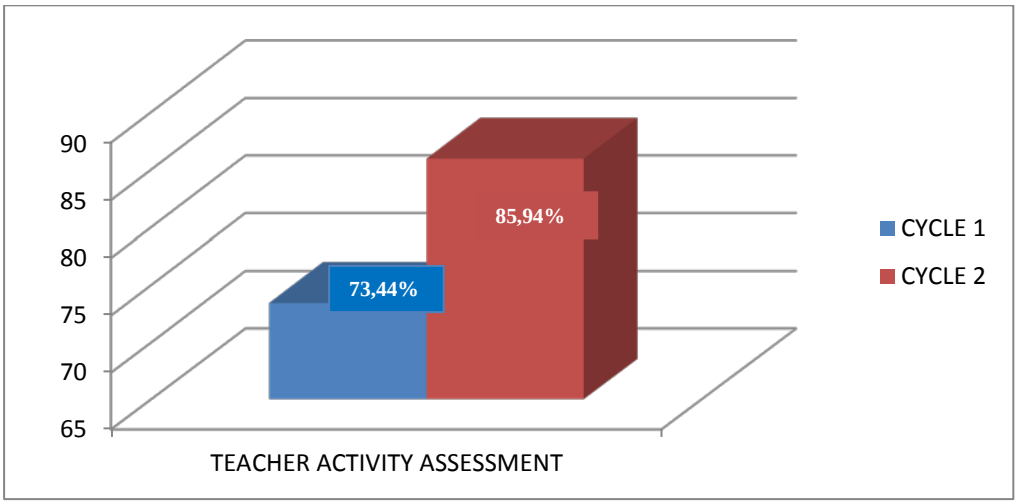

Figure 2. Teacher Activity Analysis Results Diagram

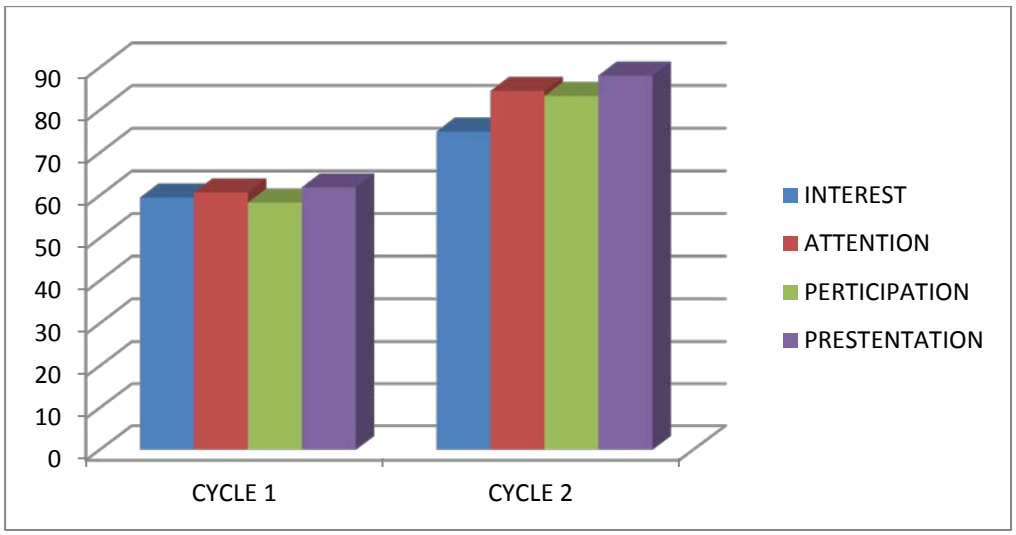

Figure 3. Student Activity Analysis Results in Diagram

Based on the diagram in Figure 2 above, it can be seen that there was an increase in the results of observing teacher activities using the Science, Technology, Engineering, and Mathematics (STEM) approach to water purification material d which was originally 73.44% with a moderate category in cycle I, then increased to 85,94% with high category in cycle 2. The increase in teacher activity in learning has increased from cycle 1 to cycle 2 dues to an increase in teacher knowledge and understanding of the application of STEM approaches so that students are more interested and motivated to further explore the material presented by the teacher.

Furthermore, from the diagram in Figure 3. above, it can be seen that student activities using Science, Technology, Engineering, and Mathematics (STEM) on water purification material in the first cycle in the interesting aspect reached a score of 50 (59.52%), in the attention aspect it reached a score of 51

(60.71%), in the aspect of participation it reached a score of 49 (58.33%), and in the presentation aspect, it reached a score of 52 (61.9%). Then there was an increase in cycle 2, in all aspects of observation already in the high category, namely, in the attention aspect it reached a score of 71 (84.52%), then the participation aspect reached a score of 70 (83.33%), in the presentation aspect it reached a score 74 (88.1%) and the interesting aspect reached a score of 66 (78.57%). The results of the analysis of the teacher and student activity observations above explain that both of them experienced a significant increase from cycle 1 to cycle 2.

Based on the results of the study, it can be proven that the Science, Technology, Engineering, and Mathematics (STEM) approach to water purification material is suitable for use because it can improve student learning outcomes in class IX. Because a Science, Technology, Engineering, and Mathematics (STEM) approach, can shape students into human resources who can think critically and creatively, systematically and logically so that they can meet the standards of human resources in the 21st century and can face increasingly complex global challenges.

CONCLUSION

Based on the research results, it turns out that the Science, Technology, Engineering, and Mathematics (STEM) approach can improve student learning outcomes on water purification material in class IX. Of the 21 students in cycle 1, there are 4 (19,05%) students in the category high and in cycle 2 there were 18 (85.71%) students. while based on the results of teacher and student activities there was also an increase from before treatment to after treatment using the Science, Technology, Engineering and Mathematics (STEM) approach.

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