How is the Education for Environmental Sustainable Development Support Students' Environmental Caring Character?

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Abstract: The Adiwiyata program has been implemented in several elementary schools in Indonesia, but its implementation has not been integrated into learning. As a result, students' contextual understanding of the environment is low. The aims of this research are: 1) to find out the implementation of the EESD approach in science learning; 2) find out the effectiveness of the EESD approach towards students' environmentally caring character. This research uses an experimental method with a one group pretest-posttest design. The population of this study was fifth grade MIN 2 Bantul students consisting of class A and class B. The sample was selected using cluster random sampling and 29 students were selected for class B. The instruments used in this research include observation sheets and questionnaires. The research results show that: 1) The EESD approach was implemented with a percentage of 95% in the very good category; 2) The EESD approach is effective in increasing the character of caring for the environment in the sufficient category.

Keywords: EESD; Environmental Care Character; Science Learning

Introduction

Indonesia is a country with a variety of biota, plants and animals. Eastern Indonesian waters are the region with the highest marine biodiversity in the world (Nirwansyah, 2014). Apart from that, Indonesia's tropical rain forests have great potential, namely 52.3% of Indonesia's area (Utami, 2022).

The richness of biota in Indonesia must of course be balanced with the enthusiasm of the younger generation in preserving it. The reality is that currently there is a lot of environmental damage occurring in Indonesia (Adha & Irwan, 2021), One of them is environmental pollution (Rusdiyanto, 2015), deforestation (Wahyuni & Suranto, 2021), and accumulation of rubbish (Khoiriyah, 2021). It is a challenge for today's generation to manage the environment, so that they can preserve the environment as well as possible. Good environmental management

can create sustainable resources. One effort to manage the environment is through education (Indahri, 2020).

Insight into the environment needs to be given to students. A sensitive and caring attitude towards the environment should be instilled in students, so that students are able to pay attention to current environmental conditions and think about maintaining the continuity of a good environmental carrying capacity. As stated by (Ratnasari, 2020); (Jalal Kazemi & Samouei, 2024); (Meng et al., 2023) Various environmental damages are caused by humans' lack of concern for the environment.

Education about the environment must start from basic education (El-Aasar et al., 2024). According to Jean Piaget (Lefa, 2014) Cognitive development of elementary school age children in the concrete operational phase. Children are able to think logically about something concrete at this stage. The environment

can be concrete learning for students. Students can make observations and obtain information that comes directly from phenomena in the environment (Sita et al., 2014; Zárate-Navarro et al., 2024). The environment is also a forum for students to express their thoughts and activities in the learning process (Haryati, 2016).

Instilling environmental care needs to be done since elementary school (Santika et al., 2022). One way to instill this environmentally caring character is through science learning. The environment is one of the sources of science learning (Lamasai et al., 2017; Taufiq et al., 2014; Do et al., 2023). One of the goals of teaching science is to understand the surrounding environment (Sulthon, 2017; Lan et al., 2023).

The Adiwiyata program has been implemented in several elementary schools in Indonesia. The aim of implementing this program is to create a school that cares and has an environmental culture (Putri, 2019). One of the schools preparing Adiwiyata applications is MIN 2 Bantul. Various Adiwiyata programs carried out include: creating water catchments, green houses and processing compost fertilizer. However, this environmental program has not been integrated into science learning. Around the school you can see leaf litter strewn about and there are traces of burnt plastic waste. There has been no effort from the school to utilize the rubbish around the school. Burning plastic waste has a negative impact on the environment. The process of burning plastic waste releases substances that are harmful to health (Sasputra et al., 2020). A learning approach that is suitable to be implemented in environmentally based science learning is Education for Environmental Sustainable Development (EESD).

The EESD approach can be applied in science education to prepare environmental knowledge in students, so that they can contribute actively in solving various problems in the environment (Ekantini & Wilujeng, 2018b). EESD is an effort to change attitudes and lifestyles through awareness of natural resources, sensitive physical environments, the influence of human activities, and decision making related to environmental sustainability in the future (Ekantini & Wilujeng, 2018a).

Previous research conducted by (Ekantini & Damayanti, 2022) shows that environment-based learning facilitates the improvement of students' environmentally caring character. Students are able to manage nature, get to know the ecosystem around where they live, understand the damage that occurs in the environment, and be creative with existing waste. Study (Ekantini & Wilujeng, 2018b) shows that EESD-based science LKPD facilitates students with EESD characteristics, namely: "*System Thinking, Foresighted Thinking and Strategizing, Collaborating, and Action-Orientation* (Redman, 2013)" which directs students to be sensitive and sensitive to environmental issues.

This research is novel, namely implementing the EESD approach into science and science learning at Adiwiyata schools. Where the school is environmentally based but has not been implemented in learning. By implementing environment-based learning in this lesson, it is hoped that students will be able to understand their environment and be able to take real action on existing environmental problems.

This EESD approach will bridge teachers in teaching environmental sensitivity and awareness to students through science learning. Each stage in the EESD approach will facilitate students to develop an environmentally conscious character.

Based on the urgency of the problem, researchers conducted research with the title "The Influence of Education for Environmental Sustainable Development in Improving the Environmentally Caring Character of Elementary School Students." It is hoped that implementing the EESD approach in science learning can improve students' environmentally caring character.

Method

This research uses a quantitative approach with experimental methods. The experimental method used is quasi-experimental, namely an experiment in which not all variables or experimental conditions can be completely controlled. The research design uses a one group pretest posttest design, namely research in one class and given a pretest and posttest. The first step is to give a pretest. After the pretest, students are given treatment, namely learning with the theme "Getting to Know the Ecosystem Around Us" using the EESD Approach.

$$O1 \ X \ O2 \qquad\qquad\qquad (1)$$

Information
O_1 = Environmental care character pretest
X = Treatment of implementing the EESD approach
O_2 = Posttest character who cares about the environment (Sugiyono, 2014).

The aim of this research is to determine the effectiveness of implementing the EESD approach on the environmentally caring character of fifth grade students at MIN 2 Bantul. The population of this study was all fifth grade students at MIN 2 Bantul for the 2023/2024 academic year, consisting of two classes, namely class A and class B. One class was selected using the cluster random sampling technique for this research. The sample class is class A with a total of 29 children.

This research uses two variables, namely the independent variable and the dependent variable. The independent variable in this research is treatment, namely the implementation of the EESD approach, while the dependent variable is the character of caring for the environment. The learning tools developed in this research are RPP and student worksheet.

The data that will be explored in this research is data on students' environmentally caring character. The instruments used were observation sheets and questionnaires. The observation sheet is used to obtain learning implementation data using the EESD approach, the learning implementation observation instrument grid is in Table 2. The questionnaire instrument is used to obtain data on students' environmentally caring character. The questionnaire consists of positive and negative statements related to the caring character of students. There are 20 statement items in the environmental care character questionnaire. The environmentally caring character questionnaire was given before and after the implementation of the EESD approach in learning. The grid of the environmental care character questionnaire instrument can be seen in Table

3. The two instruments used have been validated by experts and declared to be valid.

Table 1. Grid of the Observation Sheet on Implementation of Learning with the ESD Approach

Meeting to-	Assesment aspect	Number of indicators
1	Aspect Systems Thinking	4
	Aspect Foresighted Thinking and Strategizing	4
2	Aspect Collaborating	4
3	Aspect Action-Orientation	8

The observation sheet instrument for implementing learning using the EESD approach consists of 20 statement items. This instrument is used to determine the implementation of learning using the EESD approach. The purpose of this observation is to ensure that the lesson actually implements the EESD approach.

Table 2. Environmental Care Character Questionnaire Grid

Indicator	Statement	
	Positive	Negative
Keeping the environment clean	I like sweeping the yard	I'm lazy about cleaning the windows of the house
Throw away rubbish in its place	I am happy if the home or school environment is clean from scattered rubbish	I just leave it like that when I see used bottles scattered in the yard
	If I see rubbish left around the rubbish bin, I will put it in the rubbish bin	I mix wet waste and dry waste when throwing out the trash
Recycle plastic waste	I always throw rubbish in the rubbish bin	I like throwing rubbish in the river
	I like recycling used plastic waste into more valuable items	I like buying bottled drinks rather than bringing my own drink container
	I like making crafts from used plastic bottles.	I just throw away the used plastic bottles in my backyard
Caring for the Environment	I like to draw on paper rather than dirtying the table or wall	I like to scribble on the walls of the house
	When I see scribbles on the study table, I clean it	When studying I like to scribble on the study table
Aware of greening	I like planting trees around the house	I like trampling plants in the yard
	I like to water my plants.	I let the plants dry without watering them

Analysis of learning implementation in the form of implementation percentage. The learning implementation formula can be seen in Formula 2.

$$\% \text{ implementation} = \frac{\sum aspects \text{ of learning carried out}}{\sum all \text{ aspect}} \times 100\% \quad (2)$$

The quantitative data on the percentage of learning implementation obtained was then converted into qualitative data using the criteria for this learning implementation category in the form of percentages which are presented in Table 3. Based on Table 3, it can be seen that the learning implemented implements the EESD approach well if the percentage of implementation is above 60%.

Hypothesis test data analysis using t-paired test and n-gain. Previously, a prerequisite hypothesis test was carried out which included normality and

homogeneity tests. After the prerequisite hypothesis test is fulfilled and the data is declared normal and homogeneous, the hypothesis test is then carried out, namely the t-paired test. The t-paired test was chosen because the data is paired data from the same population. Based on the results of the t-paired test, if the $t_{count} < t_{table}$, it can be concluded that there is no difference in the character of caring for the environment between the pretest and posttest. Next, an n-gain test was carried out to see the effectiveness of learning. The N-Gain formula is in Formula 3. The hypotheses in this research are as follows.

Table 3. Percentage and Categories of Learning Implementation

Percentage	Category
>80	Very Good
>60-80	Good
>40-60	Enough
>20-40	Not Enough
≤20	Very Less

Source: (Widoyoko, 2016).

H_0: The implication of the EESD approach is that it is not effective in improving the environmentally caring character of fifth grade MIN 2 Bantul students. H_a: Implications of the EESD approach to effectively improve the environmentally caring character of fifth grade MIN 2 Bantul students

$$< g > = \frac{S_{post} - S_{pre}}{S_{m\,ideal} - S_{pre}} \quad (3)$$

The n-gain criteria for the effectiveness of implementing the EESD approach towards improving students' environmentally caring character is shown in Table 4.

Table 4. N-Gain Effectiveness Criteria

Normalized Gain Vlue	Efectiveness Criteria
0.7 ≤ g <1.0	tall
0.3 < g <0.7	currently
0 <g <0.3	laww

(Hake, 1999)

Information:
g = Normalized average gain score
Spost = Average final test score obtained by students
Spre = Average initial test score obtained by students
Sm ideal = Ideal maximum score

Result and Discussion

This research consists of two variables, namely the EESD approach as the independent variable and environmental care character as the dependent variable. The aim of this research is to determine the effectiveness of the EESD approach on students' environmentally caring characteristics. This research is experimental research carried out in three stages, namely pretest, treatment and posttest.

The first stage of this research is the pretest. The pretest was carried out to determine the initial environmental caring character of students before learning using the EESD approach. The pretest was carried out seven days before treatment was given. The results of the pretest can be seen in Table 9.

The second stage of this research is treatment. Treatment is learning with the EESD approach. EESD is an educational concept for sustainable development that refers to various environmental dimensions. EESD is an effort to change attitudes and lifestyles through awareness of natural resources, sensitivity to the physical environment, the influence of human activities, and decision making related to environmental sustainability in the future (Li et al., 2024; Wilujeng et al., 2019). This treatment is given three times, where each meeting is 2 hours of study. The learning activities when providing treatment with the EESD approach can be seen in Table 5.

Table 5. Learning Activities with the EESD Model

EESD Competencies	Activities	Meeting to-
System Thinking	Activity 1: Get to know the surrounding environmental ecosystem Activity 2: Understanding environmental phenomena in schools	1
Foresighted Thinking and Strategizing Collaborating	Activity 3: Developing Strategies to Overcome School Environmental	2
Action Orientation	Activity 4: Be creative in making crafts from plastic	3

This learning activity is of course adapted to the curriculum used by the school, namely the Independent Curriculum. Analysis of Learning Achievements and Learning Objectives used can be seen in Table 6.

Table 6. Learning Achievements and Objectives

Learning Outcomes (CP)
Students investigate how the interdependent relationship between biotic-abiotic components can influence the stability of an ecosystem in the surrounding environment
Learning Objectives (TP)
1. Explain the ecosystem
2. Identify biotic and abiotic objects in the surrounding environment
3. Identify the food chain
4. Identify ecosystem problems
5. Explain environmental pollution
6. Analyze the causes of environmental pollution
7. Describe how to prevent environmental pollution
8. Find solutions to environmental pollution
9. Explain students' responsibilities in protecting the environment
10. Create crafts from plastic waste

The first activity is Getting to Know the Ecosystem. In this activity, students are invited to leave the classroom to make observations in the environment around the school. Participants were asked to classify living and non-living objects that they found in the school environment. From these observations the teacher explains the concepts of biotic, abiotic and ecosystem.

The second activity is to find out environmental phenomena around the school. They were invited to tour the school and record every phenomenon they found. The hope is that in this activity they will be able to think about finding problems that occur in the school environment. During this observation, students found scattered leaf litter and burnt plastic waste behind the school. From the results of this discovery they found that plastic waste should not be burned. Burning plastic waste can produce substances that have a negative effect on the respiratory system(Sasputra et al., 2020). Burning plastic waste can trigger toxic gases such as carbon monoxide (CO) and hydrogen cyanide (HCN) (Nirmalasari et al., 2021). This should raise awareness among school residents not to burn plastic waste.

Activity 3 is to develop strategies to overcome problems found in the school environment, in this case the problem of processing plastic waste. Each student is asked to express their own ideas or opinions regarding appropriate strategies for overcoming existing problems. After each student puts forward their idea, then they join their respective groups that have been determined by the teacher. They discussed in groups the best strategies for overcoming the problem of plastic waste in schools.

Activity 4 is to be creative in making crafts from plastic waste found at school. Each group was given the freedom to be creative according to the strategy they had developed using plastic waste as the main ingredient. This creation from plastic waste is a form of action towards problems that exist in the school environment. Plastic waste is waste that is difficult to decompose Hu et al. (2024), Higuchi & Isobe (2024), so it requires recycling to overcome its accumulation (Nasution et al., 2019).Therefore, turning plastic waste into reusable items can help reduce environmental pollution

Process Students find plastic waste at school	Montage work results from one of the groups

Figure 1. Students Learning Activity

The implementation of learning using the EESD approach was observed by three observers who understood the research methodology. This observation was carried out to ensure that the EESD approach was actually implemented well in the learning carried out. Based on the results of the analysis, it is known that the percentage of learning implementation using the EESD approach is 95%. These results show that the EESD approach has really been implemented well, namely that all EESD competencies including systems thinking, foresighted thinking and strategizing, collaborating, and action orientation have been implemented.

The third stage of this research is the posttest. The posttest was carried out to determine the environmentally caring character of students after treatment, namely learning using the EESD approach. The posttest was carried out seven days after the treatment was given.

The PreTest and PostTest scores obtained for each statement item can be seen in Table 7. Table x shows the pretest and posttest scores of 29 students on the 20 items submitted. Table 8 shows summary data from the ECC PreTest and Posttest Scores.

Table 7. Average Score of Each Statement in the Environmental Caring Character (ECC)

No.	Question code	PreTest	Post Test
1	ECC 1	59	68
2	ECC 2	86	93
3	ECC 3	73	75
4	ECC 4	72	85
5	ECC 5	72	72
6	ECC 6	86	77
7	ECC 7	70	73
8	ECC 8	91	97
9	ECC 9	55	68
10	ECC 10	62	68
11	ECC 11	78	77
12	ECC 12	79	84
13	ECC 13	82	78
14	ECC 14	59	57
15	ECC 15	76	86
16	ECC 16	85	89
17	ECC 17	56	71
18	ECC 18	72	78
19	ECC 19	87	93
20	ECC 20	81	82

Table 8. Score ECC PreTest and Posttest

No.	Category	PreTest	PostTest
1	The Highest Sore	73	91
2	The Lowest Score	44	55
3	Mean	60	74
4	Standard Deviation	9.01	11.26

Based on Table 8, it can be seen that the average environmentally caring character of students after being given the treatment is higher than before being given the treatment. A more detailed comparison between students' environmentally caring character before and after being given can be seen in Figure 1.
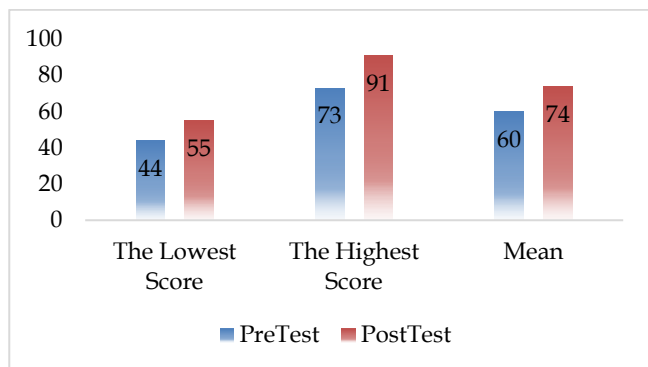

Figure 2. Students' Environmental Care Character Score

Figure 2 shows that the environmental care character score of students after being given treatment is higher than before being given treatment. To determine whether there is a significant difference between the Pretest and Posttest scores, a T-paired Test analysis was carried out. Before testing the hypothesis, the prerequisite hypothesis test is first carried out, namely the normality test.

Table 9. Hypothesis Prerequisite Test Results

Hypothesis Prerequisite Test	Significance value
Normality test	0.533

Table 9 shows the significance value of the normality test is sig.2-tailed 0.533>0.05. This shows that if the data is normally distributed, then the next step is to test the hypothesis. Hypothesis testing was carried out using the T-Pired Test with the results shown in Table 10.

Table 11. T-Paired Test Results

Hypothesis Test	Significance value
T-Paired Test	0.000

The results of the T-Paired Test analysis using SPSS show that the 2-tailed sig. value is 0.000 <0.05, indicating that H₀ is rejected and Ha is accepted. It can be said that there is a difference in environmental care character scores before and after the treatment. Next, an n-gain test was carried out to determine the effectiveness of learning using the EESD approach towards environmentally caring character. Based on the analysis results, it is known that the n-gain value is 0.4, according to Table 5, it is included in the quite effective category.

A sustainability approach is applied to increase students' understanding and sensitivity to the environment (Perelló Marín et al., 2018; Cuenca-Soto et al., 2023). The EESD approach trains students' sensitivity to understand environmental problems and play a role in overcoming existing problems (Ekantini & Wilujeng, 2018b). Education for sustainable environmental development has emerged as an important approach to encourage students to conserve and preserve nature in their environment (Sutanto, 2017).

The implementation of the EESD approach is effective in improving students' environmentally caring character in the quite effective category. This is due to the implementation of new research in three meetings, while the character needs time to change. Character education in building students' character takes a long time (Utami et al., 2020; Fatmah, 2018). Longer periods of habituation and application of continuous learning are needed to produce good environmentally caring character in students.

Conclusion

The author has reviewed how to implement the EESD approach into learning. Students are facilitated with various activities related to environmental conservation consisting of systems thinking, foresighted thinking and strategizing, collaborating, and action orientation competencies. Students are invited to carry out direct learning activities with environmental sources, starting from observing and understanding environmental phenomena, developing strategies, working in groups to taking real action to overcome existing problems. The results of the analysis of learning implementation using the EESD approach were 95%, indicating that it was implemented well. Based on the results of the T-Paired Test analysis, it is known that the 2-tailed sig. value of 0.000 <0.05 means there is a significant difference in the environmental care character score before and after being given treatment. Next, an N-Gain test was carried out and a value of 0.4 was obtained in the medium effectiveness category. This shows that the implementation of the EESD approach in learning is quite effective in improving students'

environmentally caring character. As a suggestion, further longer research can be carried out in cultivating character in students. The recommendation of this research is that the EESD approach is very suitable to be applied to environment-based learning as an effort to protect and preserve the environment.

Conflicts of Interest
The funders had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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