The influence of scientific approach on environmental problem solving skills in elementary school students

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Abstract. This study aims to determine the effect of using a scientific approach to problem-solving skills related to environmental problems in fourth-grade students in elementary school. This type of research is quasi-experimental with an equivalent control group design. The research subjects were students at SD LAB UPI Kampus Cibiru class IV-A (control / 26 students) and IV-B class (experimental / 26 students). Data collection used the pre-test – post test technique. Data analysis used descriptive and inferential parametric statistics with SPSS 23.0 for windows program. The result of the problem-solving skills (Pretest) earned \( t_{\text{count}} (0.087) < t_{\text{table}} (1.677) \), indicating no difference in problem-solving skills. After being given treatment, problem-solving skills (Post-test) obtain \( t_{\text{count}} (2.754) > t_{\text{table}} (1.677) \), indicating there are differences in student problem-solving skills. The problem-solving skills in the experimental class are higher than the control class. Based on data analysis, it was concluded that the scientific approach had a significant positive effect on problem-solving skills related to environmental problems.

1. Introduction

High Order Thinking Skills have been the focus of educational goals in many parts of the world in the last few decades. This is indicated by the number of studies related to efforts to improve high-order thinking skills.

Educational goals in 2000 included critical thinking skills, problem solving and communication [1]. These skills are interrelated and equally a focus in contemporary education. Rapid technological and scientific developments in the world have created more complex problems than before [2]. On the one side, technological and scientific developments provide convenience in various aspects of life. But on another side, often technological and scientific developments that are not accompanied by good self-control can cause environmental damage. Therefore equipping students with problem-solving skills becomes very important. Problem-solving skills are used in environmental education to identify environmental problems and solve them by supporting multi-dimensional development [3]. Environmental concerns are expected not only to appear in adults but also in children and teenagers. Efforts to develop an environmentally responsible attitude is to promote environmental concern at the school level [4]. Environmental problems such as environmental pollution, environmental protection, sustainability, and recycling are very common things students encounter.

Problem-solving according to Jonassen [5] is the ability to solve problems that have not even been faced without relying on the general problem-solving process because it can interpret and respond to certain situations in an effective way. To be able to interpret and respond to situations effectively, critical thinking skills are critical too. However, according to Conie [6] has the ability to think critically does
not necessarily make someone use it in situations where skills or capabilities are needed. Basically every human being has the potential to be able to think critically. However, not all humans are able to use critical thinking skills in various situations so that a person's ability to solve problems is often difficult to obtain. Therefore, it is necessary to improve the disposition of critical thinking. Tishman & Andrade (1996) [7] says the disposition of critical thinking is a tendency to use the ability to think when in certain situations. That is, it has a good response in using its ability to think and act critically in any situation required. Facione, Facione, and Giancarlo (1997) [8] describe the disposition of critical thinking like one's internal motivation for critical thinking when faced with problems to be solved, ideas for evaluating, or making a decision. Therefore it is very important to develop critical thinking dispositions because a good critical thinker must have the ability and critical thinking dispositions at once. If critical thinking skills are already owned and used correctly, of course the skills in problem solving will also be better.

Implementation of the 2013 curriculum raises a scientific approach as a major approach in learning activities. The implementation of the 2013 curriculum is a means to prepare students to face competition in the era of globalization by prioritizing HOTS principles [9]. A scientific approach is an approach that requires students to exercise as a science specialist. The series of activities in question include 1. formulating the problem; 2. propose a hypothesis; 3. collecting data; 4. processing and analyzing data, and; 5. make a conclusion [10]. Classroom learning can be conditioned to fulfill these steps simply to be easily followed by elementary school students. The characteristics of learning with scientific methods [11] are: 1. student-centered; 2. involve the skills of the process of science in constructing concepts, laws or principles; 3. involves potential cognitive processes in stimulating the development of the intellect, especially the students' high-order thinking skills; and 4. can develop student character.

The scientific approach is also relevant applied to the various learning models. The curriculum 2013 emphasizes the scientific approach, known as the 5 M (Mengamati (Observing), Menanya (Asking), Menalar (Reasoning), Mencoba (Trying), and Mengomunisasikan (Communicating)) [12]. That is, the priority is the active role of students in learning, while the teacher is only a facilitator in helping students find and build the knowledge learned. Students are assigned to deduce characteristics based on simulations that have been carried out [13].

Learning by applying a scientific approach is expected to spur students to actively observe the phenomena that exist in their environment. All problems in the environment such as pollution, environmental protection, sustainability, and recycling are the focus of student observation. This activity can stimulate students' curiosity about the causes and effects of symptoms of environmental damage. Students will also actively seek solutions to various problems that arise in their surroundings. Students are invited to discuss actively so that they can develop their logic and scientific communication at least in the class forum. That way, students are accustomed to recognizing the problems that occur and are used to solving all problems in a smart way. By applying a scientific approach, the expected learning outcomes are students who are productive, creative, innovative, and effective through strengthening integrated attitudes, skills, and knowledge [11].

The purpose of this study was to determine the influence of applying a scientific approach to problem-solving skills related to environmental problems. The expected benefits of this study are: (1) to increase student awareness about the causes and effects of environmental damage, (2) improve students' skills in solving problems related to environmental problems (3) provide good results for students from the learning process.

2. Methods
This research was conducted by a quasi-experimental method. The research pattern uses a non-equivalent control group design (unequal pretest-posttest). The use of the method is based on a research plan using two sample classes, the experimental class, and the control class. The class chosen is a class which is estimated to have the same conditions or conditions [14].

Data were obtained by pretest and posttest of control class and experiment class. The data were analyzed by parametric descriptive and inferential statistics. Descriptive statistical data analysis is used to describe or provide data description in the form of tables, graphs, frequency, and standard deviation. Meanwhile, inferential statistics use a prerequisite analysis, which is a test for normality and
homogeneity. The normality test in this study used the Kolmogorov-smirnov test at 5%. Meanwhile, the homogeneity test in this study used the Levene test. The use of the Levene test aims to find out the variance between categories in the variable has no difference (equivalent) [15]. Inferential statistical data analysis is used to test the proposed hypothesis. The hypothesis was tested to prove the influence of using a scientific approach to problem-solving skills related to environmental problems in the experimental class students. This will be compared to the control class where learning only follows directions in the teacher's book and student book. Comparison of these results will be tested by the t-test. Before the t-test, normality and homogeneity tests were carried out.

3. Result and discussion

3.1. Normality and Homogeneity Test
To test the data normality, SPSS 23.0 for windows is used with one sample Kolmogorov-smirnov technique at 5% or 0.05 significance level. In this case, the tested hypothesis is:
Ho = samples derived from normally distributed populations
Ha = the sample does not come from a normal distributed population
Basic decision making to know whether the distribution of normal population or not are:
a. if the value of significance > 0.05, then the distribution is normal;
b. if the value of significance < 0.05, then the distribution is not normal.
After the normality test on all tests, the result of significance > 0.05 then the distribution test is normal. The data presented in the table as follows:

| Variables                                      | Kolmogorov-Smirnov | Sig  |
|------------------------------------------------|--------------------|------|
| Control class (learning according to available teaching materials) | Pretest            | 0.647| 0.797|
|                                                 | Posttest           | 1.289| 0.072|
| Experimental class (applying scientific approach with discovery learning model) | Pretest            | 0.784| 0.570|
|                                                 | Posttest           | 1.127| 0.158|

Source: Data processed

Based on the above table, it can be concluded that the data is normally distributed with an average significance level > 0.05. After the normality test, a homogeneity test with a significance of 0.887 on the pretest of problem-solving skills. These results meet the criteria of the test if the value of significance or probability > 0.05, then the variance of each homogeneous group.

3.2. The effectiveness of teaching materials
This research was conducted by giving a pretest in the control class and the experimental class. After the pretest, the experimental class received treatment with a scientific approach by raising environmental issues around students. While the control class was not treated, learning only followed the direction of the teacher's books and student books. After learning done in each way, the control class and experimental class are given a post-test. Analysis of the effect of applying the scientific approach to solving problems related to environmental problems is done by comparing the results of the pretest and post-test. The basis of decision making is the comparison of \( t_{\text{count}} \) price with \( t_{\text{table}} \) at 5% error rate as follows.
a. If \( t_{\text{count}} \) is larger or equal to \( t_{\text{table}} \) (\( t_{\text{count}} \geq t_{\text{table}} \)), then null hypothesis (H0) proposed is rejected and the alternative hypothesis (Ha) is accepted.
b. If \( t_{\text{count}} \) is smaller or equal to \( t_{\text{table}} \) (\( t_{\text{count}} \leq t_{\text{table}} \)), then null hypothesis (H0) is accepted and the alternative hypothesis (Ha) is rejected.

The results of the test are presented as follows.
Table 2. Average Value of Pretest - Posttest of Problem Solving Skills

| Group  | Average pretest | Average posttest | Increase (%) |
|--------|-----------------|------------------|--------------|
| Control | 54.62           | 74.42            | 19.8         |
| Exsperiment | 55.00       | 81.15            | 26.15        |
| Different (%) | 0.38        | 6.73             | 6.35         |

Source: Data processed

Table 2 shows that the average pretest to solve the problem of students in the control class is 54.62, while in the experimental class is 55.00. So the difference between the experimental class and the control class is 0.38%. Based on the data obtained $t_{count}$ (0.087) < $t_{table}$ (1.677) with a significant level of 0.931. This shows that there is no significant difference between pretest problem-solving in the experimental and control classes.

After the pretest, the experimental class was given care and the control class was not given care. The average posttest value for solving students' problems in the control class is 74.42, while in the experimental class is 81.15. So the difference between the control class and the experimental class is 6.73%. Based on the data obtained $t_{count}$ (2.754) > $t_{table}$ (1.677) with a significant level of 0.008. This shows that there is a significant difference between the posttest problem solving of students in the control class and experiment.

4. Conclusion

Based on the description of the results of the study, it can be concluded that the application of the scientific approach to learning in the fourth grade of elementary school can have a significant positive impact on problem-solving skills related to environmental problems. Data were obtained from the pretest and posttest given to the experimental class (given treatment) and the control class that only followed the teaching materials provided. Both data were compared and calculated through the t-test in the SPSS 23.0 for windows program.

The level of significance obtained is 0.008 from $t_{count}$ (2.754) > $t_{table}$ (1.677) on posttest problem-solving skills. This number fulfills the basic criteria for decision making, that is, if $t_{count}$ is greater or equal to $t_{table}$ ($t_{count} \geq t_{table}$), then the null hypothesis (H0) proposed is rejected and the alternative hypothesis (Ha) is accepted. With Ha = There is an influence between the use of a scientific approach to problem-solving skills related to environmental problems in elementary school students.

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