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The Influence of Environmentally Based Experimental Methods on Students' Science Process Skills

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ABSTRACT : The focus of the problem in this research is the lack of student involvement in direct learning, while the Physics material is mostly abstract in nature which requires practicum to master the material. This research is a quasi-experiment that aims to describe students' science process skills. Samples were taken using a purposive sampling technique, and class X MIPA 3 was chosen as the experimental class and X MIPA 5 as the control class. The research design is a nonequivalent control group, which provides an initial test and a final test after being given treatment. The results of data analysis in the initial test showed that the Sig (2-tailed) hypothesis test value was 0.225 > 0.05, which means that the science process skills in the experimental class and the control class were the same. After giving treatment (environmentally based experimental method) in class X MIPA 3 and conventional methods in control class X MIPA 5, the Sig value was obtained. (2-tailed) is 0.034 < 0.05, which means there are differences in the two classes so it can be concluded that there is a significant influence on students' science process skills. It is hoped that this research will become a recommendation for Physics teachers in secondary schools to embed experimental methods in Physics learning in every learning achievement

Keywords - environment-based learning, experiments, science process skills

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1. INTRODUCTION

Physics is a science that studies the interaction between energy and matter which is the basis of natural science [1]. When studying Physics in secondary schools, students are not only expected to master theoretical Physics concepts, but also be able to understand and apply these Physics concepts in everyday life [2]. Physics learning emphasizes direct experience to develop student competencies [3]. Learning is directed at finding out and doing to help students gain a deeper experience of the natural surroundings. Providing direct experience through the process of finding out and doing it yourself so that the implementation is very effective if learning is carried out through practical activities [4]. The practical method guides students in studying the physical symptoms of a phenomenon by observing an object, analyzing, proving, and drawing conclusions [5], [6].

Based on the results of learning observations carried out at secondary school A, over the last few years teachers have taught using lecture, demonstration, question and answer, and group methods. Teachers have not used experimental methods optimally in learning. Experiments are given in the form of limited simulations by teachers and do not fully involve students in practicums. This is due to the limited teaching aids owned by the school.

The limitations of experimental activities in Physics learning are certainly a serious problem in learning, considering that the study of Physics subjects is predominantly abstract [7]. Therefore, researchers provide something new in the form of innovative learning solutions, namely by applying environmental-based experimental methods [8]. Environment-based experiments will make it easier for students to learn and fully understand physics concepts. Apart from that, teachers are also helped in introducing physics concepts through direct involvement of students in learning. Student involvement in the practicum will stimulate students to develop potential scientific process skills [9], which also increases mastery of cognitive, psychomotor, and affective aspects. Science process skills are performance skills that contain two aspects of skills, namely skills from the cognitive side and skills from the sensorimotor side [10]. Learning using the experimental method also helps students build concepts meaningfully by developing previously held theories. Learning using environmental-based experimental methods will give students new experimental experiences.

Previously there had been several studies that applied experimental methods in teaching physics in secondary schools [11]. The novelty in this research is the use of the environment as an experimental medium for middle school students. The use of the environment in learning is the use of materials from the natural environment that are environmentally friendly. This will of course indirectly raise students' attitudes and feelings of concern for the environment. Based on these explanations and considerations, researchers conducted research entitled The Influence of environmentally based experimental methods on Students' science process skills.

2. METHOD

This research is a quasi-experimental research, where research subjects are not differentiated from one another [12]. This research has a control group, but it does not function fully to control external variables that influence the implementation of the experiment. Sampling in this research used a purposive sampling technique where samples were taken with a specific aim or purpose [13]. The classes used as samples in this research were class X MIPA 3 as an experimental class with 36 students and class X MIPA 5 as a control with 36 students. Classes X MIPA 3 and XI MIPA 5 were chosen to compare differences in students' science process skills in both classes with pretest and posttest.

The research instrument in this study is a science process skills test instrument on physical quantities and vectors which consists of eight numbers with the indicators 1) observing, 2) collecting and processing data, 3) formulating hypotheses, 4) experimenting and 5) communicating. The data analysis technique used in the research was the normality test with the Kolmogrov-Smirnov test and the data homogeneity test.

The research design used by researchers is the nonequivalent control group. The experimental group and control group in this design were not chosen randomly. This research was carried out by giving an initial test (pretest), and then giving different treatments. In the experimental class, treatment was given in the form of environmental-based experimental learning methods, while in the control class, conventional learning methods were used. Both groups were given a final test (posttest) to determine differences in Science Process skills. Graphically, the research design is depicted in Table 1 below:

Table 1. Nonequivalent control group design research design

Kelas	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_1	X_2	O_2

[14]

After the data was obtained, the next step was to see the categorization of science process skills achievement, student scores were analyzed descriptively and entered in the science process skills posttest categorization table.

Table 2. Posttest categorization of science process skills

Category	interval class
Very high	$X > 96$
High	$80 < X \leq 96$

Medium	62 < X ≤ 80
Low	46 < X ≤ 62
Very low	X ≤ 46

(source: processed research data 2022)

3. RESULT AND DISCUSSION

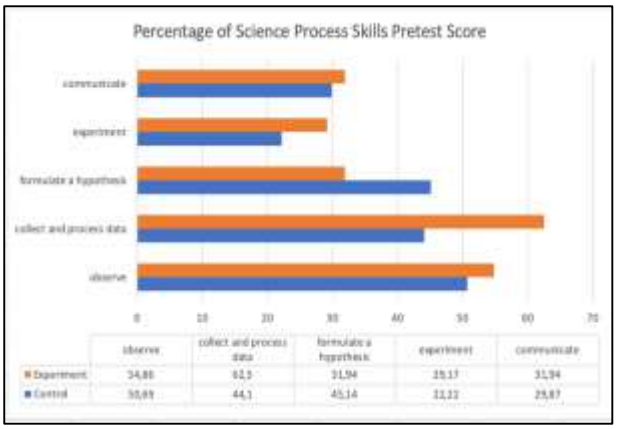
Science process skills are basic skills that facilitate learning in science, allowing students to be active, developing a sense of responsibility in learning [15]. The development of science process skills places more emphasis on students' abilities in the field of tests, so that development will be seen from the cognitive side, not just psychomotor and affective [16]. Results of descriptive analysis of students in class X MIPA SMA A who were taught using environmentally based experimental learning methods in the experimental class and using conventional learning methods in the control class. Descriptive analysis in each class was carried out by analyzing pretest and posttest data. The results of data acquisition on students' Science Process Skills are presented in Table 3 below.

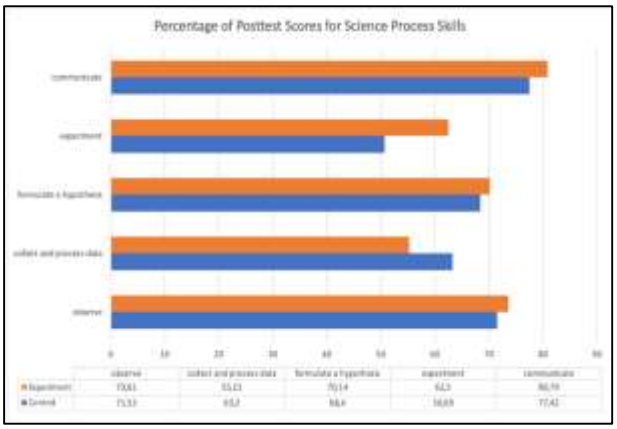
Table 3. Results of descriptive analysis of students' science process skills data (pretest and posttest)

Categori	Pretest		Posttest	
	Experiment	Control	Exsperimen t	Control
Number of samples	36	36	36	36
Average value	41,83	38,81	70,81	65,61
Standard deviation	9,938	11,019	10,062	10,274
The highest score	59	53	91	88
Lowest value	25	16	53	47
Variance	98,771	121,418	101,247	105,559
Ideal value	100	100	100	100

(source: processed research data 2022)

From Table 3 above, it can be seen that the average score obtained in both the experimental class and control class experienced an increase in scores on the posttest. While the deviation values are visible both at the pretest and posttest stages, the smallest deviation and variance values are in the experimental class. This indicates that the data distribution obtained is very close, meaning the data distribution is very good when compared to the control class. The highest score obtained by students was in the experimental class for the posttest with a score of 91. Apart from being completely analyzed for science process skills, researchers also analyzed each indicator of science process skills. The results of the analysis per indicator of science process skills can be seen in Figures 1 and 2 below.





Figures 1 and 2 Percentage of pretest and posttest scores

Figure 1 shows the highest score obtained for students' science process skills located in the indicator of collecting and processing data. Meanwhile, the indicator that has the lowest percentage is the experimenting indicator. At the pretest stage, the KPS scores on the observing, experimenting and communicating indicators did not differ much between the experimental class and the control class, each showing almost the same scores. Figure 2 shows that the highest KPS value is in the communicating indicator and the lowest is in the indicator of formulating a hypothesis. The findings of this research are research conducted by Fathiah (2018) testing science process skills by implementing a virtual laboratory on the indicators of observing, collecting, and processing data, compiling hypotheses, experimenting, and communicating [17].

Posttest data on students' science process skills after being included in Table 2 posttest categorization of science process skills, the level of students' science process skills in the experimental class is in the medium category with a score of 70.81; and in the control, class taught using conventional methods, the level of students' science process skills was in the medium category with a score of 65.61.

The next stage is analysis of the normality test and homogeneity test. The normality test data is the Sig value. for the experimental pretest data, the value is 0.120 and the experimental posttest value is 0.200. This shows that all data values are greater than Sig. 0.05 so it can be concluded that all data is normally distributed. The homogeneity test was carried out using the one-way ANOVA test in the SPSS application. The homogeneity test in the pretest obtained a Sig value. of 0.705. Because the significant value is greater than 0.05 (0.705 ≥ 0.05), the student's pretest data has the same variance (homogeneous). Meanwhile, for the post-test data, the Sig value is known. of 0.857 which indicates that this value is greater than Sig. 0.05 so it can be concluded that the posttest data comes from a homogeneous class.

From the results of the prerequisite tests, namely the normality test and homogeneity test, it is known that the data analysis obtained is normally distributed and homogeneous. After that, a hypothesis test was carried out to see whether there was an influence on Science Process Skills based on the pretest and posttest between the experimental class and the control class. The hypothesis test used in this research is the independent sample T-test. The results of hypothesis testing on pretest and posttest data can be seen in Table 4 below.

Table 4. Hypothesis test results on pretest and posttest data

	Pretest	Posttest
Sig. (2-tailed)	0,225	0,034
T-test	(sig.2-tailed)>0,05	
conclusion	H_0 accepted	H_0 rejected

(source: processed research data 2022)

Based on Table 4 above, the results of hypothesis testing using the SPSS application using the independent-samples T test can determine the Sig value. (2-tailed) in the pretest is 0.225, which means the value is greater than the Sig value. (2-tailed) or 0.225 > 0.05. This shows that there is no difference in students' Science Process Skills before treatment is applied. With this, H0 is accepted and H1 is rejected, namely that there is no significant influence on students' Science Process Skills. Meanwhile, the posttest data is 0.034, which means the value is smaller than the Sig value. (2-tailed) or 0.034 < 0.05. This shows that there are differences in students' Science Process Skills after being given learning methods using environmental-based experiments in the experimental class and using conventional learning methods in the control class. With this, H0 is rejected and H1 is accepted, namely that there is a significant influence on students' Science Process Skills. This is in accordance with research conducted by Lestari (2019) which measured science process skills with inquiry learning [18]. Apart from that, science process skills can also be improved with virtual laboratories through computer simulations [19], [20].

4. CONCLUSION

From the results of data analysis, it can be concluded that the level of science process skills of students in the experimental class who have been taught using environmentally based experimental methods is in the medium category with an average score of 70.81; The average value of students' science process skills in the control class

after being taught using conventional methods was in the medium category with a value of 65.61; There are significant differences in the science process skills of students taught using environmentally based experimental methods and those taught using conventional methods. Furthermore, it is hoped that this research can become a recommendation for Physics teachers in secondary schools to embed experimental methods in Physics learning in every learning achievement.

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