Effectiveness of Inquiry-Based Science Programs in Improving Science Process Skills and Knowledge in SMAN 2 Raha Students Using the Environmental Exploration Method (EEM)

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Abstract. This study aims to evaluate the effectiveness of the Inquiry-Based Science Program in improving science process skills and students' knowledge at SMA Negeri 2 Raha. The research method used is quantitative with a pre-test and post-test design. The research sample consists of 10th-grade students involved in the program. Data were collected through skill and knowledge tests, as well as observations of student engagement during the teaching and learning process. The Environmental Exploration Method (EEM) helps enhance awareness, skills, and responsibility toward a better environment. The analysis results show a significant improvement in students' science process skills and knowledge after participating in the inquiry program. These findings indicate that the inquiry-based approach is effective in enhancing students' understanding of science concepts and practical skills, as well as increasing their motivation to learn science. This study recommends the broader application of the inquiry method in science classes to create more interactive and meaningful learning experiences.

Keywords: inquiry, effectiveness, science process skills.

1 Introduction

The effectiveness of learning is the process carried out by the teacher to transform students' abilities and perceptions from finding learning difficult to making it easier. Learning effectiveness is related to the level of success in the learning process. It occurs when there is an improvement in student learning outcomes. The improvement can be seen by comparing students' understanding before and after the learning process. Learning effectiveness is a measure of the success of the interactive process in an educational setting to achieve learning objectives. It can be observed through students' activities during learning, their responses, and mastery of concepts [1].

The effectiveness of learning has three criteria, namely: 1) the teacher's ability to manage the classroom well, 2) student activity during learning is good, and 3) students' learning outcomes are completed at the class level [2]. Classroom management is the

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teacher's skill in creating and maintaining an optimal learning environment and restoring it when disruptions occur in the teaching and learning process. In classroom management, the teacher must be able to maintain a comfortable environment during the teaching and learning process. Here, the teacher is not only required to keep the class orderly, but also to pay attention to students' behavior, provide rewards for timely task completion, and other similar aspects [3].

The science process skills need to be applied to students because process skills can be understood as the development of intellectual, social, and physical skills that stem from the fundamental abilities that are already inherent in students. Mariana, I.M.A., & Wijaya (2020) proposed the basic stages of science process skills, which include observing, measuring, inferring, classifying, predicting, and communicating [4]. Meanwhile, the basic skills of science process skills are observing, communicating, classifying, measuring, inferring, and predicting. These process skills are intended to develop the abilities students already possess, as well as to help them appreciate and understand the subject matter effectively.

One effort to support process skills that are student-centered (Student-Centered Learning) is the need for an appropriate teaching approach. A teaching approach is a teacher's perspective that is still theoretical but can be used to determine steps in learning activities, where this perspective will influence the teacher in choosing the learning model, teaching methods, and learning strategies [5]. The " Environmental Exploration Method" (EEM) method is one such approach that involves student activities to enhance science process skills. The EEM method is a learning method that brings students out of the classroom to observe and study natural phenomena directly. This method gives students the opportunity to actively engage in the learning process and build their own knowledge. The EEM method provides a comprehensive learning experience that captivates students through direct exploration of the natural environment. By combining exciting field activities with scientific principles, the EEM method not only helps students develop science process skills but also strengthens their connection to nature and encourages awareness of the importance of environmental preservation.

The EEM method is a learning approach that uses the student's surrounding environment as the object of learning science, which can be studied through scientific work. This approach is characterized by observation or exploration activities that make the learning atmosphere more engaging. Previous research shows that students are more active in the learning process when it involves inquiry or practical activities. The selection of the right method is expected to influence the development of students' science process skills. A good learning model has its own characteristics, as outlined by Chauchan in Jazuli Yusup et al., (2021), which include: scientific steps, learning development, learning areas, standards of learning development, and a clear learning system [6].

Based on observations and interviews with teachers and students conducted in September 2024 at SMA Negeri 2 Raha, it was found that during the learning process, the teacher has implemented some aspects of science process skills. However, the teacher has not yet developed instruments or assessments based on science process skills (KPS). The assessments used by the teacher still refer to cognitive aspects, using assessment instruments in the form of multiple-choice tests or essays only.

2 Research Method

The Environmental Exploration Method (EEM) plays an important role in environmental education and outdoor activities by providing individuals the opportunity to learn through direct experience. It helps enhance awareness, skills, and responsibility towards the environment in a better way.

Choosing only five science process skills in research or teaching methods, such as in the Environmental Exploration Method (EEM), may be based on several practical and pedagogical considerations. Here are some reasons why only five science process skills are selected: 1) Focus on Key Skills; 2) Alignment with Learning Objectives; 3) Relevance of Skills; 4) Teaching Effectiveness; 5) Time and Resource Management.

This research method uses the Classroom Action Research (CAR) method, which consists of 4 stages: planning, implementation, observation, and reflection. The instruments used are observation sheets and Student Worksheet (LKPD). The observation sheet in this study is used to observe student activities from the beginning of the lesson until it is completed. This data is useful to determine the improvement in the percentage of students' science process skills in aspects such as observing, classifying, interpreting, predicting, and communicating. The observation data is analyzed using a Likert scale. The content of the LKPD consists of essay questions that include several indicators of science process skills, including: 1) observing, 2) classifying, 3) interpreting, 4) predicting, and 5) communicating. The data analysis technique for science process skills in each cycle is calculated using the Tianto formula [7].

$$Percentage\ (\%)\frac{score\ obtained}{maximum\ score}x100 \quad (1)$$

The calculation results of the Minimal Completeness Criteria (KKM) of science process skills for each student are then categorized according to Table 1.

Table 1. the Minimal Completeness Criteria (KKM) of science process skills

Score	Criteria
81%-100%	Very Good
61%-80%	Good
41%-60%	Satisfactory
21%-40%	Poor
0%-20%	Very Poor

Furthermore, to determine the completeness clasical vs individual, it is considered achieved if 70% of all students understand the material that has been taught. The analysis is carried out using a formula.

$$Percentage\ (\%)\frac{\sum students\ completed}{\sum total\ students}x100 \quad (2)$$

3 Results and Discussion

Based on the analysis of all learning cycles to improve students' science process skills, the research was carried out in two cycles to assess the improvement in science process skills. From the two cycles that were conducted, data showed that there was an increase in students' science process skills. The success criterion in this study is that 70% of students achieve an average score of at least 70, based on the assessment of science process skills. The first and second cycles, presented in a classical manner, are shown in the following diagram:

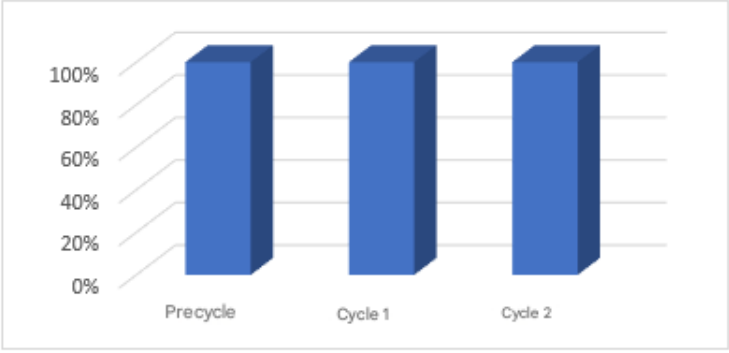

Fig. 1. Diagram of the improvement in science process skills for each cycle

The graph above shows that there was an improvement in students' science process skills in each cycle. The pre-cycle results were used to assess the initial ability of students to master science process skills in the learning process. From the analysis of the pre-cycle data, it was found that most students still had difficulty applying science process skills in learning, as shown by 79% of students struggling to apply these skills, due to their underdeveloped process skills. Therefore, in this study, the researcher used Student Worksheets (LKPD) as a guide for students, which contained questions related to the science process skills to be observed. According to Khairunnisa (2019), science process skill questions should be trained or developed in science lessons because students not only learn what already exists but also how to acquire that knowledge [8]. Additionally, these questions encourage students to be more active and creative in problem-solving and to link research patterns to solve problems. Students should not only answer questions based on their knowledge, but they should also respond to HOTS (Higher Order Thinking Skills) questions, which are integrated into the questions, so that students are expected to be able to solve problems on their own and provide solutions to everyday issues they encounter.

In the first cycle, students' science process skills reached only 58%, categorized as "adequate," meaning their science process skills in Physics had not yet met the minimum criteria of 70%, leading to the continuation of the second cycle. In the second cycle, students' science process skills improved to 82%, which is categorized as "very

good." This improvement occurred because students gained direct understanding from the scientific activities they conducted. This aligns with Santika's statement in Rosalia et al. (2021), which states that students use all five senses to solve problems and find solutions, resulting in better learning outcomes [9]. Science process skills are mastered by students when practiced repeatedly and continuously, allowing them to become accustomed to applying them [10]. The level of achievement for each indicator in each cycle can be seen in the graph below.

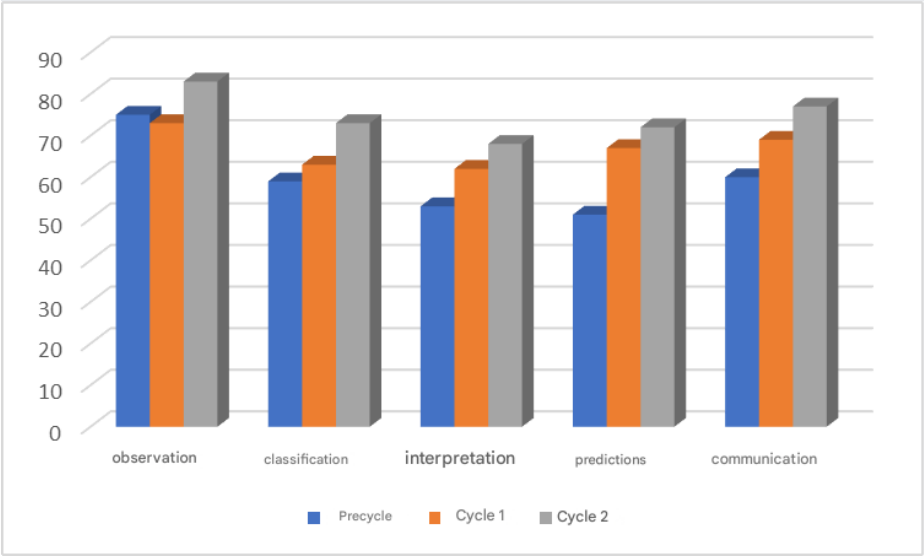

Fig. 2. Improvement in science process skills for each indicator

The Environmental Exploration Method (EEM) is an approach that involves student activities to enhance science process skills. This method is a learning approach that takes students outside the classroom to observe and study natural phenomena directly. It provides students with the opportunity to actively engage in the learning process and construct their own knowledge. The Environmental Exploration Method (EEM) offers a comprehensive learning experience that captivates students through direct exploration of the natural environment. By combining interesting field activities with scientific principles, the Environmental Exploration Method (EEM) not only helps students develop science process skills but also strengthens their connection with nature and encourages awareness of the importance of environmental conservation. The Environmental Exploration Method (EEM) is a learning method that uses the students' surrounding environment as the object of science learning, which can be studied through scientific work. This approach is characterized by observation or exploration activities that make the learning atmosphere more engaging. Previous research indicates that students are more active in the learning process when it involves inquiry or practical activities [11].

Based on the data above, it shows that the science process skills of students at SMA Negeri 2 Raha in each cycle showed improvement in all aspects of science process skills. The highest score was found in the first aspect, observation, which indicates that students did not experience difficulties in observation skills. However, there was a slight decline from the pre-cycle to the first cycle in the observation aspect. This is consistent with Rahmah (2021) who states that uncontrolled teaching and learning processes occur when too many students are distracted [12]. According to Rustaman in Khairunnisa (2019), there are several activities involved in observation skills, including using the senses of sight, smell, hearing, taste, and touch to observe the characteristics of an object and using relevant and adequate facts from the observation [8]. In line with this opinion, students were able to use more than one sense during observation and were directly engaged with concrete objects, making their understanding of the material more meaningful. This is supported by Novita et al. (2019), who state that learning by providing real-life examples can enhance students' science process skills [13]. Observation skills are the most fundamental skills in the knowledge acquisition process and are critical for the development of other science process skills.

The second highest aspect is communication. During the learning activities, students presented their observations and discussions in various forms. Communication skills are the ability to convey ideas to others. The ability to communicate observation results (communication skills) is a fundamental component of science process skills and is related to social skills. Communication skills are very important because humans interact with others through communication, whether verbal, written, visual, or sensory [8].

The next aspect is classification. In this case, students were asked to classify the objects they found according to their characteristics, similarities, and differences, based on the LKPD provided by the teacher. Classifying is a science process skill used to sort various objects or events based on specific properties, resulting in groups of similar events. Classification is a system used to categorize things based on certain criteria. The process of classifying includes activities such as finding similarities, finding differences, contrasting features, comparing, and determining the basis for classification [8].

The third aspect observed was interpretation. Students' science process skills in the interpretation aspect also showed significant improvement in each cycle. Although this aspect showed the lowest improvement compared to other science process skill aspects, it increased from 60% in the first cycle to 65%. This achievement is still in the "incomplete" category, as it is <70%. After students made observations, the next step was for them to interpret the results using the LKPD provided. If the observations were not interpreted, they would be in vain. Students interpreted by performing activities correctly according to the instructions in the LKPD provided by the teacher. They analyzed the results by looking for similarities and/or differences, then evaluating them [14].

The last aspect is predicting. In the first cycle, the prediction aspect achieved a classical result of 67%, categorized as insufficient, then improved in the second cycle to 72%, categorized as good. In the predicting aspect, students were asked to use patterns from their observations to speculate about what would happen before or after the observed event. Students' ability to predict or estimate an event from an experiment that

has not yet occurred shows that their thinking patterns are developing, as prediction activities are hierarchical and inseparable from science process skills.

Here are some limitations of using the Environmental Exploration Method (EEM) in teaching: 1) Resource Limitations, implementing the EEM method often requires greater resources, such as time, teaching staff, and transportation costs for outdoor activities. This can be a challenge, especially in schools with limited budgets; 2) Dependence on Weather, Outdoor activities like nature exploration are highly dependent on weather conditions. If the weather is bad or unsuitable, these activities may not be carried out as planned, disrupting the learning process; 3) Classroom Management Challenges, Outdoor activities can make classroom management more difficult. With many students involved in the exploration, teachers must be extra careful in supervising and ensuring the safety of all participants during the activity; 4) Limited Access to Natural Locations, Not all schools have easy access to safe and interesting natural locations for exploration. Long distances or hard-to-reach locations can be barriers to implementing this method; 5) Teacher Knowledge and Skill Limitations, The EEM method requires teachers to have in-depth knowledge of the natural environment and the skills to facilitate field exploration. Teachers with less experience in outdoor activities or ecology may face difficulties in managing these activities; 6) Assessment Limitations, Assessing science process skills through outdoor activities can be more challenging to carry out objectively and consistently, as outdoor activities tend to be more informal and less structured than classroom learning; 7) Differences in Student Abilities, Not all students have the same physical ability or interest in outdoor activities. Some students may feel uncomfortable or struggle with physical activities or nature exploration, which could reduce their involvement in the learning process.

4 Conclusion

The science process skills (SPS) of the 10th-grade students at SMA Negeri 2 Raha improved after implementing the nature exploration learning model (EEM). This can be seen from the five observed SPS indicators: observation, classification, interpretation, prediction, and communication. When looking at the achievement of SPS indicators in a classical manner, the first cycle did not meet the "good" criteria, but there was an improvement in the second cycle, reaching the "very good" category. Based on the discussion and data analysis, it can be proven that the Nature Exploration Learning Model (EEM) can enhance students' science process skills at SMA Negeri 2 Raha.

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